

Economic Data Analysis

- study degree – Graduate/ Master
- language – English
- credits/ study duration – 120 ECTS/ two years study program
- form of study – full-time program
- start of studies – in September
- application deadline – 28 February/ 30 April
- tuition fee – 3.800 EUR per academic year
- two specializations: Master in Official Statistics (MOS) and Data Analysis and Modelling (DAM), students choose their specialization during the first semester
- MOS has been [internationally accredited with the EMOS label](#), awarded by the European Statistical Committee

Study plan

MOS	DAM
Compulsory core courses - 63 ECTS Elective/optional courses – min.15 ECTS Internship – 30 ECTS Final state exam and Thesis defence – 12 ECTS	Compulsory core courses – 90 ECTS Elective/optional courses – 18 ECTS Final state exam and Thesis defence – 12 ECTS

1st Semester

[Economic Demography I](#)

[Economic Statistics](#)

[Introduction to Data Analysis with R and SQL](#)

[Probability and Mathematical Statistics I](#)

[Survey Methodology](#)

[Regression](#)

[Project Management](#)

Students choose their specialization, either [Master in Official Statistics \(MOS\)](#) or [Data Analysis and Modelling \(DAM\)](#).

2nd Semester

MOS	DAM
Multiple Criteria Decision Making Advanced Econometrics 1 Official Statistics National Accounting: Concepts and Analyses Excel Skills for Business: Fundamentals + elective courses for 6 ECTS	Multiple Criteria Decision Making Advanced Econometrics 1 Probability and Mathematical Statistics II Real Data Analysis Computational Methods and Data Analysis

3rd Semester

MOS	DAM
Internship	Applied Multivariate Statistics Combinatorial Optimization + elective courses for 18 ECTS Exchange semester abroad - optional

4th Semester

MOS	DAM
Time Series Understanding Economic and Social Indicators + elective courses for 9 ECTS Final State Exam and Thesis Defence	Time Series Understanding Economic and Social Indicators Case Studies in Operations Research Statistical Methods and Capital Markets Final State Exam and Thesis Defence

Compulsory core courses (syllabus)

Economic Demography I - 4DM465, 3 ECTS

Aims of the course:

There are many connections between demographic and economic development. Demographic development influences economy and vice versa, economy influences reproduction behavior of population. The intention of the course is to acquaint students with basic indicators and methods used in economic demography. Special attention is placed on issues connected with population ageing. Students will learn about human resources topic and human capital from the point of view of demography as well.

Learning outcomes and competences:

Upon successful completion of this course, students will be able to analyze population structure regarding economic activity and evaluate economic and social consequences of population development.

Course contents:

1. Definition of economic demography. Demography and statistics, demography and economics, demography and population politics.
2. Census and its usability in economic demography. Basic sources of data in economic demography.
3. Population and its categories. Study of elementary social groups, family and household.
4. Labour force statistics, employment, unemployment.
5. Economic, educational and social structure of population. Relation between population and social-economic trends.
6. Traditional demographic characteristics of economic burden. Social burden.
7. Life tables.
8. Economic activity tables.
9. Life cycle and demographic biography.
10. Health and disease, disparity in death and potential demography. Characteristics of potential demography.
11. Demographic prognoses and their use in economics. Specific demographic prognoses of CZSO.
12. Human capital and its reproduction.
13. Population ageing (absolute and relative) and its social-economic consequences.

Economic Statistics – 4ES611, 6 ECTS

Aims of the course:

The aim of the course is to explain different ways of production of statistical information including practical surveys in economy, links between indicators, possibilities and limits of interpretation. Students are facing the issues of comparability in time and between indicators. Statistical methods are presented on practical examples and analyses taken over from statistical practice.

The course contains information about all segments of modern economy. Following list of topics forms the key structure of the course: principles and standards of European statistics, prices and inflation, labour market, demography and human capital, macroeconomic statistics, government deficit and debt, composite indicators, productivity measurement, social statistics, international comparisons.

