

Opasraportti

LuTK - Department of Mathematical Sciences (2008 - 2009)

Tutkintorakenteisiin kuulumattomat opintokokonaisuudet ja -jaksot

800009Y: Acting as a Student Tutor, 2 op
 802637S: Advanced Problem Solving, 2 - 6 op
 802623S: Advanced mathematical modeling, 2 - 24 op
 802628S: Advanced studies special course, 2 - 18 op
 800343A: Algebra 2, 8 op
 801694S: Algebra III, 10 op
 802330A: Algebra tutorial, 1 op
 806623S: An introduction to stochastic modelling, 8 op
 805398A: An introduction to stochastic modelling, 8 op
 800120P: Analysis I, 8 op
 800322A: Analysis II, 8 op
 800624S: Analysis III, 10 op
 805334A: Analysis of categorical data, 9 op
 805678S: Analysis of categorical data, 9 op
 805646S: Analysis of longitudinal data, 5 op
 805308A: Analysis of longitudinal data, 5 op
 802329A: Analysis tutorial, 1 op
 800118P: Basic Mathematics for Economics II, 7 op
 801387A: Basic Course in Numerics, 6 op
 801389A: Basic Geometry for University Students, 6 op
 800117P: Basic Mathematics for Economics I, 7 op
 800147P: Basic Methods in Mathematics I / appl., 8 op
 801111P: Basic Methods in Mathematics I / math, 10 op
 806109P: Basic Methods in Statistics I, 9 op
 806112P: Basic Methods of Data Analysis, 10 op
 806110P: Basic methods in statistics II, 10 op
 802322A: Basics in mathematical modelling, 5 op
 800104P: Basics of School Mathematics, 4 op
 806315A: Bayesian Data Analysis, 10 op
 805380A: Clinical biostatistics, 6 op
 800667S: Coding Theory, 10 op
 801385A: Complex Analysis I, 4 op
 801386A: Complex Analysis II, 4 op
 801698S: Cryptography, 5 op
 800345A: Differential Equations I, 4 op
 800346A: Differential Equations II, 4 op
 802312A: Discrete mathematics, 6 op
 805683S: Econometrics, 5 - 6 op
 805339A: Econometrics, 5 - 6 op
 802107P: Financial Mathematics, 4 op
 802638S: Formal Models and Quantitative Methods for Psychology, 5 - 10 op
 800674S: Fourier-analysis and distribution theory, 10 op

802629S: Function estimation, 10 op
 800651S: Functional analysis, 10 op
 800660S: Group Theory, 10 op
 801390A: History of Mathematics, 6 op
 802636S: Information Theory, 10 op
 801346A: Introduction to Cryptography, 4 op
 800149P: Introduction to LaTeX, 2 op
 801195P: Introduction to Probability Theory I, 5 op
 801396A: Introduction to Probability Theory II, 5 op
 806113P: Introduction to Statistics A, 5 op
 802635S: Introduction to partial differential equations, 10 op
 802118P: Linear Algebra I, 4 op
 802119P: Linear Algebra II, 5 op
 806308A: Linear Models, 10 op
 801344A: Mathematical Programming, 8 op
 805611S: Mathematical statistics II, 10 op
 800653S: Matrix Theory, 10 op
 802631S: Modern real analysis, 10 op
 800657S: Number Theory, 10 op
 802328A: Number Theory I, 5 op
 806604S: Principles of bayesian inference, 10 op
 800697S: Pro Gradu Thesis, 20 op
 800698S: Pro gradu thesis, 30 op
 805642S: Pro gradu thesis, 30 op
 805331A: Project seminar I, 6 op
 801323A: Seminar, 6 op
 801645S: Special Work in Applied Mathematics, 10 op
 802632S: Special course for teachers of mathematics, 10 op
 802632S-02: Special course for teachers of mathematics / Correcting tests in mathematics, 3 op
 802632S-01: Special course for teachers of mathematics / Lesson plans for teaching mathematics, 4 op
 802632S-03: Special course for teachers of mathematics / Other training, 3 op
 805310A: Statistical Inference I, 10 op
 802633S: Statistical Pattern Recognition, 10 op
 805609S: Statistical methods in epidemiology, 9 op
 805309A: Statistical methods in epidemiology, 9 op
 800688S: Theory of Optimization, 10 op
 805679S: Time series analysis, 5 op
 805324A: Time series analysis, 5 op
 801643S: Topology, 10 op
 800329A: Topology, 8 op
 805667S: Training report, 5,5 op
 802327A: Tutoring, 4 op

Opintojaksojen kuvaukset

Tutkintorakenteisiin kuulumattomien opintokokonaisuuksien ja -jaksojen kuvaukset

800009Y: Acting as a Student Tutor, 2 op

Opiskelumuoto: General Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

802637S: Advanced Problem Solving, 2 - 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Peter Hästö

Opintokohteen kielet: English

Ei opintojaksokuvauksia.

