МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ

ХАРКІВСЬКИЙ НАЦІОНАЛЬНИЙ ЕКОНОМІЧНИЙ УНІВЕРСИТЕТ ІМЕНІ СЕМЕНА КУЗНЕЦЯ

"ЗАТВЕРДЖУЮ"
Заступник керівника
(проректор з науково-педагогічної роботи)
М. В. Афанасьєв

ЕКОНОМІКО-МАТЕМАТИЧНІ МЕТОДИ
робоча програма навчальної дисципліни

Галузь знань	**29 Міжнародні відносини**
Спеціальність	**292 «Міжнародні економічні відносини»**
Освітній рівень	**перший (бакалаврський)**
Освітня програма	**Міжнародний бізнес**

Вид дисципліни	**базова**
Мова викладання, навчання та оцінювання	**іноземна (англійська)**

Завідувач кафедри вищої математики та економіко-математичних методів — Малярець Л.М.

Харків
ХНЕУ ім. С. Кузнеця
2018

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ЗАТВЕРДЖЕНО
на засіданні кафедри вищої математики та економіко-математичних методів
Протокол № 1 від 27.08.2018 р.

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Лист оновлення та перезатвердження
робочої програми навчальної дисципліни

Навчальний рік	Дата засідання кафедри – розробника РПНД	Номер протоколу	Підпис завідувача кафедри

1. Introduction

The task of the economic and mathematical modelling is construction of models of economic objects and processes in order to describe, optimize, analyze, forecast, provide analytical support for these objects and processes when making decision at all levels of management. Thus, modelling is a fundamental basis of the methodology of management of the economy. Economic and mathematical models are constructed with the help of mathematical methods. Economic and mathematical methods are tools for learning and investigation of economic systems of different complexity. They form a fundamental basis for solving real analytical problems in different fields of activity of management subjects.

The fundamental basis in the mathematical preparation of economists and managers is the academic discipline "Economic and Mathematical methods" which is a compulsory discipline of the natural scientific series and a component of the structural logical scheme which is provided for the educational professional program of Bachelor's (first) degree students of speciality 292 "International economic relations".

The basic problems of teaching the academic discipline is giving students knowledge of the basic parts of economic and mathematical methods; raising the level of the fundamental mathematical training of students with intensification of its applied direction, mastering the fundamentals of economic and mathematical methods and application of this knowledge to the economic investigations for solving economic problems, forming skills in the application of elements of economic and mathematical methods to investigations where mathematical methods (the mathematical programming and econometrics) are applied as an instrument of investigation and solving optimization economic problems for forming models of economic processes and deve-lopments, acquiring the necessary theoretical and practical knowledge for solving specific problems which are set in the process of forming and a construction of economic and mathematical models, and obtaining the required mathematical knowledge for the study of other disciplines.

The basic condition for mastering of this discipline is students' knowledge of Higher Mathematics, Probability Theory and Mathematical Statistics, and Economic Theory, Microeconimics, Manufacturing Organization.

The annotation of the academic discipline:

The main purpose of teaching is to form future specialists' basic mathematical knowledge for solving theoretical and practical problems in professional activity of a competent specialist in any sphere of his activity, skills in analytical thinking and skills in using mathematical knowledge for formation of real processes and developments, and for solving economic problems.

The main tasks that should be carried out in the process of teaching the discipline are: giving students knowledge of the basic parts of economic and mathematical methods; definitions, theorems, rules; proving the main theorems; mastering the fundamentals of the methodology of mathematical investigation of the applied economic problems; independent broadening of knowledge, development of logical and algorithmical thinking; obtaining primary skills in independent learning of mathematical and applied literary sources by students.

The subject of the academic discipline "Economic and Mathematical Methods" is the fundamentals of mathematical programming and econometrics.

In the process of learning the academic discipline "Economic and Mathematical methods" a student receives analytic and investigatory competences which are necessary for a modern economist in any sphere of his activity.

The syllabus of the academic discipline "Economic and Mathematical Methods" is compiled according to the statements of the field standard of the higher education of the Ministry of Education and Science of Ukraine based on the educational professional program

of bachelor training, which is made by the Scientific Methodical Committee of Economics and Enterprise of the Ministry of Education and Science of Ukraine.

A student starts studying the academic discipline "Economic and Mathematical Methods" in the second term of the first year of studies.

