

МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
ХАРКІВСЬКИЙ НАЦІОНАЛЬНИЙ ЕКОНОМІЧНИЙ УНІВЕРСИТЕТ
ІМЕНІ СЕМЕНА КУЗНЕЦЯ

ЗАТВЕРДЖЕНО

на засіданні кафедри
економічної кібернетики і системного аналізу
Протокол № 7 від «20» грудня 2023 р.

ПОГОДЖЕНО

Проректор з навчально-методичної роботи


Каріна НЕМАШКАЛО



ЕКОНОМЕТРИКА

робоча програма навчальної дисципліни (РПНД)

Галузь знань	07 «Управління та адміністрування»
Спеціальність	073 «Менеджмент»
Освітній рівень	перший (бакалаврський)
Освітня програма	«Логістика»

Статус дисципліни	обов'язкова
Мова викладання, навчання та оцінювання	англійська

Розробник(и):
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к.е.н., доц.

Підписано КЕП

Світлана ПРОКОПОВИЧ

Завідувач кафедри
економічної кібернетики
і системного аналізу



Лідія ГУР'ЯНОВА

Гарант програми



Тетяна КОЛОДІЗЄВА

Харків
2023

INTRODUCTION

The curriculum for the compulsory course "Econometrics" is designed in accordance with the educational-professional program for Bachelor's degree in the field of 073 "Management" within the educational program " Logistics".

The purpose of teaching the discipline "Econometrics" is to form a system of theoretical knowledge and acquire the skill of constructing econometric models that quantitatively describe the relationships between economic variables. It also involves studying the conditions and possibilities of applying econometric methods to solve economic problems in real conditions.

The main objectives of studying the discipline "Econometrics" include mastering the fundamental principles, methods, and tools related to the formulation of tasks in econometric modeling, methods of solving them, and analysis for broad application in economics, entrepreneurship, finance, and management.

The subject of the discipline covers econometric methods and models that allow for determining and analyzing quantitative relationships between socio-economic phenomena, as well as developing spatial-temporal forecasts for the development of economic systems.

The object of study includes socio-economic, financial, and other systems from various sectors of the economy and different levels of hierarchy.

The learning outcomes and competencies formed by the course are defined in table 1.

Table 1

Learning outcomes and competencies formed by the course

Learning outcomes	Competencies
LO3	SC3
LO6	SC2, SC12
LO7	SC2
LO8	SC2, SC7
LO12	SC6
LO19	SC3

where, LO3. Demonstrate knowledge of theories, methods, and functions of management, as well as contemporary leadership concepts.

LO6. Display skills in searching for, gathering, and analyzing information, calculating indicators to justify managerial decisions.

LO7. Demonstrate skills in organizational design.

LO8. Apply management methods to ensure organizational effectiveness.

LO12. Evaluate the legal, social, and economic consequences of organizational functioning.

LO19. Apply a logistical approach to managing organizational resources and ensure their competitiveness. Demonstrate skills in optimizing organizational and technological aspects of logistics functions using communication and information support.

- SC2. Ability to analyze the results of organizational activities, comparing them with factors influencing the external and internal environment.
- SC3. Ability to determine the organization's development prospects.
- SC6. Ability to act socially responsibly and consciously.
- SC7. Ability to select and use modern management tools.
- SC12. Ability to analyze and structure organizational problems, formulating reasoned decisions.

COURSE CONTENT

Content module 1. Methods of econometric modeling

Topic 1. Econometrics and Econometric Modeling

1.1. The Role of Econometric Research in Economics.

Subject, Methods, and Objectives of the Discipline. The Role of Econometric Research in Economics. Econometric Model. Classification of Econometric Models. Stages of Constructing Econometric Models.

1.2. Features of Econometric Models.

Formation of a Set of Observations. Concept of Homogeneity of Observations. Accuracy of the Initial Data.

1.3. Examples of Econometric Models.

Demand and Supply Model in a Competitive Market. Laffer Curve Model. Phillips Curve. Keynesian Model. Consumption Model.

Topic 2. Simple Linear Regression

2.1. Simple Linear Regression.

Simple econometric model, basic assumptions.

2.2. Methods of Regression Parameter Estimation.

Essence of the least squares method (LSM), system of normal equations. Properties of model parameter estimates.