Learning outcomes and competences:

The course is focused on understanding key economic and social statistical indicators. After successful completion of the course, students will be able to find out proper statistical indicators at both micro-level and macro-level. Due to understanding the substance of indicators, students will be able to use them for improvement the decision making process at business sphere and the policy making process at the governmental sphere as well.

Information provided to the students is based on the newest statistical methodology with respect to the main statistical fundamentals and the international best practice.

Course contents:

1. Description of the current system of statistical indicators and their links with statistical system of the EU.
2. Practical procedures for data surveys, data processing and data analyses of economic environment.

Introduction to Data Analysis with R and SQL – 4ST604, 3 ECTS

Aims of the course:

The main aim of the course is to teach students the essential skills every data analyst should know. Practical implementation of the skills will be presented. Statistical software R together with the SQL language will be used to manipulate the data.

Learning outcomes and competences:

Upon successful completion of the course students will be able to fully use important tools of basic statistical data analysis and visualization. They will learn how to work in free software environment for statistical computing and visualization R and will acquire basic skills of working with SQL. They will be able to utilize these skills in any quantitative modelling or data analysis.

Course contents:

1. Data preparation and manipulation (allowance 0/8)

- a. Introduction to SQL; CREATE, DROP, JOIN and SELECT statements
- b. WHERE clause to filter records
- c. Basic aggregation functions - COUNT, AVG, SUM and grouping tables using GROUP BY statement

2. Data analysis and basics of R (allowance 0/18)

- a. The R statistical software and basic operations and computations with R
- b. Data manipulation and customization of functions
- c. Data obtaining and cleaning with R
- d. Fundamentals of descriptive statistics with R
- e. Basic graphical methods of data analysis with R
- f. ggplot2 package as a tool for graphical analysis
- g. Visualization of multivariate data
- h. Shiny package as a tool for creating interactive outputs
- i. Data manipulation in R (sqldf, merge, aggregate...)

Probability and Mathematical Statistics I – 4ST621, 6 ECTS

Aims of the course:

The course is designed for all students interested in deepening their knowledge of statistical concepts in the English language. The aim of the course is to get students acquainted with the elements of probability and mathematical statistics.

Learning outcomes and competences:

After a successful completion of this course, students will be able to apply the most important probability and statistical methods.

Course contents:

The course gives an introduction to the fundamental elements of the theory of probability and mathematical statistics. It covers the following areas:

1. concept of probability,
2. random variables,
3. probability distributions,
4. multidimensional random variables,
5. discrete distributions,
6. continuous distributions,
7. limit theorems,
8. estimation of parameters,
9. confidence intervals,
10. hypothesis tests.

Survey Methodology – 4ES620, 3 ECTS

Aims of the course:

The course topic is survey methodology. The course content covers the process of designing of a survey, sampling, questionnaire design, fieldwork data collection and processing of collected survey data – their theoretical foundations and their practical implementation in survey projects.

Learning outcomes and competences:

Upon successful completion of this course, students will be familiar with the theoretical background for work with surveys – for their design and implementation. They acquire knowledge for work on surveys or for informed work with data from sample surveys.

Course contents:

1. Populations and sampling frames (population and sampling units, sampling frames etc.)
2. Sample designs and techniques common in survey practice (simple random sample, stratification, PPS sampling etc.)
3. Choosing the right sample design (reasons behind the choice of various sample designs, geographical properties of sample designs in face-to-face surveys, simulation techniques in analysis of sample designs)
4. Questionnaire design (questionnaire design and testing; concepts, definitions, questions – and their international harmonisation; cognitive aspects of survey questions)
5. Implementing the sample in the field – data collection techniques (Overview of the data collection techniques; Interviewing and interviewers)
6. Nonresponse (how can nonresponse harm the survey data; standardised models of the survey nonresponse process etc.)
7. Weighting and the use of weighted survey datasets (techniques for weighting of survey data; design weights, nonresponse correction, calibration)
8. Imputation of the missing data (overview of techniques)
9. Final synthesis – quality of survey data and quality reporting (sampling and nonsampling error; total survey error; quality evaluation and reporting; going through the lifetime of a survey project and its various stages, highlighting the statistical quality aspects of each of them etc.)