In the process of learning students obtain the required theoretical knowledge during lectures and acquire practical skills at the practical and laboratory studies and during independent work and fulfillment of individual tasks. Independent and individual work of students has a great value in the process of mastering the material and consolidating knowledge. All of these types of studies were devised according to the statements of the Bologna Declaration.

As a result of studying the academic discipline a student **must know**:

basic mathematical optimization methods as an instrument of construction of optimization models for solving problems in economics;

basic mathematical econometric methods as an instrument of construction of econometric models for solving problems in economics;

basic principles of construction of economic and mathematical models for investigation of optimization problems;

possibilities and restrictions of mathematical methods which are used for solving optimization problems in economics;

basic principles of construction of multidimentional econometric models which are used for solving problems of quantative analysis and forecasting of processes of functioning and development of the economic system;

ways of defining accuracy and reliability of methods which are used for processing of empirical data;

be able *to***:**

fulfill statement and formalization of practical tasks according to the general technology of modelling in economics;

classify models of mathematical programming problems and chose the mathematical methods for solving them;

solve economic problems with the help of methods of linear programming;

construct a model of a dual problem, define a solution to the initial problem according to the solution to a dual problem and give an economic explanation of dual estimations;

investigate constancy of an optimal plan relative to the influence of coefficients of an objective function and the right part of the basic system of constraints;

solve transportation problems with the help of the method of potentials;

solve separate problems of nonlinear programming using the graphical method and the method of Lagrange’s multipliers;

use elements of game theory for solving pair matrix games with a zero sum;

construct a pair linear regression equation;

carry out the choice of factors for construction of a multiple regression equation;

define statistical estimations of parameters of a multifactorial econometric model and verify their statistic significance;

carry out estimation of parameters of a regression equation for time series and define the ability of this equation for a forecasting;

use statistical tests for defining the correspondence of an econometric model which is constructed with the help of sample data to basic hyphothesis which lies in its basis;

construct economic models on the basis of the system of structural equations;

construct dynamic econometric models;

model one-dimensional time series;

analyse time series;

learn mathematical literature by oneself;

broaden the knowledge, develop logical and algorithmic thinking by oneself.

use mathematical methods as an instrument of the economic and mathematical modelling for solving practical economic problems;

A modern tendency in higher education is a reorientation of students of higher educational institutions from the process of education to a result, from knowledge to skills, forming definite competences.

The purpose of the academic discipline:

Academic year	**1st**	
Term	**2nd**	
Number of credits	**5**	
The form of studies	**lectures**	**32**
	practical studies	**16**
	laboratory studies	**16**
Independent work		**86**
Form of final control	**exam**	

Structural and logical scheme of studying the academic discipline:

Previous academic disciplines	Next academic disciplines
Algebra, Geometry (Mathematics) Higher mathematics	Statistics

2. Competences and result of mastering the academic discipline:

Competences	Results of mastering the academic discipline
Forming analytic thinking. Development of the ability to construct mathematical and economic models. Forming the ability to use basic mathematical optimization methods as an instrument of construction of optimization models when solving practical problems in economics	A student must 1) solve problems of linear programming; 2) form a dual problem for the given primal problem; 3) find a solution to a dual problem knowing a solution to a primal problem with the help of duality theorems; 4) give economic interpretations of solutions to a primal and a dual problem; 5) be able to solve and find an optimal solution to transportation problems; 6) be able to solve problems of integer programming; 7) solve problems of nonlinear programming; 8) solve problems of game theory
Forming analytic thinking and skills in independent formation of economic and mathematical models for description of different economic processes. Forming the ability to use basic mathematical econo-metric methods as an instrument of construction of econometric models when solving practical problems in economics	A student must 1) construct a pair regression equation; 2) check the quality of the constructed pair linear model; 3) verify the statistical significance of coefficients of regression and correlation; 4) check the adequacy of econometric models; 5) construct a multiple regression equation;

Competences	Results of mastering the academic discipline
	6) check the statistical significance of coefficients of a regression equation; 7) use methods of elimination of multicollinearity; 8) use methods of defining heteroscedasticity; 9) use methods of elimination of autocorrelation; 10) use advanced methods of regression analysis; 11) use systems of econometric equations; 12) use methods of partitioning of dynamic econometric models

3. The syllabus of the academic discipline

Thematic module 1. Optimization methods

Theme 1. The general theoretical foundations of optimization methods and models in economics

1.1. Construction of economic and mathematical models

A conceptual statement of the problem of construction of economic and mathematical models. The place of modelling among the methods of learning social and economic systems. The objective of modelling. Defining models, properties of models.