802623S: Advanced mathematical modeling, 2 - 24 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Erkki Laitinen

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

Ei opintojaksokuvauksia.

802628S: Advanced studies special course, 2 - 18 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

Ei opintojaksokuvauksia.

800343A: Algebra 2, 8 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Niemenmaa Markku

Opintokohteen oppimateriaali:

Herstein, I. N., , 1996

Opintokohteen kielet: Finnish

Leikkaavuudet:

800323A Field extensions 5.0 op

802333A Permutations, Fields and Galois Theory 10.0 op

ECTS Credits:

8 cr

Learning outcomes:

On successful completion of this course, the student will be able to

- compute with permutations and deal with their applications
- solve equations of third and fourth degree
- work with the structures of different finite fields

Contents:

The aim is to introduce three main topics which are related to each other: Elementary number theory: division algorithm, greatest common divisor, prime numbers and congruences. Group theory: group axioms, subgroups. Lagrange's theorem, homomorphisms and factor groups. Commutative ring theory: fields, polynomial rings, quotient rings and finite fields.

Person responsible:

Markku Niemenmaa

801694S: Algebra III, 10 op**Opiskelumuoto:** Advanced Studies**Laji:** Course**Vastuuyksikkö:** Department of Mathematical Sciences**Arvostelu:** 1 - 5, pass, fail**Opettajat:** Tapani Matala-aho**Opintokohteen kielet:** Finnish**Learning outcomes:**

As usual in my mathematical studies I shall be able to solve problems arising from the subject and to prove essential theorems starting from the given definitions using the tools applied in the course. More detailed; For example, when I pass the course with the grade 1/5, I shall recognize most definitions and I am able to solve closely related problems. Also I am able to rewrite short proofs with some understanding. When I pass the course with the grade 5/5, then I shall understand well the given definitions with the proofs of the theorems deduced from them. Further, I am able to solve challenging problems which demand independent deductions with several stages and applications of appropriate tools.

Contents:

In the lectures we consider the following structures and tools of mathematics: axiomatic set theory, modules and algebras, categories and functors, exact sequences, tensor products, simplex complexes, cycle-, boundary- and homology groups and chain maps.

802330A: Algebra tutorial, 1 op**Opiskelumuoto:** Intermediate Studies**Laji:** Course**Vastuuyksikkö:** Department of Mathematical Sciences**Arvostelu:** 1 - 5, pass, fail**Opettajat:** Peter Hästö**Opintokohteen kielet:** Finnish

Ei opintojaksokuvauksia.

806623S: An introduction to stochastic modelling, 8 op**Opiskelumuoto:** Advanced Studies**Laji:** Course**Vastuuyksikkö:** Department of Mathematical Sciences**Arvostelu:** 1 - 5, pass, fail**Opettajat:** Läärä Esa

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

805398A: An introduction to stochastic modelling, 8 op

Voimassaolo: - 01.09.2012

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Läärä Esa

Opintokohteen oppimateriaali:

Severini, Thomas A. , , 2005

Mood, Alexander M. , , 1974

Giri, Narayan C. , , 1975

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

800120P: Analysis I, 8 op

Voimassaolo: - 15.03.2011

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

8 cr

Learning outcomes:

On successful completion of this course, the student will be able to

- deal with basic topological concepts
- manipulate sequences and series
- define and calculate improper integrals
- manipulate function sequences and series
- differentiate and integrate the above mentioned

Contents:

The aim of the course is to provide a rigorous and comprehensive treatment of the basic concepts of real analysis. Basic topological concepts on real line; limits of sequences and functions; continuity and uniform continuity of real functions; improper integrals; sequences and series of real numbers, convergence tests; sequences and series of functions, derivation and integration; power series, Taylor polynomials and series; short introduction to Fourier series. This is a continuation of (801111P, mat); the basic aims, namely mathematical thinking and calculation strategies, are the same as in that course.

Person responsible:

Peter Hästö

800322A: Analysis II, 8 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

800328A Calculus of several variables 5.0 op
 802351A Vector Calculus 5.0 op

ECTS Credits:

8 cr

Learning outcomes:

On successful completion of this course, the student will be able to

- differentiate multivariate functions
- apply the derivative to minimization problems
- define and use multidimensional integrals

Contents:

The course deals with multidimensional real calculus. The topology of \mathbb{R}^n is reviewed, after which differential and integral calculus is derived for vector-valued functions of multiple arguments are derived.