Regression – 4ST606, 6 ECTS

Aims of the course:

Regression analysis is a very important tool used for studying relationships between variables. The course provides an insight into the concept of linear regression models. Properties of ordinary least square estimates of the parameters of these models are provided. A brief discussion of other techniques which are relevant to regression analysis (such as non-parametric regression, robust regression, bootstrapping etc.) is also included. The course also provides a guide how to apply the methods to real data.

Learning outcomes and competences:

Upon successful completion of this course, students will be able to understand linear regression models, their properties and limitations. They will understand the concept of linear regression models in a wider context. Students will be able to apply the methods to real data.

Course contents:

1. Regression model, linear regression model
2. Classical linear regression model, ordinary least squares estimation and its properties
3. Categorical explanatory variables
4. Transformation of variables
5. Relative importance of explanatory variables in linear regression model
6. Diagnostics of residuals, violation of assumptions and its correction
7. Variable selection, multicollinearity
8. Bootstrapping in regression
9. Robust and non-parametric regression

Project Management – 4EK603, 3 ECTS

Aims of the course:

This course teaches how to manage project of new product development from an interdisciplinary perspective. You will learn how to effectively integrate strategy, marketing, design, and manufacturing decisions not only by discussing state-of-the-art frameworks/tools for effective project development in large organizations but also by developing a new product or service idea in a course project.

Learning outcomes and competences:

Upon successful completion of this course, students will be able to use the following benefits:

- Comprehension of the managerial and operational issues associated with each stage of the project process.
- Proficiency with a set of managerial tools and methods for effective product and service development.
- Recognition of the role of multiple disciplines in developing new products and services and the need for their successful integration.

Course contents:

1. Project Planning and Development Economics.
2. Project Control, Documentation and Reporting.
3. Activity Scheduling.
4. Managing Strategic Project Portfolios.
5. Capacity Management of Multiple Projects.
6. Overlapping Multiple Stages of Project.
7. Managing Complexity in Large Projects.
8. Product Development Strategy.
9. Measuring Project Performance.
10. R&D Project Evaluation and Real Options.
11. Technology Push Project.

Multiple Criteria Decision Making – 4EK606, 6 ECTS

Aims of the course:

The course objective is to explain to students the possibility of modeling decision situations with the existence of multiple evaluation criteria. To explain the possibility of solving multi-criteria evaluation of alternatives and multi-objective programming problems. To show application possibilities of explained models and methods of multi-criteria decision making.

Learning outcomes and competences:

After successful completion students will be able to create models of multiple criteria decision situations, to analyze them, to choose an appropriate method to deal with and to find appropriate solutions.

Course contents:

Content is the classification of decision situations, the definition of model for multi-criteria evaluation of alternatives and model of multi-objective programming, the classification of additional information for solving, a description of the corresponding solution methods available for additional information and examples of applications of models and methods.

1. Basic concepts of multi-criteria decision making
2. Formulation of selected multi-criteria decision-making tasks
3. Modeling of user preferences
4. Models of multi-attribute evaluation of alternatives
5. Methods with information on aspiration criteria levels
6. Methods with ordinal criteria information
7. Methods with cardinal criteria information
8. Methods based on evaluation of preference relations
9. Case studies from multi-attribute evaluation of alternatives
10. Multi-objective programming models
11. Properties of the set of non-dominated decisions
12. Methods with a priori information
13. Methods with progressive information - interactive methods
14. Methods with a posteriori information
15. Case studies from multi-objective programming

Advanced Econometrics 1 – 4EK608, 6 ECTS

Aims of the course:

The course focuses on advanced econometric techniques with topics such as regression models based on time series, panel data models, linear and nonlinear simultaneous equations, models of vector autoregression, or econometric forecasts and policy evaluation. Software packages R / RStudio are used in classroom exercises and case studies.