1.2. The choice a method of solving economic and mathematical problems

The choice of a method of solving economic and mathematical problems and explanation of this choice. Possibilities of realization of search for solution to optimization problems with the help of the package of applied programs for personal computer.

1.3. Foundations of the classical optimization theory

Foundations of the classical optimization theory. General remarks. Classification of problems. Information support for economic and mathematical optimization models.

1.4. Optimization and mathematical programming problems

The statement of an optimization problem. The conditional extremum. Lagrange's method of multipliers. The economic meaning of Lagrange's multipliers. The iterative method of solving problems of mathematical programming.

Theme 2. Problems of linear programming and methods for solving them

2.1. Statements and basic definitions of linear programming problems

Economic and mathematical statements of linear programming problems (LPP). The system of hypothesis. Basic definitions. A standard form of a linear optimization model. A set of feasible solutions and an optimal solution to LPP.

2.2. The graphical method of solving LPP

The graphical method of solving LPP. The geometrical meaning of LPP. The graphical method of solving LPP, its possibilities and the field of application. Examples of problems, which can be solved by the graphical method.

2.3. The simplex method of solving LPP

The simplex method of solving LPP. The canonical (basic) form of LPP. The construction (plotting) of support solutions. The optimization criterion. Searching an optimal solution using the algorithm of the simplex method. The geometrical meaning of the simplex method. The theoretical aspects of the simplex method. A problem with mixed constraints.

2.4. The method of artificial basis

The method of artificial basis. The features of solving LPP, which are given in the general form of LPP for solving economic problems.

Theme 3. Duality theory and analysis of linear models of economic optimization problems

3.1. Basic definitions, problems and theorems of the duality theory

The basic concepts of duality theory. Mutual dual problems of linear programming. The economic meaning of the primal and dual LPP as the example of the product mix problem. Rules of construction of the mathematical model of the dual problem.

3.2. Theorems of the duality theory

The basic duality theorems and their economic explanation. Finding an optimal solution to the initial problem using the solution to the dual problem.

3.3. Postoptimization analysis of LPP

Postoptimization analysis of LPP. Dual estimations and the shortage of resources in the neighbourhood of the optimal solution to LPP.

3.4. The analysis of a range of coefficients of basic components

The analysis of a range of changes of components of the matrix-column of the right part of the basic system of constraints. The analysis of a range of changes of coefficients of the objective function. The analysis of a range of changes of coefficients of the basic matrix of the constraints system.

Theme 4. The transportation problem

4.1. The basic statement of the transportation problem and methods of finding the support basic solution

Solving the transportation problem using the criterion of costs. The statement of the transportation problem using the criterion of the transportation cost. Finding the support basic solution. Transformation of the other basic solution. The problem of solution degeneracy of the transportation problem and ways to eliminate the degeneracy.

4.2. The method of potentials

Finding an optimal solution using the method of potentials. The optimality criterion of the solution. The method of potentials. The economic meaning of potentials.

4.3. Investigation of stability of an optimal solution

Investigation of stability of an optimal solution as a problem of parametric programming. Transportation problems with additional conditions.

4.4. Solving a transportation problem using the criterion of time

Solving a transportation problem using the criterion of time. Problems with economic content which are reduced to transportation problems.

Theme 5. Integer programming

5.1. The basic statement of integer programming problems

The economic statement of the integer programming problem and its mathematical model.

5.2. Types of integer programming problems

An assignment problem. Solving an assignment problem as a transportation problem. The investment portfolio as a problem of combinatorial optimization.

5.3. The geometrical meaning of solutions

The geometrical meaning of solutions to the integer programming problem on a plane.

5.4. The methods of solving integer programming problems

The general characteristic of the methods of solving integer problems: cutting methods, combinatorial methods, methods of approximate computations. The branch and bound method. Gomory method (the cutting method). Generation of additional constraints.

5.3. Examples of integer programming problems

Examples of economic problems which require using models of integer programming.

Theme 6. Nonlinear optimization models of economic systems

6.1. The statement and the geometrical meaning of a nonlinear programming problem

Economic and mathematical statements of a problem of a nonlinear programming. The geometrical meaning of a nonlinear programming problem.

6.2. Basic difficulties of solving nonlinear programming problems

Basic difficulties which arise in solving nonlinear programming problems.

6.3. Necessary and sufficient conditions and theorems

The necessary and sufficient conditions of the existence of a saddle point. Kuhn – Tucker theorem.

