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

ЗАТВЕРДЖЕНО

на засіданні кафедри економічної кібернетики і системного аналізу Протокол № 1 від 2 вересня 2024 р. ИОГОДЖЕНО Проректор з навчально-методичної роботи

Каріна НЕМАШКАЛО

ЕКОНОМЕТРИКА

робоча програма навчальної дисципліни (РПНД)

Галузь знань Спеціальність Освітній рівень Освітня програма 07 «Управління та адміністрування» 075 «Маркетинг» перший (бакалаврський) Маркетинг

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

Розробник(и):

к.е.н., доц

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Завідувач кафедри економічної кібернетики і системного аналізу

Гарант програми

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Харків 2024

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE SIMON KUZNETS KHARKIV NATIONAL UNIVERSITY OF ECONOMICS

APPROVED

at the meeting of the Department of Economic Cybernetics and System Analysis Protocol № 1 of 2 September 2024



ECONOMETRICS

Program of the course

Field of knowledge Specialty Study cycle Study programme

07 Management and Administration 075 «Marketing» first (bachelor) Marketing

Course status Language

mandatory English

Developers: PhD (Economics), Associate Professor

PhD (Technical), Associate Professor.

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Kharkiv 2024

INTRODUCTION

Relevance of the course and its necessity and role in specialist training. the course "Econometrics" provides analytical tools for processing, analyzing, and interpreting economic data. It enables the identification of patterns in economic processes, forecasting future trends, and assessing the impact of external factors and internal drivers on the studied economic system or process. This course is particularly relevant for students majoring in specialty 075 "Marketing," as marketing activities are increasingly based on data analysis, forecasting, and informed decision-making. Econometrics helps marketers analyze how price, advertising, quality, and other factors influence consumer decisions, identify key demand drivers, and create consumer profiles and market segments. This allows for a deeper understanding of the target audience and its needs. Marketers use econometric methods to forecast sales volumes, assess demand seasonality, and plan inventories and resources based on future needs. This facilitates better management of marketing campaigns and company resources.

The curriculum for the compulsory course "Econometrics" is designed in accordance with the educational-professional program for Bachelor's degree in the field of 075 "Marketing" within the educational program "Marketing".

The purpose of teaching the course "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 course "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 course 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

Evaluing outcomes and competencies formed by the course				
Learning outcomes	Competencies			
LO2	GC6, SC3			
LO8	SC5			
LO9	SC8			
L017	SC12			

Learning outcomes and competencies formed by the course

where, LO2. Analyze and forecast market phenomena and processes based on the application of fundamental principles, theoretical knowledge, and practical skills in marketing activities.

LO 8. Apply innovative approaches to marketing activities of a market entity, adapting flexibly to changes in the marketing environment.

LO 9. Assess the risks of marketing activities and determine the level of uncertainty in the marketing environment when making managerial decisions.

LO 17. Demonstrate written and oral professional communication skills in the state and foreign languages, as well as proper use of professional terminology.

GC6. Knowledge and understanding of the subject area and professional activities.

SC3. Ability to use theoretical marketing concepts to interpret and forecast phenomena and processes in the marketing environment.

SC5. Ability to correctly apply marketing methods, techniques, and tools.

SC8. Ability to develop marketing support for business development under conditions of uncertainty.

SC12. Ability to justify, present, and implement research results in the field of marketing.

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 noncyclic 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

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	Checking for the presence of errors autocorrelation involves using the Durbin-Watson method, the Neuman method, and the cyclic autocorrelation coefficient.