2.3. Verification of Simple Regression Model.

Checking the model for adequacy using Student's and Fisher's criteria. Coefficient of correlation and determination. Forecast based on a simple linear model.

Topic 3. Multiple Linear Regression

3.1. Methods of Constructing Multiple Linear Econometric Model.

Concept of multiple linear model, basic assumptions. Estimation of parameters of the multiple model and checking its adequacy. Multiple correlation coefficient. Forecast based on multiple linear model.

3.2. Various Aspects of Multiple Regression: Dummy Variables.

Concept of a dummy variable. Types of dummy variables. Features of constructing a model with dummy variables.

Topic 4. Multicollinearity and its Impact on Model Parameter Estimates

4.1. Multicollinearity, Causes of its Occurrence.

Concept of multicollinearity, causes of its occurrence. Impact of multicollinearity on characteristics of multiple linear model.

4.2. Methods of Assessing the Degree of Multicollinearity.

Methods for assessing the degree of multicollinearity. Farrar-Glauber method.

4.3. Methods for Eliminating Multicollinearity.

Methods for eliminating multicollinearity. Ridge Regression. Algorithm for eliminating unnecessary factors.

Topic 5. Building a Model with Autocorrelated Residuals

5.1. Residual Autocorrelation. Methods for Testing Residual Autocorrelation.

Residual autocorrelation. Consequences of autocorrelation in building econometric models. Durbin-Watson criterion. Neuman criterion. Cyclic and non-cyclic correlation coefficient.

5.2. Methods for Estimating Parameters with Autocorrelated Residuals.

Methods for estimating parameters with known and unknown autocorrelation coefficient ρ , Cochran-Orcutt procedure, Hildreth-Lu procedure, Durbin's procedure.

Content module 2. Applied Econometrics

Topic 6. Heteroskedasticity in Econometric Models

6.1. Heteroskedasticity in Econometric Models and Methods of its Identification.

Concepts of homoskedasticity and heteroskedasticity. Criteria for testing heteroskedasticity. Properties of parameter estimates in the case of heteroskedasticity.

6.2. Generalized Least Squares Method (GLS).

Aitken's theorem. Generalized least squares method. Properties of model parameter estimates obtained using GLS.

Topic 7. Nonlinear Econometric Models. Production Functions

7.1. Nonlinear Econometric Models.

Nonlinear single-factor econometric models and their properties. Methods for estimating parameters of nonlinear models. Examples of linearization.

7.2. Production Functions, their Classification, Basic Properties.

Cobb-Douglas production function, its properties and parameter estimation.

7.3. Key Characteristics of Production Functions, their Geometric and Economic Interpretation.

Characteristics of the production function (average and marginal resource productivity, elasticity of output with respect to resource costs, isoquants and substitutability of resources, isocline).

Topic 8. Econometric Models of Dynamics

8.1. Basic Concepts and Types of Dynamic Series.

Key concepts. Types of econometric models of dynamics.

8.2. Trend Models.

Trend, types of trends. Testing a time series for the presence of a trend. Methods for smoothing time series. Decomposition models for time series.

8.3. Models for Smoothing Dynamic Series.

Autoregressive and moving average models, Box-Jenkins models. Identification and estimation of parameters. Autocorrelation function. Application of spectral and harmonic analysis theory to study periodic time series.

Topic 9. Econometric Models Based on a System of Structural Equations

9.1. Simultaneous Equation Systems: Classification, Identification, Specification.

Features of simultaneous equation systems. Types of simultaneous equation systems. Structural and reduced forms of models. Identification problem of structural models.

9.2. Methods for Estimating Parameters of Structural Equations.

Methods for estimating parameters of structural equations.

The list of practical studies in the course is given table 2.

