Operations Research

**Code:** ORMS1020  
**Credits:** 5 ECTS  
**Prerequisites:** basic studies in mathematics  
**Learning Outcomes:** introduction to mathematical modelling of economic and technical phenomena appearing both in scientific study materials and real life. Critical and analytical thinking, IT skills (Octave/Matlab), Problem-solving and decision-making skills, Oral skills (presentations is exercise sessions)  
**Content:** basic concepts and principles in mathematical modelling, different types of models, basic structure of a Linear Programming (LP) model, formulation and solving the LP model and interpreting its solution, sensitivity analysis, examples of other basic OR models (inventory models, dynamic programming, network models, simulation), examples of computer tools for OR models  
**Study Materials:** Tommi Sottinen: Operations Research with GNU Octave  
http://lipas.uwasa.fi/~tsottine/or_with_octave/or_with_octave.pdf  
**Teaching Methods:** lectures 36 h and exercises 12 h  
**Students' Workload:** 135 h, of which 48 h contact teaching  
**Modes of Study:** exercises and exam  
**Languages:** Language of Instruction Finnish/English, Completion Language Finnish/English  
**Grading:** scale 1-5 or fail  
**Responsible Person:** Tommi Sottinen  
**Teacher(s):** Tommi Sottinen  
**Responsible Unit:** Department of Mathematics and Statistics  
**Additional Information:** registration in advance, lectures held every other year in Finnish and every other year in English, 2017-2018 in English

Integral Transforms

**Structure type:** Course  
**Code:** MATHC1210  
**Type:** VY in the Master's Programme of Communications and Systems Analysis  
**Credits:** 3 ECTS/points  
**Responsible Organisation:** VAMK/VY (every second year)  
**Responsible Teacher (VAMK):** Jarmo Mäkelä  
**Responsible Teacher (VY):** Seppo Hassi  
**Team of Teachers:** VY: Seppo Hassi, Dmytro Baiduik and Marko Moisio; Vamk: Jarmo Mäkelä  
**Language of Instructions:** English  
**Course Implementations, Planned year of Study and Semester:**  
**Learning Outcomes:** The solution of various mathematical problems becomes considerably easier, if the functions under study are replaced by their integral transforms. When a function is replaced by its integral transform, the function transforms, by means of integration, to a new function of a new variable. The most important integral transforms are the Fourier transform, which is applied, in particular, in the analysis of vtyhe oscillatory phenomena, and the Laplace transform, which is used in the solution of differential equations. Closely related to the differential equations are the so-called difference equations, which have sequences as their solutions. The difference equations may be solved by means of the so-called z-transforms. In this course, which is heavily based on the complex analysis learned in the Advanced Analysis course, the student learns the basics of all these transforms and their application.  
**Student Workload:** The total amount of student's work is 108 h, which contains 56 h of contact studies when VAMK is teaching and 20 hours when VY is teaching.  
**Suositellut valinnaiset opinnot /Prerequisites /Recommended Optional Courses:** Basic courses in mathematics (Calculus and Linear Algebra I and II) / Analysis: Differential- and Integral Calculus basics and Differential equations and series.  
**Content:**
1. A brief summary of complex analysis and the theorem of residues from the Advanced Analysis course.
2. Fourier series; the Dirichlet theorem.
3. Complex Fourier series.
7. Fourier transforms and inverse transforms.
8. Examples of the determination of the Fourier transforms and inverse transforms by means of the theorem of residues.
10. Laplace transform.
11. Inverse Laplace transforms.
12. Bromwich integral. (Or Mellin’s inverse formula)
16. The convolution theorem.
17. Shift of the origin in the Laplace transforms and inverse transforms.
18. Causal sequence.
19. Z-transform of a causal sequence.
20. Inverse z-transform.
22. Difference equations.
23. Solution of difference equations by means of z-transforms.
24. Elements of Mellin transforms.

Study Materials: Kreyszig, E: "Advanced Engineering Mathematics", John Wiley & Sons; the material prepared by the lecturer.

Planned Learning Activities and Teaching Methods: Theory, examples and exercises during the lectures. Homework exercises.

Generic skills: Critical and analytical thinking, problem-solving skills and decision-making skills, oral skills (presenting the solutions both orally and written during the exercise groups)

Assessment Criteria:
Grade 1: The student knows those subjects of the course, which are necessary for the forthcoming studies and working life.
Grade 3: The student is well-abled to utilize the course contents.
Grade 5: The student is able to apply creatively the contents of the course.