The list of practical studies

Presence of	
Autocorrelation"	
Topic 7. Task 6.	Estimating the parameters of the Cobb-Douglas production function
"Construction of the	involves linearization and analysis of its key properties. Calculating
Cobb-Douglas Production	the fundamental characteristics of production functions is also part of
Function"	the process.
Topic 8. Task 7.	Solving practical tasks related to trend model construction includes
"Construction of the	determining the presence of a trend and estimating its parameters.
Trend Model"	

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	Solving tasks related to the analysis of a discrete and interval
Ranges and Their Statistical	series. Calculation of statistical characteristics of the series.
Characteristics"	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	Solving practical tasks related to building a single-factor linear
of a Simple Linear Model"	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	Solving practical tasks related to the construction of a multiple
Linear Model"	unitables Collection and properation of date
Linear Woder	Specification of the multiple linear regression model
	Estimation of model perspectors 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	Solving practical tasks related to the assessment of the degree
of the Model for the Presence of	of multicollinearity and its exclusion from the model involves:
Multicollinearity"	Checking the model for multicollinearity.
	Identifying multicollinear variables.
	Applying the Ferrar-Glover algorithm.
	Utilizing methods to alleviate multicollinearity.
Topics 5-6. Task 5.	Methods for determining heteroskedasticity and its
"Construction of a Multiple	consequences, including the generalized method of least
Linear Model under	squares (GLS), are part of the analysis. Additionally, checking
	for autocorrelation and estimating model parameters with

Heteroskedasticity and Autocorrelation Conditions"	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

Торіс	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 list of self-studies

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

TEACHING METHODS

In the process of teaching the course, 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, and laboratory 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 an exam: maximum amount is 60 points; minimum amount required is 35 points.

The final control includes current control and an exam.

Semester control is carried out in the form of a semester exam.

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

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

Current control: competence-oriented tasks on topics (maximum score -30 points); express tests (maximum score -18 points); control works (maximum score -12 points).

Semester control: Grading including Exam (40 points).

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

An example of an examination card and assessment criteria.

An example of an exam card.

SIMON KUZNETS KHARKIV NATIONAL UNIVERSITY OF ECONOMICS

Bachelor's degree Training Direction: Marketing Semester: 3 the course: Econometrics

Examination paper number 1 Task 1

The goal is to assess the student's cognitive knowledge of the course, which makes it possible to determine the level of possession of the study material

Test questions of single and multiple choice "Examination tests" are in the root directory of the course "Econometrics" on the website of the distance learning system <u>https://pns.hneu.edu.ua/</u>

Task 2

The goal is to assess the student's ability to apply the knowledge gained in practice to solve a wide class of management tasks for various socioeconomic objects (processes)

The matrix of coefficients of pair correlations of factor attributes is known. It is necessary to verify the presence of multicollinearity in an array of independent variables using the Farrar - Glauber method and draw conclusions.

Table 1. Initial data							
X1	X2	X3					
4	10	30					
2	13	35					
3	14	40					
8	15	44					
7	18	45					
10	20	42					
15	23	48					
14	25	50					
10	27	55					

Table 1. Initial data

Task 3

The goal is to assess the student's ability to apply the knowledge gained in practice to solve a wide class of management tasks for various socioeconomic objects (processes) In Table. 2 presents the initial data. It is necessary to check the presence of autocorrelation of the residuals in the model using the Durbin-Watson criterion and the cyclic autocorrelation coefficient. Draw conclusions.

	Table 2.	Initial dat	a					
Х	64,5	46,5	38,1	32	19,7	19,5	6,5	8,1
Y	81,5	72,5	56,5	50,2	41,9	24,7	17,6	11,9

Task 4

The goal is to assess the creative thinking of the student, his ability to integrate the knowledge gained for the selection and application of economic and mathematical methods and models for assessing, analyzing and planning socioeconomic processes.

The marketing department of the enterprise is tasked to analyze the dependence of the volume of sales of products Y (UAH thousand) on advertising expenses X1 (thousand UAH) and prices for goods X2 (UAH). In Table. 2 shows the initial data. It is necessary: 1) to propose an idea of the type of connection between the dependent and independent characteristics; 2) to determine the parameters of the corresponding econometric model; 3) to test, with the help of Student's criterion, the hypothesis of the significance of the influence of advertising costs and prices on the value of products sold; 4) to check the adequacy of the model; 5) to plot the actual and calculated (theoretical) values of the sales volume; 6) to find the forecast value of the sales volume, if the advertising costs are 10 thousand UAH, and the price - 15 UAH.