Table 2

List of Practical Studies

Name of the topic and/or task	Content
Topic 1. Task 1. "Mathematical and Statistical Processing of Sample Data"	The solution of practical tasks involves the analysis of statistical characteristics of a series, calculation of general characteristics of random variables, graphical analysis of random variables, and the application of statistical tests to check hypotheses regarding the nature of the distribution of a random variable.
Topic 2. Task 2. "Construction of a Simple Linear Model"	The construction and estimation of model parameters using the method of least squares involve calculating key characteristics of the model, checking the statistical significance of model parameters and the correlation coefficient. The adequacy of the model is analyzed, and forecasting is performed using the linear econometric model, followed by an economic interpretation of the results.
Topic 3. Task 3. "Construction and Analysis of a Multiple Linear Model"	The construction of a multiple-factor econometric model involves estimating the parameters of the model and assessing their statistical significance. Checking the adequacy and overall statistical significance of the model is performed. Multiple and partial correlation coefficients are calculated, and forecasting, along with confidence intervals, is carried out. The results are then economically interpreted.
Topic 4. Task 4. "Investigation of the Model for the Presence of Multicollinearity"	Checking the model for multicollinearity involves identifying multicollinear variables. The Farrar-Glauber algorithm is used for this purpose. Methods for alleviating multicollinearity are then applied.
Topic 5. Task 5. "Checking for the Presence of Autocorrelation"	Checking for the presence of errors autocorrelation involves using the Durbin-Watson method, the Neuman method, and the cyclic autocorrelation coefficient.
Topic 7. Task 6. "Construction of the Cobb-Douglas Production Function"	Estimating the parameters of the Cobb-Douglas production function involves linearization and analysis of its key properties. Calculating the fundamental characteristics of production functions is also part of the process.
Topic 8. Task 7. "Construction of the Trend Model"	Solving practical tasks related to trend model construction includes determining the presence of a trend and estimating its parameters.

The list of laboratory studies in the course is given in the table 3.

Table 3

The list of laboratory studies

Name of the topic and/or task	Content
Topic 1. Task 1. "Variation Ranges and Their Statistical Characteristics"	Solving tasks related to the analysis of a discrete and interval series. Calculation of statistical characteristics of the series. Construction of a histogram and a frequency polygon for the random variable distribution. Testing the hypothesis of a normal distribution using Pearson's and Kolmogorov-Smirnov tests. Identification and exclusion of anomalous observations.
Topic 2. Task 2. "Construction of a Simple Linear Model"	Solving practical tasks related to building a single-factor linear model. Specification of the multiple linear regression model. Estimation of model parameters using methods such as the least squares method. Evaluation of the statistical significance of the model and individual coefficients. Checking the assumptions of the multiple linear regression model. Interpretation of the results and making predictions.
Topic 3. Task 3. "Construction and Analysis of a Multiple Linear Model"	Solving practical tasks related to the construction of a multiple linear regression model. Selection of relevant independent variables. Collection and preparation of data. Specification of the multiple linear regression model. Estimation of model parameters using methods such as the least squares method. Evaluation of the statistical significance of the model and individual coefficients. Checking the assumptions of the multiple linear regression model. Interpretation of the results and making predictions.
Topic 4. Task 4. "Investigation of the Model for the Presence of Multicollinearity"	Solving practical tasks related to the assessment of the degree of multicollinearity and its exclusion from the model involves: Checking the model for multicollinearity. Identifying multicollinear variables. Applying the Ferrar-Glover algorithm. Utilizing methods to alleviate multicollinearity.
Topics 5-6. Task 5. "Construction of a Multiple Linear Model under Heteroskedasticity and Autocorrelation Conditions"	Methods for determining heteroskedasticity and its consequences, including the generalized method of least squares (GLS), are part of the analysis. Additionally, checking for autocorrelation and estimating model parameters with autocorrelated residuals are included in the solution of the tasks.
Topic 7. Task 6. "Construction of the Cobb-Douglas Production Function"	Solving tasks related to the construction and analysis of Cobb-Douglas production function characteristics involves: Estimating model parameters. Linearization of the model. Analysis of the fundamental properties of the function. Calculation of the basic characteristics of production functions. Geometric analysis of characteristics.

Topic 8. Task 7. "Construction of the Trend Model"	Practical tasks for constructing a trend model, graphical analysis of dynamic indicators, smoothing time series, identifying trend presence, and estimating its parameters.
Topic 8. Task 8. "Construction of a Time Series Decomposition Model"	Practical tasks for constructing a time series decomposition model and calculating forecasts

The list of self-studies in the course is given in table 4.