6.4. The bases of quadratic programming problems

The economic statement and mathematical models of some quadratic programming problems.

6.5. The bases and methods of solving convex programming problems

Problems of convex programming and methods of solving them.

6.6. The bases and methods of solving linear fractional programming problems

The economic and a mathematical statement of a linear fractional programming problem. The geometrical meaning of a linear fractional programming problem. Solving a linear fractional programming problem with the help of reducing it to a linear programming problem.

Theme 7. Game theory. Analysis and risk management in eco-nomics on the basis of the concept of game theory

7.1. The basic definitions and models of game theory

The basic notions of game theory, a mathematical model of the matrix game as a particular case of probabilistic models of economic systems.

7.2. The basic notions and the basic theorem of two players' matrix games

Matrix games of two players. The payoff matrix. Minimax and maximin criteria. The game price. The game in pure strategies. A saddle point. The game in mixed strategies. The basic theorem of game theory (Neumann theorem). Reducing a matrix game of two players to a linear programming problem.

7.3. A graphical method of solving a matrix game

The geometrical meaning of the matrix game of two players. Finding active strategies of players. The content of basic ways of quantitative pricing risk. The system of quantitative estimations of the measure of an economic risk. A game price as the risk appraisal.

Thematic module 2. Econometric methods

Theme 8. Particular properties of construction of econometric models and ways of construction

8.1. Particular properties of construction of econometric models

Particular properties of econometric models. The role and place of econometric models in the analysis of socioeconomic systems. An economic model and problems of econometric modelling.

8.2. Properties of observations and data

Forming of a set of observations. The concept of homogeneity of observations. The accuracy of initial data.

8.3. The basic steps of construction of an econometric model

The basic steps of construction of an econometric model. The general characteristic of the basic steps of construction of an econometric model.

8.4. Checking the statistical significance and quality of a model

Particular properties of interpreting of the form of an econometric model. Checking the statistical significance of a model. Characteristics and criteria of the quality of econometric models. Statistical estimations of parameters of econometric models.

Theme 9. A pair linear model

9.1. The content and the estimator of parameters

The specification of a model. Linear regression and correlation: the content and the estimator of parameters.

9.2. The method of least squares

Estimation of parameters of a linear model of pair regression with the help of the method of least squares.

9.3. Checking the quality and statistical significance of the constructed pair linear model

Checking the quality of the constructed pair linear model. The estimator of the statistical significance of coefficients of regression and correlation. Nonlinear regression.

9.4. Variance analysis

Variance analysis. The determination coefficient. Checking the adequacy of an econometric model.

Theme 10. Methods of construction of a multiple regression model

10.1. The basic steps and specification of construction of a multiple regression model

The general questions of construction of a multiple regression model. The specification of a model. Estimation of parameters of a regression equation. Methods of construction of general linear regression.

10.2. The method of least squares

The method of least squares (MLS), statistical properties of MLS-estimators. The variance and standard errors of parameters of an equation.

10.3. Analysis of the quality of a multiple linear regression equation and interval estimators of its coefficients

Estimation of parameters of a linear equation of multiple regression. Interval estimators of coefficients of a theoretical regression equation. Analysis of the quality of an empirical equation of multiple linear regression. Partial equations of a regression.

Multiple and partial correlation.

10.4. Checking the statistical significance and general quality of a regression equation

Checking the statistical significance of coefficients of a regression equation. Checking the general quality of a regression equation.

10.5. Forecasting and accuracy of prediction

Forecasting according to regression models. The accuracy of prediction.

Theme 11. Problems in the construction of linear multiple regression models

11.1. Sequences and methods of elimination of multicollinearity.

Different aspects of multiple regression and problems which arise as a result of disorder of conditions of using MLS. Multicollinearity and its sequences. Methods of elimination of multicollinearity.

11.2. Sequences and methods of elimination of heteroscedasticity

Heteroscedasticity and methods of defining heteroscedasticity. The generalized method of least squares.

11.3. Sequences and methods of elimination of autocorrelation

Autocorrelation of model residuals and methods of elimination of autocorrelation. Implications of autocorrelation of model residuals. Durbin – Watson test. Methods of elimination of autocorrelation of model residuals.

11.4. Autoregression

Estimation of parameters of a model with autoregression.

11.5. Interpreting the obtained linear multiple regression models

Interpreting problems of parameters of a multifactor model.

