RUDN university

FACULTY OF SCIENCE

PROBABILITY THEORY AND MATHEMATICAL STATISTICS

MASTER'S DEGREE PROGRAMME

PROGRAM ADVANTAGES

- Knowledge of the mathematical apparatus for solving modern problems of pro-fessional activity.
- Ability to apply modern mathematical and algorithmic methods, as well as modern information technology to solve relevant research problems of profes-sional activities.
- Involving students in issues both in the field of knowledge of probability theo-ry and mathematical statistics, and in the field of mathematical modeling and computational experiment.
- The peculiarity of training is the ability of participation in different research projects under the guidance of leading scientists.
- Regular lectures and master classes by invited foreign and domestic scientists and practitioners, organization of international and all-Russian conferences.
- The opportunity to participate in academic international mobility programs, in-cluding internships in foreign partner universities.

STUDYING PROCCESS

120 credits
Lectures, practical and laboratory studies, independent research work, educational and undergraduate practice.

APPLIED PROBLEMS OF MATHEMATICAL MODELING

- Elementary mathematical models.
- The universality of mathematical models.
- Modeling of economic systems.
- Mathematical modeling of rivalry.
- Models of economic dynamics.
- Macroeconomic growth modeling.
- Mathematical foundations of the innovation-cyclic theory of economic devel-opment Schumpeter-Kondratiev.

NUMERICAL METHODS FOR SOLVING MATHEMATICAL MODELING PROBLEMS

- Mathematical models.
- Examples of models leading to initial problems for ODEs.
- Introduction to numerical methods.
- The simplest methods of numerical analysis.
- Posterior error estimates.
- One-step methods for solving Cauchy problems for ODEs.
- Multistage methods for solving Cauchy problems for ODEs.
- Stiff Cauchy problems for ODEs.
- Examples of models leading to boundary value problems for ODEs.
- Methods for solving such problems.

CONTINUOUS MATHEMATICAL MODELS

- Models layout.
- The fundamental laws of nature.
- Variation principles.
- Hierarchy of models.
- Two types of nonlinear models.
- The universality of mathematical models.
- Small fluctuations in the interaction of two biological populations.
- Getting models from the fundamental laws of nature.
- Joint application of several fundamental laws.

DISCRETE MATHEMATICAL MODELING

- Markov models of queueing systems in discrete time.
- Non-Markov models of queueing systems in discrete time.
- Discrete-time queueing systems with special service disciplines.

RANDOM PROCESSES THEORY

- Recovery processes and semi-Markov processes.
- Diffusion processes and processes with independent increments.
- Stationary processes.

APPLIED STOCHASTIC MODELS

- Recovery processes and their application.
- Hopping Markov processes and their applications in models of reliability and queueing theory.
- Semi-Markov processes and their applications.

MATHEMATICAL THEORY OF TELETRAFFIC.

- Classic monoservice models of Erlang and Engset.
- Erlang multiservice model with obvious losses.
- Engset multiservice models with clear losses.

QUEUING NETWORKS

- Open homogeneous exponential networks (Jackson networks).
- Closed homogeneous exponential networks.
- Recursive algorithms for computing the characteristics of a closed network.
- Queuing networks with several classes of requirements.

ADDITIONAL CHAPTERS OF QUEUING THEORY

- NGN architectural concept and principles of networks models construction.
- Characteristics of the main types of traffic for next-generation networks.
- Construction of the main monoservice teletraffic models of next-generation networks.
- Methods of monoservice models and algorithms analysis for calculating their probabilistic characteristics.
- Construction and analysis of a multiservice network link model with unicast and multicast traffic.
- Precise and approximate methods for calculating service quality indicators.

ADDITIONAL CHAPTERS OF MATHEMATICAL STATISTICS

- Nonparametric methods in statistics.
- Descriptive statistics for features that do not obey the normal distribution.
- Wilcoxon test for paired observations in the case of dependent samples.
- Mann-Whitney test for two independent samples.
- Rank criteria for communication.
- Nonparametric factor analysis.
- Univariate analysis.
- Two-factor analysis.
- Time series.
- Time series based on forecasting.
- Smoothing methods: moving average, exponential smoothing.
- Autoregressive models of the first and second order.
- Assessment of the quality of models.

ECONOMETRIC MODELING

- Econometric modeling: concepts and steps.
- Basic methods of econometric modeling.
- Dynamic models of econometrics.
- Econometric modeling of distributional processes in society.
- Econometric modeling of industries and regions.
- Econometric modeling of the financial and economic state of the company.