Assessment Methods: Homework exercises and an examination.

Additional Information: cooperation course with Vaasa University of Applied Science
Integral Transforms 3 credits consists of the second half of Complex Analysis and Integral Transforms 5 credits.

Probability and Statistics

Code: MATH1170
Credits: 5 ECTS
Prerequisites: Basic differential and integral calculus
Learning Outcomes: The student can summarize data in terms of statistics and diagrams, can calculate probabilities of events and conditional probabilities, can apply the most important discrete and continuous probability distributions, joint distributions, moment generating functions, and sampling distributions. The student can apply the method of least squares and conduct inference concerning one and two means, variances, and proportions, correlation, and concerning linear regression coefficients. Oral skills, critical and analytical thinking

Content: Population and Sample, descriptive statistics, probability of events, conditional probability, continuous and discrete random variables and their distributions, joint distributions, moment generating
functions, sampling distributions, inferences concerning one and two means, variances, and proportions, the method of least squares, correlation, and regression inference.

**Study Materials:**
Johnson/Freund/Miller: Probability and Statistics for Engineers, Chapters 1-11

**Teaching Methods:** lectures 40 h and exercises 20 h, 75 h student homework

**Modes of Study:** exam

**Language:** English

**Grading:** scale 1-5 or fail

**Responsible Person:** Bernd Pape

**Teacher:** Bernd Pape

**Responsible Unit:** Department of Mathematics and Statistics

**Additional Information:** this course with a main focus on probability calculus is targeted mainly at Faculty of Technology students as a replacement for Tilastotieteen perusteet (Introduction to Statistics STAT1030) which has a stronger focus on statistics, it is not possible to earn credits for both Tilastotieteen perusteet and Probability and Statistics (or Basic Course in Statistics STAT1020). This course is strongly recommended as a prerequisite for the course Probability and Stochastic Processes
Learning Outcomes: provide the student with sufficient skills to analyze the dependence between statistical variables, both with pen and paper calculations and using a spreadsheet program

Generic Skills: oral skills, critical and analytical thinking, IT skills

Content: contingency tables, non-parametric methods, ANOVA and regression analysis, software used in the exercises: Microsoft Excel. Oral skills, Critical and analytical thinking, IT skills

Study Materials:

Teaching Methods: lectures 30 h and exercises 14 h, 91 h student homework

Modes of Study: exam

Languages: Language(s) of instruction: English; Completion language(s): Finnish/English

Grading: scale 1-5 or fail

Responsible Person: Bernd Pape

Teacher(s): Bernd Pape

Responsible Unit: Department of Mathematics and Statistics

Additional Information: www.uwasa.fi/~bepa/Riippu.html

Statistical Data Processing SAS EG

Code: STAT2110
Credits: 5 ECTS (5 op)
Prerequisites: Introduction to Statistics or Basic Course in Statistics or Probability and Statistics and Data Processing

Learning Outcomes: The student will be able to choose and apply an appropriate statistical method, to use a statistical software, to interpret the results of statistical analyses. Generic Skills: critical and analytical thinking, written skills (practical work), IT (SAS software).

Content: creating data sets, variable transformations, performing statistical analyses (univariate and bivariate descriptive statistics, statistical hypothesis testing: tests for the means, tests of the homogeneity of variances, tests related with statistical dependence non-parametric tests, linear regression, analysis of variance and factor analysis) with a statistical software, interpretation of the results of statistical analyses.

Study Material: courses lecture notes and user guides of the software, see Moodle.

Teaching Methods: lectures 20 h, demonstrations 20 h, student homework 95 h.

Modes of Study: 1) attendance to demonstrations and lectures and practical work OR 2) exam and practical work.

Languages: language(s) of instruction: English; completion language(s): Finnish/English.

Grading: passed/fail (modes of study 2: scale 1-5 or fail).

Responsible Person: Christina Gustafsson (www.uva.fi/~chg/)

Teacher(s): Christina Gustafsson

Responsible Unit: Department of Mathematics and Statistics

Additional Information: It is not possible to earn credits for both STAT2110 and STAT2100.