Learning outcomes and competences:

Upon successful completion of this course, students will be able to use single-equation regression models or multiple-equation models of simultaneous equations and vector autoregression in economic analysis, prediction and optimization of economic policies with use of econometric or statistical software (R and RStudio).

Course contents:

1. Introduction to the course, estimation methods (OLS, MM, GMM, MLE), predictions, k-fold cross validation. Variance-Bias tradeoff.
2. Nonlinear regression models (overview), quantile regression.
3. Regression models based on time series, stationarity, spurious regression, unit root tests.
4. Cointegrated time series (TS), testing for cointegration in linear regression models. Error correction model.
5. Testing stability in TS-based regression models (Chow tests), predictions and their evaluation.
6. Finite and infinite distributed lag models. Polynomially distributed lags (Almon type). Koyck transformation, rational distributed lags (RDL), partial adjustment model (PAM), adaptive expectations hypothesis (AEH), rational expectations.
7. Selected panel data methods for short panels ($N \gg T$), assumptions and their tests, robust estimation. Dynamic models for panel data (Arellano-Bond estimator).
8. Selected panel data methods for long panels ($T \gg N$), seemingly unrelated regression equations (SURE).
9. Selected panel data methods for T and N "large"; unit root series in panel data analysis, estimation methods, tests.
10. Simultaneous equations models (SEM), structural and reduced forms, identification of structural equations, estimation methods.
11. SEMs and panel data, non-linear SEM.
12. VAR models, their properties and use in predictions. Impulse-response functions (IRF) and IRF orthogonalization.
13. Advanced methods based on VAR models (SVAR, TVAR, IRF identification – Blanchard-Quah decomposition). Non-stationary time series, cointegration tests. Vector error-correction models (VECM), Johansen's method.

Time Series – 4ST631, 6 ECTS

Aims of the course:

The course focuses on the analysis and prognosis of the dynamics of economic indicators. Its aim is to familiarize students with models of economic and financial time series and their practical use. It is suitable for the area of macroeconomics (finance, economic policy), the area of business analysis, marketing analysis and forecasting.

Learning outcomes and competences:

Upon successful completion of this course, students will be able to analyze and model one-dimensional and multi-dimensional economic time series and to create time series forecasts. Students will be acquainted with basic conceptions and methods of economic time series modelling. They will make the acquaintance of structure, methods of construction and verification of economic time series models both from theoretical and practical points of view.

Course contents:

1. properties of economic time series
2. classical model of economic time series (trend, cycle, seasonality)
3. basic models of trend
4. basic models of seasonal part and seasonality adjustment
5. principles of forecasts construction
6. Box-Jenkins methodology of time series modelling
7. models of multivariate economic time series
8. models of financial time series

Understanding Economic and Social Indicators– 4ES526, 3 ECTS

Aims of the course:

The main point is to prepare and present a statistical analytical study concerning one of the recommended issues, covering almost all parts of the economic and social life in EU, USA, etc. Students' own formulation of the task and its structure is preferred. The elaborated studies are discussed and assessed on the seminar meetings.

Learning outcomes and competences:

Upon successful completion of this course, students will be able to prepare and present working papers from socio-economic area using appropriate statistical indicators mainly from the set of the so-called structural indicators. Students will be able to choose feasible indicators and evaluate their possibilities and limits.