Theme 12. The generalized schemes of regression analysis

12.1. The generalized schemes and methods of regression analysis

The generalized schemes of regression analysis.

12.2. The generalized methods of regression analysis

The generalized Aitken method of least squares. Dummy - variables. Advanced methods of regression analysis.

Theme 13. The systems of econometric equations

13.1. The basic notions of the systems of econometric equations

The general concept of systems of equations, which are used in econometrics. The structure and reduced forms of a model. An identification problem. Estimation of parameters of a structural model.

13.2. The method of solving systems of econometric equations

The two-stage method of least squares (2SMLS). Economic models on the basis of the system of structural equations.

Theme 14. Dynamic econometric models

14.1. Econometric models with lag variables

The concepts of lag and lag variables. The general characteristics of models with separated lags. The types of lag models. The meaning of parameters of models with a separated lag.

14.2. The basic methods

Defining the lag structure. Lags of independent variables. A mutual correlation function. A korelograma. The choice of a model type with separated lags. Methods of partitioning of dynamic econometric models. Almon's method. Koyk's method.

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4. The order of assessment of studying results

The system of assessment of competences which were formulated for a student during the learning of the academic discipline, takes into consideration the forms of studies which according to the syllabus of the academic discipline provide lectures, practical studies, laboratory works, fulfillment of students' independent work. The assessment of the formed competences of students is carried out on the accumulative 100-point system. According to the temporary provision "About the Order of Assessment of Students Academic performance on the Accumulative Point Rating System" of Simon Kuznets Kharkiv National University of Economics control ways include:

current control which is carried out within a term during lectures, practical studies and laboratory works and it is assessed as a sum of accumulative points (the maximum equals 60 points; the minimum which makes it possible for a student to pass an exam, equals 35 points);

module control which is carried out in the form of a colloquium with taking into account the current control according to a corresponding thematic module, provides an integral assessment of student's results after learning the material of a logically completed part of the discipline (or a thematic module);

final/term control: the final mark on the academic discipline is calculated according to the points obtained during the current control on the accumulative system.

Current control on the given academic discipline is carried out in the following forms: active in-class work (lecture); active in-class work (practical study); active in-class work (laboratory study); homework; competence oriented tasks (defence of laboratory works); an

independent test; a written test; independent creative work.

Assessment of student's knowledge during practical studies and carrying out laboratory works is conducted on the accumulative system according to the following criteria: understanding, the degree of the mastery of the theory and methodology of problems which are considered; the degree of the mastery of the factual material of the academic discipline; familiarizing with the recommended literary sources and modern literature on the questions which are considered; the ability to connect theory and practice in the consideration of particular examples, solving problems, carrying out laboratory works, carrying out calculations in the process of doing homework and tasks which are considered in class; the logic, structure, style of presenting the material in written works and in oral answers in class, the ability to ground one's position, carry out generalization of the information and draw conclusions.

The general criteria for the assessment of ***independent work*** of students are profound and deep of knowledge, the level of thinking, skills in systematization knowledge on particular themes, skills in drawing conclusions, attainments and techniques of carrying out practical tasks, the ability to find necessary information, carry out its classification and processing, self-realization in practical and laboratory studies.

The criteria for assessment of independent creative work and independent tests are: the ability to carry out a critical and an independent estimation of the defined problem questions; skills in the explanation of alternative views and availability of a students' own point of view, position on the defined problem question; using the analytical approach; the quality and accuracy of expressing the thought; the logic, structure and explanation of conclusions about a particular problem; independence of carrying out of the work; grammatical correctness of the presentation of the material; using the methods of comparison, generalization of the concepts and facts; the design of the work; the quality of presentation.

The final control of knowledge and competences of students on the academic discipline is carried out on the base of the term exam. The examination paper includes the syllabus of the discipline and provides for assessment of the knowledge level and a degree of the mastery of corresponding competences of students.

It should be assessed student's progress, if a sum of points, obtained as the total result of an assessment by all forms of a control, equals or exceeds 100. Accordingly the minimal possible quantity of points by a current and a module control during a term equals 60.

The final mark of the academic discipline is calculated according to the points obtained during the exam and points obtained during the current control on the accumulative system.

The total result in points during the term is "*60 and more points mean passed*", "*59 and less points mean failed*" and it is entered into the "*Mark sheet*" on the academic discipline.