Econometrics I

Code: STAT2020
Credits: 5 ECTS (5 op)
Timing: fall
Prerequisites: Elementary statistics and probability (Wooldridge, Appendix B), covering basic concepts of statistical inference (estimation and hypothesis testing, Wooldridge, Appendix C). Basic mathematics (Wooldridge, Appendix A) including, differentiation, integration, solving elementary differential equations, elasticity concept, and continuously compounded interest rate calculus. Working knowledge of basic matrix algebra (Wooldridge, Appendix D) is a benefit but not a prerequisite. Appendices of the Wooldridge’s books are available in pdf-format at http://academic.cengage.com/resource_uploads/downloads/1408093758_415141.pdf
Learning Outcomes: The student knows basics of empirical econometric research methods and approaches including types of econometric data, roles of variables, economic and econometric modeling, estimation, statistical inference, interpretation of estimation results, model checking and model evaluation, use of econometric models in practice. The course will develop students' generic skills including basics of statistical modeling, communication of estimation results in economic terms, extracting relevant information from statistical software output, and critical evaluation of empirical results. Generic skills: Critical thinking, IT (SAS, Excel), oral and written communication of econometric/statistical results.

Content: Nature of econometrics and econometric data, simple regression model, multiple regression analysis, regression with qualitative information, heteroskedasticity, time series regression, introduction to modern (econometric) software packages using primarily SAS (www.sas.com).


Teaching Methods: lectures 40 h, exercises 12 h, student homework 83 h, home page: http://lipas.uwasa.fi/~sip/Teaching/ecm/lectures/index.html

Modes of Study: exam

Languages: English

Grading: 1-5/fail

Responsible Person: Seppo Pynnönen (www.uwasa.fi/~sjp/)

Teacher(s):

Responsible Unit: Department of Mathematics and Statistics

Additional Information: Bring your personal laptop with you in classes.

Probability and Stochastics Processes

Code: STAT3120
Credits: 5 ECTS
Prerequisites: basic studies in mathematics, and probability and/or statistics
Learning Outcomes: to complete the basic skills in probability theory and introduce to the field of stochastic processes and their applications

Content: Probability and conditional probability, generating functions, Poisson, exponential and normal distribution, Markov chains, Chapman-Kolmogorov equations, stationary distributions and ergodic theorems, Poisson process, applications to queueing systems

Generic Skills: Critical and analytical thinking, IT skills (Octave/Matlab), Problem-solving and decision-making skills, Oral skills (presentations in exercise sessions)


Course Web Page: http://lipas.uwasa.fi/~tsottine/stat3120/
Teaching Methods: 40h lectures + 20h exercises
Students' Workload: 135 h, 60 h of which is contact teaching.
Modes of Study: exam

Languages: English

Grading: 1-5 or fail

Responsible Person: Tommi Sottinen

Teacher(s): Tommi Sottinen

Responsible Unit: Department of Mathematics and Statistics

Additional Information:
Econometrics II

**Code:** STAT3090

**Credits:** 6 ECTS (6 op)

for PhD students (in particular economics) the course is possible to extend to 7 ECTS (7 op) with additional reading package described below

**Timing:** spring (January-February)

**Prerequisites:** Econometrics I (STAT2020) and Mathematical Analysis (ORMS1010) recommended (including working knowledge in differentiation, integration, solving elementary differential equations, elasticity concept and continuously compounded interest rate calculus, and matrix algebra)

**Learning Outcomes:** The student gains skills to use modern econometric tools applied in empirical finance and economics, the topics cover econometric applications in empirical asset pricing and analysis of financial time series including risk measurement, panel data econometrics and introduction to multivariate time series analysis (impulse responses, cointegration), the emphasis is in empirical modelling and interpretation of the results with real data examples. As generic skills the student learns to interpret empirical estimation results and the potential of solving complicated estimation and modeling problems with modern software such as R, SAS, Stata, or EViews. Examples are demonstrated using R (www.r-project.org). Generic skills: Critical thinking, IT (R, EViews, Excel), oral and written communication of econometric/statistical results.

**Content:** financial and economic data, panel data models, financial econometrics (multivariate) time series models

**Study Materials:**
(1) Wooldridge, Introductory Econometrics: A Modern Approach, Ch 13&14;
(2) Enders, Applied Economic Time Series, Ch 5, Sec 5-9

**Teaching Methods:** lectures 42 h (classes and notes in English)
home page http://lipas.uwasa.fi/~sjp/Teaching/ecmii/lectures/), student homework 132 h.

**Modes of Study:** exam

**Languages:** English

**Grading:** 1-5 or fail

**Responsible Person:** Professor Seppo Pynnönen (www.uwasa.fi/~sjp/)

**Teacher(s):** Seppo Pynnönen

**Responsible Unit:** Department of Mathematics and Statistics

**Additional Information:** course can be included to the minor in statistics/business mathematics