Course contents:

The course is organised in the form of round table (seminar) where students present analysis on selected topic from economic and social statistics. The topics can be selected by students from following areas:

1. Inflation and prices (consumer price index, producers prices)
2. National Accounting and Macro-aggregates
3. Labour market (wages, unemployment)
4. Industrial analysis (industrial production index, services, foreign trade)
5. Standard of living (different concepts, measurement, interpretation)
6. Productivity (total factor productivity measurement, capital and labour services)
7. Social indicators (social benefits, education, health care, defence)
8. Environmental indicators (different concepts, international indicators, composite indicators)

The key emphasis is put on the most important and recent issues in the Czech or EU environment. After successful completion of this course, students will be able to prepare and present working papers from socio-economic area using appropriate statistical indicators mainly from the set of the so-called structural indicators. Students will be able to choose feasible indicators and evaluate their possibilities and limits. The course should help to improve students' orientation in modern world that is filled by plenty of indicators.

MOS – Compulsory core courses

Official Statistics – 4ES612, 3 ECTS

Aims of the course:

The subject Official Statistics is aimed to present the role and activities of the modern, user-driven statistical service in democratic society, its history, organization and future trends in its development. The course provides the students with a characteristics of the theoretical background of the statistical practice and displays of the main pillars of the legal framework of official statistics. It brings the definition of the statistical information system (SIS), its components and aspects. The statistical process is presented in the course: Ways and methods of the acquisition, processing, storing retrieving of data and modern methods dissemination of statistics. The international harmonization/standardization of official statistics and the picture of the international statistical institutions is presented as well.

Learning outcomes and competences:

A graduate of the course gets the insight how official statistics performs and to understand its drivers and trends in the modernization of the statistical information system. The course enables a graduate to get familiar with principles and logic of the process of statistical production. As a potential user of statistics a graduate gains a good understanding of released/published statistical data and a appropriate ways of access to the sources of statistical data.

Course contents:

1. The importance and the role of modern official statistics in democratic society and market-driven economy
2. A history of official statistics in a nut shell
3. Principles dominating official statistics performing in modern democratic societies
4. Official statistics and national administration. Official statistics and the government (ministries), statistics and the central bank. Official statistics and NGO's.
5. Theoretical background of official statistics (disciplines of theoretical statistic, informatics, economic theory) and the importance of the cooperation between official statistics and academia/universities.
6. Cognitive abilities/potential of official statistics. How official statistics captures and evaluate phenomena/processes of economic/social life.
7. Statistical Information System (SIS): introduction, concept, definition, structure, aspects. Interface of SIS with its users and data providers.
8. Models of the organization of official statistics: centralized, decentralized, semi-decentralized models of performing of official statistics (pros and cons). Regional decentralization of official statistics within a state. Ways of the efficient coordination of the national statistical service.
9. Legal framework of official statistics : two dominating pillars of statistical legislation: trade off between the authorization of statistical bodies to enforce a duty of data reporting and/vs. a strict, transparent and documented protection of individual data on natural or legal persons.
10. Statistical process and its phases: data acquisition, data processing, storing and retrieving, data dissemination, releasing/publishing. Statistical analysis as a completion of the statistical proses.
11. Data acquisition : primary statistics. Efficient (paperless) methods of data collection
12. Data processing, storing, retrieving: set of and structure of statistical databases, data warehouses, accessibility of statistical data, statistical metainformation system
13. Dissemination of statistical data: user oriented/driven official statistics interactive procedures making a use of data more comfortable, progressive methods of visualization of statistical production
14. Composition of the content of official statistics (a short guide through a structure of SIS): macroeconomic statistics, production statistics, institutional statistics, social statistics, population statistics.
15. International statistics: a need of harmonization/standardization of definitions (indicators, classifications) and statistical methodology. International cooperation in the area of official statistics on governmental/non-governmental level. International organizations and official statistics.

National Accounts: Concepts and Analyses– 4ES618, 6 ECTS

Aims of the course:

The aim of the course is to introduce the system of national accounts as the main source of macroeconomic information. The emphasis is put on the understanding of the structure of the system and main documents of national accounts. That is necessary for the analytical work with data on the national economy and its development.

