

Stamp: /Federal Fisheries Agency FSEI HPE "Murmansk State Technical University";
183010 Sportivnaya St.13. Murmansk/

**Extract from the course outline for discipline "Mathematics", study program
"Applied Information Technologies in Economics"**

13. Mathematics (600 academic hours)

Discipline contents:

Fundamentals of theory of sets.
Statements from logical algebra.
Predicates. Boolean algebra. Logical formulae.
Combinatorics.
Vectors in Euclidean space. Norm of vector. Scalar product. Linear independency. Basis vectors.
Matrixes. Matrix manipulation. Commutativity.
Matrix determinant. Properties of determinants. Minors. Calculation of determinants. Matrix grade.
Systems of linear equations. Cramer formula. Gauss method. Concept of ill-conditioned systems.
Linear operators. Representation by matrices. Eigen pairs. Reduction to eigenvector basis.
Quadric forms. Positive and negative definite forms and matrixes. Reduction to sum of squares.
Function limit. Concept of infinitesimal value. Fundamental theorems of limits. Remarkable limits.
Continuity of function. Fundamental theorems of continuous functions.
Differentiation. Calculation of derivatives on the basis of differentiation. Table of derivatives. Higher derivatives. Differential. Theorems of derivation of functions.
Derivatives of composite function, inverse function, implicit function, parametrically prescribed functions.
Mean-value theorems for differentiable functions. Formula of finite increments. L'Hospital rule.
Taylor formula. Evaluation of residual member. Application for approximate computation of function values and computation of limits.
Study of functions (increase, decrease, extremums, convexity, asymptotes)
Concept of a graph.
Oriented and unoriented graphs.
Euler problem. Travelling salesman problem.
Utilization of graphs.
Concept of a primitive. Properties of indefinite integral. Table of integrals. Methods of immediate integration. Simplest changes of variable.
Integration of fractional rational functions. Integration by parts.
Integrals, reduced to integration of rational functions. Integration of irrationalities.
Riemann sum. Riemann integral. Properties of definite integral. Integrability of continuous functions. Fundamental theorem of calculus. Change of variable in definite integral.
Integrals, depending on parameter. Differentiation of an integral with respect to a parameter.
Applications of definite integral: calculation of areas of planar figures, arc curve length, volumes and areas of the surfaces of solids of revolution.
Improper integrals. Absolute convergence. Simplest convergence criteria.
Definition of the function of multiple variables. Contour lines. Limit and continuity.
Partial derivatives, partial and total differential. Derivatives and

differential of higher orders. Derivative by direction.
Differential operators: gradient, divergence, curl. Taylor formula for function of two variables. Extremums of functions of two variables. Necessary and sufficient conditions.
Concept of a double integral. Reduction to iterated integral. Change of variables in a double integral. Simplest applications.
Definition of a complex number. Complex plane representation. Operations with complex numbers. Trigonometric representation. Extraction of a root. Moivre formula. Euler formula.
Concept of numerical series. Convergence and divergence. Necessary convergence criterion. Comparison criterion. D'Alembert criterion. Cauchy, integral. Alternating series. Leibniz criterion. Alternating series. Absolute and conditional convergence.
Functional series. Domain of convergence. Integration and differentiation of functional series. Power series. Radius of convergence. Taylor series.
Orthogonal and orthonormal systems of functions. Fourier series. Trigonometric series. Convergence.
Concept of ordinary differential equation. General and particular solutions. Initial data. Cauchy problem. Simplest differential equations.
First order equation. Existence and uniqueness of the solution. Equations with separable variables and reduced to them. Equations, allowing reduction of order.
Linear differential equations. Principle of superposition. Linear equations of first order. Method of variation of parameters.
Linear equations with constant coefficients. Equations of second order. Solution of nonhomogeneous equations with special right members.
Laplace transformation. Operator calculus. Application for solution of linear nonhomogeneous equations.
Systems of linear differential equations with constant coefficients. Matrix method of solution. Phase plane. Stability and instability of solutions.
Concept of function of a complex variable. Limit and continuity of function. Differentiability of the function of a complex variable. Cauchy-Riemann ratios.
Regular functions. Configuration integrals. Integral Cauchy formula.
Principle of analytic continuation. Continuation of main elementary functions into complex domain. Euler formula.
Fourier series in complex form. Fourier transformation. Inverse transformation. Concept of spectral analysis.
Linear normed spaces. Metric spaces. Norm as the basis of obtaining approximate solutions in computational problems. Mostly used norms in finite dimensional and function spaces.
Variational calculus. Brachistochrone problem. Lagrange lemma.
Simplest variational problem. Euler equation.
Free-terminal-state problem. Isoperimetric problem.
Lagrange problem.
Concept of fuzzy sets. Main operations.
Fuzzy logics. Fuzzy statements. Fuzzy formulae.