The distribution of points by weeks

Themes of the thematic module			Lectures	Practical study	Laboratory study	Homework	Competence-oriented task	Independent test	Written test	Independent creative work	Colloquim	Total
1	2	3	4	5	6	7	8	9	10	11	12	13
Thematic module 1 Optimization methods	Theme 1	week 1	0.3	0.3	–	–		–	–	–		0.6
	Theme 2	week 2	0.3	–	0.3	0.2		–	–	–		0.8
	Theme 3	week 3	0.3	0.3	–	0.2		–	–	–		0.8
	Theme 4	week 4	0.3	–	0.3	0.2						0.8
	Theme 5	week 5	0.3	0.3	–	0.2		5				5.8
	Theme 6	week 6	0.3	–	0.3	0.2	5					5.8
	Theme 7	week 7	0.3	0.3	–	0.2			5		6	11.8
Thematic module 2 Econometric methods	Theme 8	week 8	0.3	–	0.3	0.2						0.8
	Theme 9	week 9	0.3	0.3	–	0.2						0.8
	Theme 10	week 10	0.3	–	0.3	0.2						0.8
	Theme 11	week 11	0.3	0.3	–	0.2						0.8
	Theme 12	week 12	0.3	–	0.3	0.2						0.8
	Theme 13	week 13	0.3	0.3	–	0.2		5				5.8
	Theme 14	week 14	0.3	–	0.3	0.2	5				6	11.8
		week 15		0.3	–	0.2			5			5.5
		week 16		–	0.3	0.2				6		6.5
Exam												40
Total			**4.2**	**2.4**	**2.4**	**3.0**	**10**	**10**	**10**	**6**	**12**	**100**

The scales of assessment: national and ECTS

Sum of points including all forms of study	Mark on the ECTS scale	Mark on the national scale	
		for an exam, a term paper, practice	for a test
90 – 100	A	excellent	passed
82 – 89	B	very good	
74 – 81	C	good	
64 – 73	D	satisfactory	
60 – 63	E		
35 – 59	FX	unsatisfactory	failed
1 – 34	F		

5. Recommended reading

5.1. Main

1. Єгоршин О. О. Математичне програмування : підручник / О. О. Єгоршин, Л. М. Малярець. – Харків : ВД «ІНЖЕК», 2006. – 438 с.

2. Єгоршин А. А. Лабораторний практикум з економетрики в Excel : навчально-практичний посібник / О. О. Єгоршин, Л. М. Малярець. – Харків : Вид. ХНЕУ, 2011. – 140 с.

3. Збірник вправ з навчальної дисципліни «Економіко-математичне моделювання» для студентів усіх галузей знань усіх форм навчання / уклад. Л. М. Малярець, Е. Ю. Железнякова, Л. О. Норік. – Харків : Вид. ХНЕУ, 2009. – 88 с.

4. Лабораторний практикум з навчальної дисципліни «Економіко-математичне моделювання» : начально-практичний посібник / Л. М. Малярець, П. М. Куликов, І. Л. Лебедєва та ін. – Харків : Вид. ХНЕУ, 2009. – 136 с.

5. Малярець Л. М. Економіко-математичні методи та моделі: навчальний посібник / Л. М. Малярець, Е. Ю. Железнякова, Є. Ю. Місюра. – Харків : Вид. ХНЕУ ім. С. Кузнеця, 2011. – 320 с.

6. Малярець Л. М. Економіко-математичні методи та моделі: навчальний посібник / Л. М. Малярець. – Харків : Вид. ХНЕУ ім. С. Кузнеця, 2016. – 405 с.

7. Малярец Л.М. Экономико-математические методы и модели: учебное пособие для иностранных студентов / Л.М. Малярец. – Х.: Изд. ХНЭУ, 2013. – 288 с.

8. Малярец Л. М. Эконометрика в примерах и задачах / Л. М. Малярец, Э. Ю. Железнякова, Л. А. Норик. – Харьков : изд. ХНЭУ им. С. Кузнеца, 2014. – 268 с.

9. Методичні рекомендації до виконання контрольних робіт з навчальної дисципліни «Економіко-математичне моделювання» для студентів усіх напрямків підготовки заочної форми навчання / уклад. Л. М. Малярець, Е. Ю. Железнякова, І. Л. Лебедєва, Л. О. Норік. – Харків : Вид. ХНЕУ, 2008. – 36 с.

5.2. Additional

10. Англо-русский словарь математических терминов / под ред. П. С. Александрова. – Москва : Мир, 1994. – 416 с.

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