Learning outcomes and competences:

After successful completion of this course, students will understand the principles of the system of national accounting and they will be able to use the national accounts indicators for their analytical works.

Course contents:

The course introduces the main components of the system of national accounts:

1. introduction to National Accounts,
2. accounts and accounting principle,
3. macroaggregates,
4. sector accounts,
5. government statistics,
6. the rest of the world and balance of payments,
7. capital account and wealth,
8. input-output tables and analysis,
9. volume measurement,
10. consistent approach to national accounts,
11. satellite accounts and extensions,
12. national accounts standards – future perspective.

Excel Skills for Business: Fundamentals – 4IT523, 3 ECTS

Aims of the course:

The course deals with the use of advanced features in MS Excel to design and solving analytical problems for outputs designed mainly for managers at the tactical level management. The course prepares students to design solutions analytical tasks, design the table structure and its presentation. Students solve tasks using analytical functions, pivot tables, data transactions and data visualization.

Learning outcomes and competences:

After completing the course students:

- are able to use more advanced features in the Excel,
- are able to propose an effective solution of the analytical task,
- can design a suitable way to visualize data in a selected data area,
- can create a form with insert controls and use it for data analysis.

Course contents:

Seminar content:

1. Basic statistical functions. Advanced functions in MS Excel - calculation formulas, embedded functions, conditional formatting, scales, logical and text functions.
2. Data operations in table - filters, summary, input data checking.
3. Chart types and options. Sparklines.
4. Pivot Table - principles, design and structure of pivot table, pivot charts.
5. Analytical tools in MS Excel - What-If analysis.
6. Insert Controls.

Internship in State Statistical Service and Master Thesis Project– 4ES620, 30 ECTS

Aims of the course:

The course enables students to practically apply their knowledge and skills achieved during their studies at the official statistics institution. The internship allows the student to apply existing skills, achieve new skills and prepare the first part of the master thesis.

The internship consists of two parts:

1. Practical work at the institution – 320 hours (12 ECTS).
2. Preparation of the Master thesis project I under VŠE and expert from the institution supervisors (18 ECTS).

Learning outcomes and competences:

After successful completion of the course, students improve their theoretical skills, learn their usage in the practice, they will be able to process the data by themselves. Furthermore, they will be able to prepare the expert analysis.

Course contents:

Individual consultation on the topic and aim of the Master thesis project. The internship under the supervision of the expert from the official statistics institution where the internship will take place. The preparation of the Master thesis project under the supervision of VŠE teacher and expert from the internship institution.

MOS - list of elective courses– min. 15 ECTS

Advanced Statistical Methods (3 ECTS) – 4ST650
Applied Multivariate Statistics (6ECTS) – 4ST611
Case Studies in Operations Research (6 ECTS)– 4EK607
Combinatorial Optimization (6 ECTS) – 4EK605
Czech for Foreigners (3 ECTS) – 4SA622
Data Science in Python and R (6 ECTS) – 4IZ565
Economic Demography II (6 ECTS) – 4DM475
Information Systems Management (3 ECTS) – 4SA431
Information Technologies in Entrepreneurship (6 ECTS) – 4IT487
Introduction to Financial and Insurance Mathematics (6 ECTS) – 4ST608
Real Data Analysis (6ECTS) – 4ST606
Statistics with R (3ECTS) – 4ST605
International Week courses (3 ECTS) – intensive courses in January

DAM – compulsory core courses

Probability and Mathematical Statistics II – 4ST630, 6 ECTS

Aims of the course:

The goal of the subject is to extend and master students' knowledge of probability and statistical methods from the bachelor level and to provide theoretical background for studying and applying advanced statistical methods. Moreover, it focuses on skills in the calculus.

Learning outcomes and competences:

Upon successful completion of this course, students will be able to study, correctly apply and interpret different statistical multivariate methods.