References:

1. N.Sh. Kremer, etc. Advanced Mathematics for Economists. - Moscow: Banks and Stock Exchanges, 1998.

Stamp: */Federal Fisheries Agency FSEI HPE "Murmansk State Technical University";
183010 Sportivnaya St.13, Murmansk/*

***Extract from the course outline for discipline "Probability Theory",
study program "Applied Information Technologies in Economics"***

16. Probability theory and mathematical statistics (115 academic hours)

Discipline contents:

Theory of probabilities and mathematical statistics. Probability, classical notion. Immediate computation. Probability of an opposite characteristic. Transitional probability. Dependent and independent characteristics. Probability of product and sum. Compatible and incompatible characteristics.
Elements of combinatorics, placement, repositioning, combination. Unequally possible results. Geometrical probabilities. Algebra of characteristics (sets). Essence and conditions of usability of the theory of probabilities. General concept of probability, Kolmogorov axioms. Probabilistic space.
Formulae of total probability and Bayes's formulae. Series of homogenous independent tests. Bernoulli distributions and polynomial formula of probability. Asymptotic formulae of Poisson and Laplace.
Random variables and ways of their description. Discrete random variables. Series of distribution of probabilities. Examples. Continuous random variables. Density function. Even and normal distributions. Expectation, dispersion and other characteristics of random variables.
Distribution function, its properties. Probability of random variable value hitting the interval. Gauss and Laplace functions. Transformations of random variables and their distributions.
Chebyshev inequality. Law of large numbers and its consequence. Chebyshev, Bernoulli, Borel, Kolmogorov theorems. Central limit theorem. Laplace integral theorem as a consequence of the central theorem.
Random vector, its distribution. Conditional distributions. Covariance and its properties, correlation. Correlation coefficient and its properties.
Random processes. Markov chains and their utilization in the simulation of social and economic processes. Markov theorem.
Mathematical statistics. Entire assembly and samples, representativeness and other characteristics. Variation series, polygon and histogram, their characteristics. Statistical methods of processing experimental data. Polygon and histogram. Statistical estimation. Point statistical estimations, consistency, nonbias, effectiveness.
Interval estimations for expectation, dispersion, probability. Verification of statistical hypotheses. Hypotheses on means.
Significance of the discrepancy between means. Multidimensional methods of estimation and statistical comparison. Dispersion analysis.
Verification of the hypothesis on the law of distribution of a random variable, Pearson concordance test. Peculiarities of statistical analysis of quantity and quality indicators. Scaling methods in processing of quality characteristics.
Simple regression. Least squares method.
Multiple regression. Multiple correlatively regressive analysis.
Multidimensional statistical analysis. Dimensionality problem in multidimensional methods of research. Reduction of the number of dimensions, component analysis, factor analysis, cluster analysis.
Classification without training. Discriminatory analysis. Classification with training. Canonical correlation. Multiple analysis of covariance.