Table 4

The list of self-studies

Topic	Content
Topic 1. Econometrics and Econometric Modeling	Search, selection, and review of literature on a given topic. Solving practical tasks related to the analysis of statistical characteristics of a series.
Topic 2. Simple Linear Regression	Search, selection, and review of literature on a given topic. Solving practical tasks related to building a simple linear regression model.
Topic 3. Multiple Linear Regression	Search, selection, and review of literature on a given topic. Solving practical tasks related to building a multiple linear regression model.
Topic 4. Multicollinearity and its Impact on Model Parameter Estimates	Search, selection, and review of literature on a given topic. Solving practical tasks related to assessing the degree of multicollinearity and excluding it from the model.
Topic 5. Building a Model with Autocorrelated Residuals	Search, selection, and review of literature on a given topic. Solving practical tasks related to checking for the presence of autocorrelation in errors.
Topic 6. Heteroskedasticity in Econometric Models	Search, selection, and review of literature on a given topic. Solving practical tasks related to checking for the presence of heteroskedasticity in errors.
Topic 7. Nonlinear Econometric Models. Production Functions	Search, selection, and review of literature on a given topic. Solving tasks related to the construction of the Cobb-Douglas production function and the analysis of its characteristics.
Topic 8. Econometric Models of Dynamics	Search, selection, and review of literature on a given topic. Solving practical tasks related to the construction of a trend model and a time series decomposition model.
Topic 9. Econometric Models Based on a System of Structural Equations	Search, selection, and review of literature on a given topic.

The number of hours of lectures, laboratory classes, and hours of self-study is given in the technological card of the course.

TEACHING METHODS

In the process of teaching an academic discipline, in order to activate the educational and cognitive activity of students, the use of both active and interactive

educational technologies is provided, including: Mini-lectures (Topic 1, 9), group work (Topic 2-8), situational tasks (Topic 8).

During lectures, practical, and laboratory classes, the following methods are employed: explanatory-illustrative material, video materials, problem-based teaching, and the research teaching method.

FORMS AND METHODS OF ASSESSMENT

The University uses a 100-point cumulative system for assessing the learning outcomes of students.

Current control is carried out during lectures, practical, laboratory and seminar classes and is aimed at checking the level of readiness of the student to perform a specific job and is evaluated by the amount of points scored:

– for courses with a form of semester control as grading: maximum amount is 100 points; minimum amount required is 60 points.

The final control includes current control and assessment of the student. **Semester control** is carried out in the form of grading.

The final grade in the course is the amount of all points received during the current control.

During the teaching of the course, the following control measures are used:

- 1) Completion of individual assignments (maximum score – 50 points).
- 2) Completion of intermediate test assessments (maximum score – 30 points).
- 3) Completion of modular control works (maximum score – 20 points).

Semester control: Grading

More detailed information on the assessment system is provided in technological card of the course.

RECOMMENDED LITERATURE

Main

1. Гур'янова Л. С. Прикладна економетрика : навч. посіб. : у двох частинах. Частина 1 : [Електронне видання] / Л. С. Гур'янова, Т. С. Клебанова, С. В. Прокопович та ін. – Харків : ХНЕУ ім. С. Кузнеця, 2016. – 235 с. <http://www.repository.hneu.edu.ua/handle/123456789/19846>

2. Гур'янова Л. С. Прикладна економетрика : навч. посіб. : у двох частинах. Частина 2 : [Електронне видання] / Л. С. Гур'янова, Т. С. Клебанова, С. В. Прокопович та ін. – Харків : ХНЕУ ім. С. Кузнеця, 2016. – 252 с. <http://www.repository.hneu.edu.ua/handle/123456789/19842>

3. Диха М. В. Економетрія / М. В. Диха, В. С. Мороз. – Київ : Центр навчальної літератури, 2019. – 206 с.

4. Економетрика [Електронний ресурс] : навч. посібник / [Л. С. Гур'янова, Т. С. Клебанова, Р. М. Яценко, С. В. Прокопович, О. А. Сергієнко]. – мультимедійне інтерактивне електрон. вид. комбінованого використ. – Харків :

ХНЕУ ім. С. Кузнеця, 2019. – Режим доступу : <https://pns.hneu.edu.ua/course/info.php?id=4842> – Назва з тит. екрана. – ISBN 978-966-676-771-7.

5. Економетрика з R : навчальний посібник / А.В. Скрипник, Д.М. Жерліцин, Ю.О. Нам'ясенко. – Київ : ФОП Ямчинський О.В., 2020. – 248 с.