Course contents:

1. Probability distributions, convergence of random variables, law of large numbers, central limit theorem
2. Multivariate normal distribution and its properties, random sample from the multivariate normal distribution, characteristics and their distribution, quadratic forms and their distribution
3. Order statistics, distribution of order statistics, empirical distribution function, Kolmogorov-Smirnov tests
4. Estimates of vector parameter, tests of hypotheses for a vector parameter
5. Nonparametric estimates and test

Real Data Analysis– 4ST606, 6 ECTS

Aims of the course:

The course introduces elementary statistical concepts, such as collection and preparation of data sets. It also presents elementary methods of data sets description and analysis (descriptive statistics, statistical tests, dependency analyses for different types of variables. The emphasis is put on a practical application of these concepts, which can be used in final theses preparation.

Learning outcomes and competences:

Upon successful completion of this course, students will be able to deal with real-world data sets according to their type. They also be able to perform elementary statistical tests and analyses, and to interpret their results.

Course contents:

1. data handling (data collection, types of data sets, working with data sets, MS Excel and other software)
2. exploratory data analysis (data preparation and visualization, dealing with outliers and missing values)
3. descriptive statistics (frequencies, measures of central tendency and variability, skewness and kurtosis, graphs)
4. statistical inference (population vs. sampling, normal distribution, point and interval estimates, p-values)
5. selected parametric and non-parametric tests
6. assessment of relationship between variables (contingency tables, analysis of variance, regression and correlation analysis)

Computational Methods and Data Analysis – 4MM451, 6 ECTS

Aims of the course:

The subject is focused on elements of numerical and optimization methods and on methods for building data mining models based on data analysis. Such models can be used e. g. for portfolio optimization, options valuation, default prediction or for building propensity-to-buy models. Computations will be performed in R computing environment. The methods covered should prove useful for business practitioners both in the role of analysts and in the roles of managers or business users.

Learning outcomes and competences:

Upon successful completion of this course, students will be able to solve (using computing environment software) selected problems in economic applications using numerical and optimization methods (methods for finding roots, numerical solution of systems of equations, methods for heuristic optimization). They will be able to build prediction model (using logistic regression or decision tree) and assess its quality.

Course contents:

1. Introduction to computational software, data retrieval - SQL.
2. Complexity of algorithms, programming, efficiency of computations.
3. Database systems, working with data sources.
4. Representation of numbers in computers, seminumerical algorithms.
5. Eigenvalues, eigenvectors, matrix decompositions, systems of linear equations.
6. Methods for finding roots, Numerical derivation, numerical integration.
7. Differential equations.
8. Exploratory data analysis and clustering.
9. Generating and testing of random numbers. Applications of random numbers.
10. Optimization, dynamic programming.
11. Heuristic optimization.
12. Least squares method and other methods, logistic regression. Evaluation of models.
13. Classification and regression trees.

Applied Multivariate Statistics– 4ST611, 6 ECTS

Aims of the course:

The course introduces selected multivariate methods that are commonly used in practice. The emphasis is put on a practical application of these methods in statistical software and interpretation of their outputs.

Learning outcomes and competences:

Upon successful completion of this course, students will be able to work with multivariable data sets, i.e. data set examine, analyze using statistical methods and to interpret the obtained results.

Course contents:

1. exploratory data analysis (data preparation, dealing with outliers and missing values, graphical analysis)
2. multivariate random variable (definition, characteristics)
3. classical linear model (regression)
4. general linear model (ANOVA, ANCOVA, MANOVA, MANCOVA)
5. generalized linear model (logistic regression, negative binomial regression, gamma regression)
6. discriminant analysis
7. principal components and factor analyses
8. cluster analysis
9. correspondence analysis

Combinatorial Optimization– 4EK605, 6 ECTS

Aims of the course:

The aim of the course is to make students acquainted with discrete models of operational research, special formulations of the models and methods for their solving. Students will work with special software products for solving discrete problems.