Extract from the course outline for discipline "Theory of systems and system analysis", study program "Applied Information Technologies in Economics"

17. Theory of systems and system analysis (115 academic hours)

Discipline contents:

Introduction. Informational approach to systems analysis. Fundamentals of system analysis: System and its properties, descriptive and constructive definitions in system analysis. Principle of simulation, consistency and complexity. Models and simulation, object, subject and environment. Measurement and types of scales.
Concepts of goal and laws of goal formation. System as part of the environment; goal definition; laws of goal formation, goal in system analysis. Problem formulation. Detection of goals. Formation of criteria. System as the means of reaching the goal. Methods of analysis of goals and functions of control systems.
Types and forms of presentation of structures. System as the total of elements. Types and forms of presentation of structures of goals (net structure or a net, hierarchic structures (strata and echelons). Efficiency of structures. Principles of feedback. Connections: direct and reverse.
Systems and laws of their functioning and development. Notions, characterizing functioning of systems: condition, behavior, controllability, reachability, stability, equilibrium, functioning, growth and development. Statistic and dynamic models of systems. Transition processes. Laws of development in time. Functioning of systems in the conditions of uncertainty, management in risky conditions. Laws of interaction between the part and the whole. Laws of hierarchic order. Classification of systems, elements of the theory of adaptive systems.
Constructive definition of economic analysis. System description of economic analysis. Model as the means of economic analysis. Principles of development of analytical economic and mathematical models.
Mathematical models and forecasting. Setting a task of building a mathematical model. Methods and models of the theory of systems. Analytical and experimental approaches to building of economic and mathematical models. Concept of simulation modeling of economic processes. Forecasting. Extrapolational approach to forecasting. Model approach to forecasting. Method of experimental estimations in forecasting. Factor analysis of financial stability in utilization of ordinal scale.
Methods of organization of complex expert reviews. Analysis of informational resources
Development of the systems of organizational management

References:

- 1 V.V. Kachala Fundamentals of the theory of systems and system analysis. - M.: Hotline – Telecom, 2007.
- 2 V.N. Volkova, A.L. Denisov Fundamentals of the theory of control and system analysis. – St. Petersburg: SPb STU, 2003.
- 3 Introduction to system analysis: Learning aid for higher educational institutions by F.I. Peregudov, F.P. Tarasenko - M.: Vysshaya shkola, 2002.
- 4 N.E. Kobrinskiy, E.Z. Maiminas, A.D. Smirnov Economic Cybernetics - M.: Economics, 2002.
- 5 A.P. Kolesnik Computer systems in finance management. - M.: Finance and Statistics, 2004.

Deputy Head

of the Department of Information Systems
and Applied Mathematics

_____/Signature/_____
N.M. Kachala

I hereby certify that the translation from Russian into English is true and corresponds to the original document.

N. Anikeeva, Head of International Cooperation Department, MSTU



Translation from Russian into English

Stamp: /Federal Fishery Agency FSEI HPE "Murmansk State Technical University";
183010 Sportivnaya St. 13, Murmansk/

**Extract from the course outline for discipline "Research of operations",
study program "Applied Information Technologies in Economics"**

18. Research of operations (120 academic hours)

Discipline contents:

Linear programming. Graphic method and simplex method of resolution of the problems of linear programming. Transport problem of linear programming. Integer programming, branch and bound method.
Elements of the games theory. Matrix games, cooperative games. Game price. Solution of antagonistic games in pure and mixed strategies. Graphic solution. Analytical solution. Games with nature. Bayes, Laplace, Wald, Savage, Hurwitz criteria.
Dynamic programming. Model of the problem of dynamic programming, Bellman optimality equation. Problem of capital distribution for 1 and 2 years. Problem of equipment replacement.
Network programming. Travelling salesman problem, transport problem in network presentation.
Network planning. Graphs. Plotting of a network graph. Time parameters of networks. Definition of critical time. Time reserves.
Systems of mass servicing. Basic notions. Classification of the systems of mass servicing. Concept of Markov random process. Closed and open-end queuing systems.
Integer programming. Problem of building the optimal whole line of products. Branch and bound method.
Non-linear programming. Operations function. Cobb-Douglas function. Analytical, geometrical methods. Method of Lagrange multipliers.