6. Dipanjan Sarkar, Tushar Sharma, Raghav Bali. Practical Machine Learning with Python A Problem-Solver's Guide to Building Real-World Intelligent Systems, 2018, 545 p. - Access mode.: <http://surl.li/polxz>

7. Jeffrey M. Wooldridge. Introductory Econometrics: A Modern Approach, Fifth Edition, 2013, South-Western, Cengage Learning, 882 p. - Access mode.: https://economics.ut.ac.ir/documents/3030266/14100645/Jeffrey_M._Wooldridge_Introductory_Econometrics_A_Modern_Approach__2012.pdf

Additional

8. Економетрика : Навчальний посібник / [О. Є. Лугінін, В. М. Фомішина, О. М. Дудченко та ін.] . – Херсон: Гельветика, 2019. – 320 с.

9. Економетрика. Методичні рекомендації і завдання до самостійної роботи за темою "Проблеми в побудові лінійних множинних регресійних моделей: гетероскедастичність" для студентів усіх спеціальностей першого (бакалаврського) рівня [Електронний ресурс] / укл. І.Л. Лебедева, А.В. Жуков, С.С. Лебедев; Харківський національний економічний університет ім. С. Кузнеця. - Електрон. текстові дан. (169 КБ). - Х. : ХНЕУ ім. С. Кузнеця, 2019. - 32 с. – Режим доступу : <http://repository.hneu.edu.ua/handle/123456789/20218>

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11. Кобець В. М. Економетрика в RSTUDIO. Навчальний посібник / В. М. Кобець. – Київ : Олді+, 2021. – 132 с.

12. Козменко О. В. Економіко-математичні методи та моделі (Економетрика) / О. В. Козменко, О. В. Кузменко. – Київ : Університецька книга, 2019. – 406 с.

13. Econometrics. Practicum for Bachelor's (first) degree students of all specialities [Electronic resource] / compil. by L. Guryanova, S. Prokopovych, S. Milevskiy; Simon Kuznets Kharkiv national university of economics. - E-text data (12,5 МБ). - Kh., 2018. - 80 p. – Режим доступу : <http://repository.hneu.edu.ua/handle/123456789/21862>

14. Guryanova Lidiya, Oksana Panasenko, Vitalii Gvozdzitskyi, Mykhaylo Ugryumov, Viktoriia Strilets, Serhii Chernysh Methods and Models of Machine Learning in Managing the Market Value of the Company. Guryanova, L., Yatsenko, R., Dubrovina, N. Babenko, V., (Eds.): Machine Learning Methods and Models, Predictive Analytics and Applications, Proceedings of the Workshop on the XIII International Scientific Practical Conference Modern problems of social and economic systems modelling (MPSESM-W 2021), Kharkiv, Ukraine, April 9, 2021, CEUR-WS.org, online. <http://ceur-ws.org/Vol-2927/>

15. Guryanova Lidiya, Roman Yatsenko, Nadija Dubrovina, Vitalina Babenko. Machine Learning Methods and Models, Predictive Analytics and Applications. Guryanova, L., Yatsenko, R., Babenko, V., Dubrovina, N. (Eds.): Machine Learning Methods and Models, Predictive Analytics and Applications, Proceedings of the Workshop on the XII International Scientific Practical Conference Modern problems of social and economic systems modelling (MPSESM-W 2020), Kharkiv, Ukraine, June 25, 2020, CEUR-WS.org, online. <http://ceur-ws.org/Vol-2649/>

Information resources

16. Методичний комплекс з навчальної дисципліни «Економетрика». – Режим доступу : <https://pns.hneu.edu.ua/course/view.php?id=9698>

17. Methodological complex for the educational discipline "Econometrics". - Access mode.: <https://pns.hneu.edu.ua/course/view.php?id=6827>

18. Сайт Державного комітету статистики України. – Режим доступу : <http://www.ukrstat.gov.ua>.

19. Сайт Національного банку України. – Режим доступу : <http://www.bank.gov.ua>.

20. Eurostat. <https://ec.europa.eu/eurostat/>

21. United Nations data, A world of information. <https://data.un.org/>

22. The World Bank, Enterprise surveys, What businesses experience. <https://www.enterprisesurveys.org/en/data>