Learning outcomes and competences:

Upon successful completion of this course, students will be able to solve real problems using discrete models and methods. The emphasis is on formulation of mathematical models. Students will get acquainted with optimization methods and heuristic approaches.

Course contents:

1. Integer programming problem. Mixed-integer programming problem.
2. Formulation of models of integer and mixed-integer programming problems.
3. Cutting stock problem. Knapsack problem. Assignment problems.
4. Set-covering problem. Set-partitioning problem. Plant location problem. Fixed-cost problem.
5. Bin Packing Problem. Container transportation problem.
6. Network theory. Maximal flow problem. Minimal spanning tree problem. Minimal Steiner tree problem.
7. Routing problems. Eulerian tour. Hamiltonian tour. Chinese postman problem. Travelling salesman problem. Vehicle routing problem.
8. Nonlinear non-convex programming.
9. Theory of valid inequalities. Methods for solving mixed-integer programming problems. Relaxations of discrete problems.
10. Cutting-plane methods. Branch and bound method. Branch and cut method. Branch and price method.
11. Computational complexity.
12. Heuristics and metaheuristics

Case Studies and Operations Research– 4EK607, 6 ECTS

Aims of the course:

The goal of the course is getting an experience with solving real case studies of operations research and using the professional software. Models and problems are based on the problems submitted to the department of econometrics from praxis and solved them with cooperation. Students will solve the problems using some hints which will be given to the problem.

Learning outcomes and competences:

Upon successful completion of this course, students will be able to solve real problems from praxis using methods of operations research and software LINGO.

Course contents:

1. delivery and pick-up optimization, modelling with integer programming and LINGO
2. case study: vehicle routing problem Brewery Písek
3. case study: quadratic assignment problem: machine allocation problem SONP Kladno
4. case study: traveling salesman problem: product ordering optimization problem Kavalier Sázava
5. case study: production scheduling optimization: Uničovské strojírny, Druchema

Statistical Methods and Capital Markets– 4ST441, 3 ECTS

Aims of the course:

The course is intended for all students interested in application of statistical methods and random processes at capital markets. The aim is to get students acquainted with the widely used tools and approaches, namely in the analysis of time series of stock returns. In some lessons guest lectures by practitioners and other experts can be included.

Learning outcomes and competences:

Upon successful completion of this course, students will be able to analyze financial time series, estimate parameters of the models and determine buy/sell trading signals. They will be capable of performing the simulations in R software.

Course contents:

1. Elementary descriptive characteristics of stock returns (measures of location, measures of variability, measures of asymmetry and peakedness, graphs)
2. Autocorrelation in the time series of stock returns and squares of stock returns
3. ARIMA models (AR, MA and ARMA models - model selection, model diagnostics, forecasts)
4. Models of volatility (ARCH and GARCH models)
5. Harmonic analysis, filtering and technical analysis
6. Other topics (neural networks, Monte Carlo simulations)

DAM - list of elective courses– min. 18 ECTS

Advanced Statistical Methods (3 ECTS) – 4ST650
Credit Risk Modelling and Management (4 ECTS) – 1BP450
Czech for Foreigners (3 ECTS) – 4SA622
Data Science in Python and R (6 ECTS) – 4IZ565
Economic Demography II (6 ECTS) – 4DM475
Games and Decisions (3 ECTS) – 4EK602
Information Systems Management (3 ECTS) – 4SA431
Information Technologies in Entrepreneurship (6 ECTS) – 4IT487
Introduction Financial and Insurance Mathematics (6 ECTS) – 4ST608
Mathematical and Probabilistic Methods in life insurance (6 ECTS) – 4ST624
Non-life Insurance Models (3 ECTS) – 4ST622
Probabilistic and Statistical Methods in non-life Insurance (6ECTS) – 4ST625
Statistics with R (3 ECTS) – 4ST605
Stochastic Processes and Risk in Finance and Insurance (6 ECTS) – 4ST644
International Week courses (3 ECTS) – intensive courses in January