References:

1. Higher mathematics for economists: Textbook for higher educational institutions. Under editorship of professor N.Sh. Kremer. - M.: Banks and stock exchanges, Unity, 1997, 2007.
2. Problem book for higher mathematics for economists: Learning aid under editorship of V.I. Ermakov M.: Infra, 2001, 2003, 2005.
3. M.S. Krass Fundamentals of Mathematics and its applications in economic education: Textbook for higher educational institutions. - M.: Delo, 2001, 2003.
4. N.I. Yaretenko Mathematics. Research of operations: Method guidelines and tasks.- Murmansk: MSTU, 2005.
5. I.K. Volkov Research of operations. - M.: MSTU named after N.E. Bauman, 2000.
6. E.S. Venttsel Research of operations.- M.: Science, 1988.

Deputy Head
of the Department of Information Systems
and Applied Mathematics

_____/Signature/_____
N.M. Kachala

I hereby certify that the translation from Russian into English is true and corresponds to the original document.

N. Anikeeva, Head of International Cooperation Department, MSTU



Stamp: */Federal Fisheries Agency FSEI HPE "Murmansk State Technical University":
183010 Sportivnaya St.13, Murmansk/*

*Extract from the course outline for discipline "High-level methods of
Information Technology and Programming",
study programme "Applied Information Technologies in Economics"*

**20. High-level methods of Information Technology and Programming (187
academic hours)**

Discipline contents:

Fundamentals of object-oriented approach to programming and programming language C#
Introduction. Newest directions in the area of creation of programming technologies. Laws of software evolution. Key direction of development of software tools.
Main programming paradigms. Structural (modular), object-oriented and logical. Programming in the environments of modern information systems: creation of modular programs, elements of the theory of modular programming, object-oriented engineering and programming. Programming languages: structural, object-oriented and logical. Object-oriented approach to engineering and development of programs. Essence of object-oriented approach. Object data type. Variables of object type. Encapsulation. Polymorphism. Classes and objects. Object-oriented engineering and unified language of simulation.
Overview of programming language C#. Language history. Structure of application program C#. Application execution. Software development environment VS .NET.
Variables and expressions: Variables. Simple types. Names of variables. Literal values. Declaration of variables and assignment of values to them. Mathematical operators. Assignment operators. Precedence of operators. Namespaces.
Cycles and logic. Logical assignment operators. Operators' precedence with additions. Ternary operator. Operators "if" and "switch". Arrangement of cycles. Cycles "do, while, for".
Amounts and strings. Definition, initialization and utilization of amounts. Strings. String literals, creation of String objects and their utilization.
Functions. Description and utilization of functions. Sphere of action of variables. Function "Main()". Overload of functions. Delegates.
Object-oriented programming in C#
Definition of classes. Constructors, destructors and "collection of waste". Interfaces and abstract classes. Definition of members of classes. Variables, methods, their determining and access to them. Determining and utilization of classes. Overload of methods. Control of access to members of classes.
Expansion of classes and inheritance. Utilization of existing classes. Inheritance of classes and inherited members of classes. Polymorphism and multiple inheritance. Abstract classes and interfaces. Nested classes.
Exceptions. Types, processing and objects of exceptions. Definition of personal exceptions.
Operation with files. Files and stream input/output. Classes for input and output. Observation of the condition of file structure, asynchronous access to files.
Graphic user interface and graphic abilities of C#. Operation with databases
Peculiarities of programming in windowed operation environments. Architecture Model-Presentation-Controller (MVC).