SCIENTIFIC PROGRAMMING

- Version systems as a tool for the implementation of research projects.
- Programming in Octave.
- Problems solving in Octave linear algebra.
- Markdown language.
- Work with polynomials.
- Limits, sequences and ranks in Octave.
- The eigenvalue problem.

COMPUTING EXPERIMENT TECHNOLOGIES

- Computational experiment and mathematical modeling.
- Research methods of mathematical models.
- Computational Algorithms.
- Computing experiment software.
- Carrying out calculations and their analysis.

VARIATION METHODS IN MATHEMATICAL MODELING

- Energy method for positive operators.
- The Ritz method.
- Least square method.
- Courant method.
- Steepest descent method.

ADDITIONAL CHAPTERS OF MATHEMATICAL MODELING

- Partial Differential Equations (PDEs).
- Transfer equation.
- Parabolic equations.
- Elliptic equations.
- Hyperbolic equations.

COMPUTER TIME SERIES ANALYSIS

- Time series.
- Data processing.
- The task of analyzing time series.
- Creating SSA software.
- Optimization of computing.

HIGH PERFORMANCE COMPUTING

- The C ++ 11 standard of the C ++ language.
- The use of threads.
- Multithreaded random number generation.
- Modeling random processes.
- Manufacturer-consumer programming template.

STUDENTS FEEDBACK

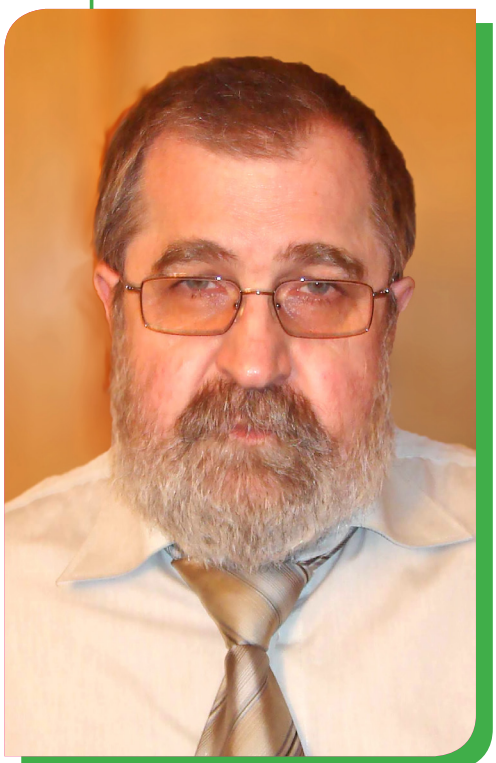
FAINA MOSKALEVA, RUSSIAN FEDERATION

Education on Master's degree program allows you to continue your research, while it possible to combine education with work in a real company, because of the low teaching load. This program is an excellent solution for those students who are interested in further studies in postgraduate programs, as it allows them to engage in their own scientific field and improve in it. There are enough opportunities for students to participate in international internships and exchange programs.

Studying at the master's program gave me the opportunity to take an active part in scientific projects, speak at scientific conferences, and receive a scholarship from the Government of the Russian Federation based on the results of my research. The gain knowledge will allow me to continue my studies in postgraduate education.

HEAD OF THE PROGRAMME

LEONID SEVASTIANOV



Doctor of Physical and Mathematical Sciences, Professor, Professor of the Department of Applied Probability and Informatics.

AREAS OF SCIENTIFIC INTERESTS:
mathematical modeling, computational physics, computer algebra, mathematical modeling of the propagation and diffraction of polarized light in optical fiber and integrated optical structures, modeling of thinfilm optical coatings, quantum measurements.

Chairman of the dissertation council of the RUDN University in the field of specialties 05.13.17 “Theoretical foundations of computer science”, 05.13.18 “Mathematical modeling, numerical methods and program complexes”. He is deputy editor-in-chief of the scientific journal Discrete and Continuous Models and Applied Computational Science, and a member of the program committees of many international conferences on mathematical modeling and computational physics. Head and co-executor of scientific projects under the grants of Russian and foreign scientific foundations. The author of scientific articles in peer-reviewed Russian and foreign scientific journals (Higher Attestation Commission, Scopus, Web of Science), regularly makes presentations at international and national conferences.