Table 3. Initial data

	1 4010 0									
X1	1,9	5,6	2,8	3,1	3,6	4,4	4,7	5	5,5	2,6
X2	5,4	7,6	2,3	5,9	11,0	12,6	10,4	4,9	2,4	1,6
Y	13,7	18,0	6,2	15,5	24,1	24,8	25,0	13,0	8,1	6,7

Draw economic conclusions.

Approved at the meeting of the Department of Economic Cybernetics and System Analysis. Protocol N_{2} from ______

Examiners ______Svitlana PROKOPOVYCH Head of Department ______Tetiana SHABELNYK

Assessment criteria

Paper consists of four tasks. Performance of each examination task estimated as follows:

Task	Points amount
Task 1 (stereotypic)	15
Task 2 (diagnostic)	10
Task 3 (diagnostic)	10
Task 4 (heuristic)	5
Total	40

The first task (stereotypic) evaluates cognitive knowledge of student discipline, to determine the level of training material, and includes 30 tests. The maximum total number of points for completing the first task is 15 points. In assessing the first task the following formula used:

$Mark = percentage of correct answers \times 15/100$

The second and third tasks (diagnostic) make it possible to determine the student's ability to apply this knowledge in practice to build and use econometric models for evaluation, analysis, forecasting in social and economic systems. In assessing these tasks the following criteria used:

10 points - student receives for completely solved complex tasks, and explanation of the chosen course of solution and findings;

9 points - student gets for quite clearly and logically consistent solved tasks and explanation of the chosen course of solution and findings, but incomplete meaningful economic interpretation of the results and the existing management decisions;

8 points - student receives for quite logically consistent solved tasks without justification and course of solving findings;

7 points - if the problem solved completely, but there is no economic justification, not quite conclusions; permitted occasional minor errors;

6 points - if the research proposed model was not complete and there is no justification, nor made clear logical conclusions; Target as a whole correctly using the

default algorithm, but their performance is assumed student errors;

5 points - if the study was made a logical error that affected the course of resolving and final conclusions;

4 points - student made significant errors that generally affect the result that proves insufficient ability to apply theoretical knowledge to solve problems;

3 points - if the student is able to offer a total solution algorithm, but failed to conduct a full investigation model or just started such a study;

2 point - not able to conduct a study model or just started an investigation and submitted the basic formula for the solution of the problem;

1 point - not able to conduct a study model or just started a research and in case the student tried to present the basic formula for the solution of the problem and made an error;

0 points - if the problem is not solved at all, without any attempts.

The fourth task (heuristic) is aimed at identifying student's creativity thinking, his ability to integrate this knowledge to select and use econometric methods and models of evaluation, analysis and forecasting of socio-economic processes. While solving the task the student must demonstrate the ability to use skills obtained in different studies. In assessing this task, the following criteria used:

5 points - for completely correctly solved tasks, with full justification conclusions and explanations student representation; possession of a clear conceptual apparatus, methods, techniques and tools to make good decisions on modeling; application for answers not only recommended, but with additional literature knowledge and creativity.

4 points - if the task correctly solved, with not enough full justification of conclusions and explanations student representation; possession of a clear conceptual apparatus, methods and techniques, the ability to use them for specific tasks and solving practical situations. Assumed to small random errors.

3 points - if the answer is right, but in the absence of its justification and explanation; if a student when performing tasks demonstrates only the basic knowledge of educational material, provided the curriculum. Target as a whole correctly using the default algorithm, but their performance student presumed substantial errors.

2 points - if the task partially solved correctly using the default algorithm, that no final conclusions or in the decision was made a technical error or student permits significant errors that generally affect the result that proves insufficient ability to apply theoretical knowledge to solve problems; student in answering only demonstrated understanding of the main provisions of material discipline

1 point - if the student demonstrated only general knowledge course major decisions or relationships of the proposed model; the student does not have a significant part of the program material can not properly carry out the tasks facing considerable difficulties in selecting tools for solving the problem.

0 points - if the problem is not solved.

Rounding of received points will be made by the general rules of rounding.

RECOMMENDED LITERATURE

Main

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