Stamp: /Federal Fisheries Agency FSEI HPE "Murmansk State Technical University";
183010 Sportivnaya St.13, Murmansk/

Extract from the course outline for discipline "Statistics",
study program "Applied Information Technologies in Economics"

31. Statistics (102 academic hours)

Discipline contents:

Statistics as a science: subject, method, objectives and organization of statistics. Statistical information. Sources of statistical information.
Statistical observation. Forms, types, ways of observation. Statistical measurement and observation of social and economic phenomena.
Statistical summary and grouping of materials of statistical observations. Types of summaries and groupings. Rows of distribution.
Statistical tables. Graphic image of statistical data
Statistical indicators. Classification, kinds and types of indicators, used in statistical measurements, rules of building statistical indicators. Absolute and relative values, mean values. Variation and indicators of its size and intensiveness.
Random observation.
Statistical studying of interconnection of social and economic phenomena. Types of connections. General characteristics of the methods of connection measurement. Concept of regression and correlation.
Statistical studying of the dynamics of social and economic phenomena. Series of dynamics and their types. Comparability in the series of dynamics. Indicators of the series of dynamics. Analysis of the series of dynamics. Interpolation and extrapolation in the series of dynamics.
Index method of statistical research. Indices and their types. System of interconnected indices. Aggregate indices. Rules of building indices. Average indices from individual indices. Indices of medium level.
General issues of analysis and generalization of statistical data. Multidimensional statistical analysis. Statistical methods of modeling and forecasting of social and economic phenomena.
Macroeconomical Statistics as a social science. Statistics of products.
Statistics of the labor
Statistics of national wealth. Statistics of basic assets and circulating funds.
Statistics of products and their production cost
Statistics of finances. Statistics of state finances. Statistics of state budget. Statistical analysis of state finances. Methods of financial and economic calculations and their utilization in statistical analysis.
Statistics of marketing, market infrastructure. Statistics of living standards and technological progress. Statistical methods of studying living standards.
Subject, method and objectives, modern organization, system of indicators of the statistics of entrepreneurship. Statistics of prices. Statistical indicators of inflation and prices.
Statistics of funds circulation, credit, stock exchange activity and insurance. Statistical indicators of funds circulation, credit, stock exchange activity and insurance.
Statistics of the finances of plants and companies. System of statistical indicators of financial activity of plants and companies. Analysis of the efficiency of functioning of plants and companies, of economic situation.

References:

1. G.L. Gromyko Theory of Statistics. - M.: INFA-M, 2005.
2. V.M. Gusarov Statistics: learning aid for higher educational institutions. - M.: UNITY-DIANA, 2006.
3. I.I. Eliseyeva General theory of Statistics. - M.: Finances and Statistics, 2006.
4. V.N. Salin, V.G. Medvedev Macroeconomic Statistics. – M.: Delo, 2004.

5. R.A. Shmoilova Theory of Statistics. - M.: Finances and Statistics. -2005

Deputy Head
of the Department of Information Systems
and Applied Mathematics _____ /Signature/ N.M. Kachala

Stamp: /Federal Fishery Agency FSFEI of HPE "Murmansk State Technical
University"; 183010 Sportivnaya St.13, Murmansk/



_____ hereby certify that the translation from Russian into English is true and corresponds to the original document. N. Anikeeva, Head of International Cooperation Department, MSTU

Stamp: /Federal Fisheries Agency FSEI HPE "Murmansk State Technical University":
183010 Sportivnaya St.13, Murmansk/

Extract from the course outline for discipline "Mathematics", study program "Applied Information Technologies in Economics"

32. Mathematical economics (102 academic hours)

Discipline contents:

Economics as object of mathematical modeling. Macroeconomic production functions. Their application.
Compounding and discounting: time and uncertainty as affecting factors. Equivalent interest rates. Effective rate. Adjustment for inflation. Simple and compound interests.
Financial equivalence of obligations. Credit calculations: equal interest; repayment of debt by equivalent sums; equivalent term payments; fund generation. Calculation of annuities. Continuous compounding and discounting. Change of contract, substitution of payments. Restructuring of loan. Mortgage loans.
Investment processes assessment: Net present value; cost effectiveness; payback period; internal rate of return; overhead costs index. Rents. Conversion of rents. Yield curves. Pre- and postnumerando. characteristics of financial instruments (stock, non-coupon bonds, bonds with regular payment of interest, perpetual stock, bank deposit certificates, state short-term non-coupon bonds).
Risks and their measures. Income utility function. Risk mitigation. Risk portfolio optimization task model. Efficient portfolio with riskless component task; theorem on investing in two funds. Market portfolio. Diversification of investments and variance of income. Equivalence equation.
Actuary. Bayes decision rule. Single risk premium; distributed risk; combination insurance; risk loading; complex solution of main actuarial tasks. Incorporation of distributed risks. Confidence theory. Models: Bayesian credibility, Buhlmann-Straub model. Probable characteristics of life expectancy: De Moivre model, Homperz model, Makeham model, Weibull model and Erlang model. Elements of utility theory. Notion of credible estimations in insurance.
Elements of actuarial mathematics. Ruin problem: ruin probability; compound Poisson processes; Lundberg inequality; impact of reinsurance on ruin probability. Insurance. Conceptual problems of stability estimation.
Mathematical programming in economics: linear programming; simplex method; transport tasks; Nonlinear programming; dynamic programming. Pareto principle. Leontiev static and dynamic models. Leontiev theorem. Dual model. Profitability. Neumann model. Kuhn-Tucker conditions. Sensitivity analysis.
Basics of managerial decisions in economics modeling; optimization models of economic dynamics; mathematical model of optimal controlled processes; general definitions of optimal control problem for uninterrupted and discrete processes, their comparative analysis. Optimal control of dynamic systems. Pontryagin's maximum principle. Linear dynamic systems stability. Conditions of economics stability by way of Samuelson-Hicks model.
Single-product macromodel of the best possible development of economics. Single-sector model of the best possible economic growth. Stagnation modeling. Consumers' preferences. Utility function. Lagrangian method for multistep processes: optimization of capital investments distribution between enterprises by way of dynamic programming.
Analysis and synthesis of dynamic systems. Transfer function of series and parallel connection. Transfer function of closed loop. Introduced production capacities development model. Model of equilibrium price fixation. Single-nomenclature system of reserves management as oscillatory link.
Keynesian dynamic model. Samuelson-Hicks model. Economics by way of Keynesian dynamic model as inertial element. Transfer functions. Characteristics of dynamic element. Economics by way of Samuelson-Hicks model as linear dynamic element of the second order. Introduction of multiplier and accelerator to feedback loop with Keynesian dynamic model.
Nonlinear dynamic systems. Business cycles in economics. Goodwin model. Solow model. Stationary trajectories. Transition mode in Solow model. Types of convergence of capital-labor ratio to stationary

Stamp: */Federal Fisheries Agency FSEI HPE "Murmansk State Technical University";
183010 Sportivnaya St.13, Murmansk/*

*Extract from the course outline for discipline "Simulation modeling of economic processes",
study program "Applied Information Technologies in Economics"*

33. Simulation modeling of economic processes (68 academic hours)

Discipline contents:

Introduction. Logical, physical and economic-mathematical modeling. Concept of SM. Utilization of SM. Subject and content of the course. Connection of the course with other disciplines.
Areas of application of SM. Classification of SM. Modeling of processes. Characteristic peculiarities. Conditions of utilization. Problem areas: interpretation, diagnostics, forecasting, engineering, planning, control. Other areas of SM utilization: CAD, teaching systems, multi-environments.
Objectives of SM. Component parts of SM. Limits of capabilities of classical mathematical methods in Economics. Mathematical prerequisites of creation of a simulation model. Processes of mass servicing in Economics. Utilization of MATLAB package tools for various problem areas and in various SM stages
Typical systems of simulation modeling. Definition of the intention and area of application of SM, classes of resolved problems. Tools of SM development: programming languages, generators, shells, engineering automation facilities. Parameterization of resolved tasks: goals, restrictions, hypotheses, concepts, source data.
Process of models creation. Identification, conceptualization, formalization, realization, testing. Structural model. Functional model. Goal trees. Decision trees. Space-time relations of objects, conditions of objects, events. Automated designing of the models of business-processes.
Imitation of main processes. Imitation of the operation of the economic object in three dimensions: material, money and information flows. Generators, queues, service nodes, terminators. Transacts and their "families". Open and closed model diagrams. Operation with the objects of the "resource" type. Resource control strategies. Overview of tools: MATLAB, Pilgrim, G2, etc.
Imitational solutions of cost minimization tasks. Key objects of the model of the firm with consideration of its interactions: with market, with banks, with budget, with suppliers, with hired labor. Dynamic models of processes at plants and in companies of various economic branches, of world economic processes. Imitation of the processes of financing and money flows. Modeling of clearing processes.
Testing and development of SM. Testing of solution accuracy. Selection of test examples. Full verification of the decision space. Studying period and accuracy indicators. Utilization of testing tools, reference points, collection of statistics, restructuring.

References:

1. A.A. Emelyanov, E.D. Vlasova, R.V. Duma Simulation modeling of economic processes: learning aid for higher educational institutions. - M.: Finances and Statistics, 2002.
2. A. Gulyayev Visual modeling in MATLAB environment: Training Course – SPb: Peter, 2000.
3. N.N. Martynov, A.P. Ivanov MATLAB 5.x. Calculations, visualization, programming. - M.: KUDITs-OBRAZ, 2000.
4. I.F. Tsisar, V.G. Neiman Computer modeling of Economy. - M.: Dialog-MIFI, 2002.

5. P. Jackson Introduction to expert systems. - M.: Williams. -2001

Deputy Head
of the Department of Information Systems
and Applied Mathematics _____ */Signature/* N.M. Kachala

I hereby certify that the translation from Russian into English is true and corresponds to the original document. _____ *N. Anikeeva*, Head of International Cooperation Department, MSTU



Stamp: *Federal Fisheries Agency FSEI HPE "Murmansk State Technical University":
183010 Sportivnaya St.13, Murmansk*

**Extract from the course outline for discipline "Econometrics",
study outline "Applied Information Technologies in Economics"**

35. Econometrics (77 academic hours)

Discipline contents:

Key aspects of economic modeling. Introduction. Mathematic prerequisites of econometric modeling. Econometric model and experimental data. Main phases and problems of econometric modeling.
Paired regression analysis. Functional, statistical and correlation dependences. Evaluation of the parameters of linear equation of paired regression using the least squares method. Correlation coefficient. Key provisions of regression analysis. Interval estimation of the regression function parameters. Estimation of the significance of the regression equation. Determination coefficient.
Multiple regression analysis. Classical linear model of multiple regression. Least squares method (LSM). Estimation of the parameters of classical regression model using the least squares method. Properties of LSM estimations. Covariance matrix and its random estimation. Gauss-Markov theorem. Estimation of disturbances dispersion. Definition of confidence intervals for coefficients and functions of regression. Indicators of regression quality. Estimation of the significance of multiple regression. Determination coefficients.
Some issues of practical utilization of regression models. Multicollinearity. Selection of existing factors. Linear regression models with variable structure. Fictitious variables. Non-linear regression models and their linearization.
Time series and forecasting. General data on time series and tasks of their analysis. Characteristics of time series. Models of stationary time series. Autocorrelation function. Analytical fitting of time series. Forecasting based on models of time series. Concept of autoregression models and moving-average models.
Heteroscedasticity and autocorrelated residuals. Generalized least squares method (GLSM). Detection and elimination of heteroscedasticity. Autocorrelation of the residuals of time series. Positive and negative autocorrelation. Autocorrelation of first order. Detection and elimination of autocorrelation. Identification of time series. Autoregression model of first order. Models of nonstationary time series and their identification.
Systems of simultaneous equations. General view of the system of linear simultaneous equations. Demand and supply model. Indirect two-step and tree-step least squares method. Problems of identifiability. Instrumental variables method. Simultaneous estimation of regression equations. Externally non-connected equations. Examples of systems of simultaneous equations.

References:

1. N.Sh. Kremer, B.A. Putko Econometrics: textbook for higher educational institutions. - M.: UNITY-Dana, 2003.
2. Practicum on Econometrics. Under the editorship of RAS corresponding member I.I. Eliseyev - M.: Finances and Statistics, 2001.