Person responsible:

Peter Hästö

800624S: Analysis III, 10 op

Voimassaolo: - 28.02.2011

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Mikael Lindström

Opintokohteen oppimateriaali:

Rudin, Walter, , 1987

Opintokohteen kielet: Finnish

Leikkaavuudet:

802652S Hilbert Spaces 5.0 op

ECTS Credits:

10 cr

Learning outcomes:

On successful completion of this course, the student will be able to

- derive and prove the basic results of Lebesgue integration theory and of the theory of Hilbert spaces.
- apply the results and methods of the course in different topics of mathematics, like in probability theory, in the theory of partial differential equations and in signal theory.

Contents:

The course presents the Lebesgue measure and integral, Hilbert spaces, L^p spaces and Fourier analysis.

Person responsible:

Mikael Lindström

805334A: Analysis of categorical data, 9 op

Voimassaolo: - 28.02.2011

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:

Agresti, Alan , , 1990

Christensen, Ronald , , 1990

McCullagh, Peter , , 1989

McCulloch, Charles E. , , 2001

Opintokohteen kielet: Finnish

ECTS Credits:

9 cr

Learning outcomes:

A student who has successfully completed the course is supposed to

- be familiar with generalized linear models and to be able to use them when studying discrete data
- be able to model the behaviour of ordinal dependent variables
- be able to make use of so-called mixed models while studying discrete or ordinal data

Contents:

The course deals with the analysis of contingency tables and with models for qualitative and ordinal dependent variables. Models for truncated dependent variables are also briefly touched. A majority of these models can be interpreted as generalised linear models (GLIM). This is why the essentials of the GLIM-theory and the corresponding phraseology is presented. So-called generalised mixed linear models (including random effects) and the estimation of their parameters by the GEE and the ML methods are also discussed. The course can be taken either as a graduate course or as an undergraduate course. It consists of 52 hours of lectures and 36 hours of exercises in the computer lab.

Person responsible:

Markku Rahiala

805678S: Analysis of categorical data, 9 op

Voimassaolo: - 28.02.2011

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:

Agresti, Alan , , 1990

Christensen, Ronald , , 1990

McCullagh, Peter , , 1989

McCulloch, Charles E. , , 2001

Opintokohteen kielet: Finnish

ECTS Credits:

9 cr

Learning outcomes:

A student who has successfully completed the course is supposed to

- be familiar with generalized linear models and to be able to use them when studying discrete data
- be able to model the behaviour of ordinal dependent variables
- be able to make use of so-called mixed models while studying discrete

Contents:

The course deals with the analysis of contingency tables and with models for qualitative and ordinal dependent variables. Models for truncated dependent variables are also briefly touched. A majority of these models can be interpreted as generalised linear models (GLIM). This is why the essentials of the GLIM-theory and the corresponding phraseology is presented. So-called generalised mixed linear models (including random effects) and the estimation of their parameters by the GEE and the ML methods are also discussed. The course can be taken either as a graduate course or as an undergraduate course. It consists of 52 hours of lectures and 36 hours of exercises in the computer lab.

Person responsible:

Markku Rahiala

805646S: Analysis of longitudinal data, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jussi Klemelä

Opintokohteen oppimateriaali:**Peter J. Diggle et al.**, , 2002**Hsiao, Cheng** , , 2003**McCulloch, Charles E.** , , 2001**Fitzmaurice, Garrett M.** , , 2004**Opintokohteen kielet:** Finnish**ECTS Credits:**

9 cr

Learning outcomes:

A student who has successfully completed the course is supposed to

- be familiar with so-called mixed models for both discrete and continuous dependent variables

- be able to make use of these mixed models while studying longitudinal data

Contents:

The purpose of the course is to teach the students, how one can simultaneously study dependencies between observed variables and variations between individuals in the panel. Linear and non-linear mixed models, variograms and so-called growth curve models are introduced as central inferential tools for these studies. Model diagnostics, dynamic ARX-type models and the GMM estimation principle also get a lot of attention. A major part of the course deals with modelling continuous dependent variables, but cases of qualitative, ordinal and count dependent variables are covered as well. The course can be taken either as a graduate course or as an undergraduate course. It consists of 52 hours of lectures and 36 hours of exercises in the computer lab

Person responsible:

Markku Rahiala

805308A: Analysis of longitudinal data, 5 op**Opiskelumuoto:** Intermediate Studies**Laji:** Course**Vastuuyksikkö:** Department of Mathematical Sciences**Arvostelu:** 1 - 5, pass, fail**Opintokohteen oppimateriaali:****Peter J. Diggle et al.**, , 2002**Hsiao, Cheng** , , 2003**McCulloch, Charles E.** , , 2001**Fitzmaurice, Garrett M.** , , 2004**Opintokohteen kielet:** Finnish**ECTS Credits:**

9 cr

Learning outcomes:

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- be familiar with so-called mixed models for both discrete and continuous dependent variables

- be able to make use of these mixed models while studying longitudinal data

Contents:

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Person responsible:

Markku RAhiala

802329A: Analysis tutorial, 1 op**Opiskelumuoto:** Intermediate Studies**Laji:** Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Peter Hästö

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

800118P: Basic Mathematics for Economics II, 7 op

Voimassaolo: - 31.07.2020

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Myllylä

Opintokohteen kielet: Finnish

Leikkaavuudet:

802159P	Basic method in Analysis for Economic Sciences	5.0 op
802160P	Matrices and optimization for Economic Sciences	5.0 op

ECTS Credits:

7 cr

Learning outcomes:

After completing the course the student

- masters the basic operations and properties of matrices
- knows how to utilize matrices with solving simultaneous equations, optimization and constructing different models
- knows the basics of linear optimization
- knows how to calculate with complex numbers
- knows how to integrate and how to calculate an area with definite integral
- knows the idea behind differential equations and knows how to solve them
- knows the idea behind difference equations and knows how to solve them
- is prepared to utilize the aforementioned items with his/her subsequent courses

Contents:

The aim of the course is to create a base for mathematics used in economics. The essential item of the course are the basic operations of matrices and their utilization in mathematical exercises. The course starts on basics and proceeds to solve simultaneous equations with multiple variables and demanding optimization problems with constraints. Those problems that are more difficult than the ones presented in Basic Mathematics for Economics I (800117P) are now solved with matrices. The student will familiarize herself with regression analysis and Input-Output-Analysis. Some linear optimization and differentiation with vectors are also presented. Another essential item of the course is the integral and its applications. The main applications within the course are within the fields of differential equations.

Person responsible:

Kari Myllylä

801387A: Basic Course in Numerics, 6 op

Voimassaolo: 01.03.2011 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Erkki Laitinen

Opintokohteen oppimateriaali:

Atkinson, Kendall, , 1993

Opintokohteen kielet: Finnish

ECTS Credits:

6 cr

Learning outcomes:

On successful completion of this course, the student will be able to

- implement efficient numerical algorithms for solving basic numerical problems
- approximate the error of numerical results

Contents:

The lecture course is focused to numerical methods, which can be used for solving numerically mathematical problems which analytical solution is unknown or complicated to construct. The lectures consist of following topics: Computer arithmetic, nonlinear equations, systems of linear equations, interpolation, integration, derivation and differential equations.

Person responsible:

Erkki Laitinen

801389A: Basic Geometry for University Students, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

801399A Geometry 5.0 op

ECTS Credits:

6 cr

Learning outcomes:

On successful completion of this course, the student will be able to

- prove simple geometric claims
- solve simple geometric problems with the help of ruler and compass
- solve basic applied problems of school geometry

Contents:

School geometry (801389A) The course presents the core material in Finnish junior high school and high school geometry courses. It is mainly meant for those students who study to become mathematics, physics and chemistry teachers. The first part of this course is classic Euclidean plane geometry and the second part is solid geometry. Students become familiar with geometric proof and how to solve simple geometric problems with the help of ruler and compass. Geometric results are used to solve problems. The second part considers spatial geometry and starts with how lines and planes can situate in ordinary three dimensional space. Basic geometric properties of solids like cube, ball and cone are considered and methods how to calculate their surface areas and volumes are presented.

Person responsible:

Martti Kumpulainen

800117P: Basic Mathematics for Economics I, 7 op

Voimassaolo: - 01.02.2013

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Myllylä

Opintokohteen kielet: Finnish

ECTS Credits:

7 cr

Learning outcomes:

After completing the course the student

- knows how process functions of a different type
- knows how to solve different equations and inequalities
- understands the concept of limit and continuity and is able to determine some limits
- understands the meaning of derivative and know how to apply it to practical problems
- knows how to solve different optimization problems
- is prepared to utilize the aforementioned items with his/her subsequent courses

Contents:

The aim of the course is to create a base for mathematics used in economics. First part of the course concerns with the same concepts that are taught in upper secondary school. These items are for example equations, inequalities, functions, limits of functions, continuity and derivative. Some of the economical applications of the concepts are also introduced. The second part of the course concerns the extreme values of different functions, aka. optimization. The examination of the extreme values will be done with the help of derivative. The emphasis will be on the functions with one variable. The most challenging case will be an optimization of a function with two variables and some constraints. The constraints can be either equations or inequalities.

Person responsible:

Kari Myllylä

800147P: Basic Methods in Mathematics I / appl., 8 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:

Aatos Lahtinen, Erkki Pehkonen, , 1987

Aatos Lahtinen, Erkki Pehkonen, , 1988

Adams, R. A.,

Opintokohteen kielet: Finnish

Leikkaavuudet:

802161P Introduction to Real Functions 5.0 op

802154P Elementary functions 3.0 op

802155P Continuity and limit 4.0 op

Ei opintojaksokuvauksia.

801111P: Basic Methods in Mathematics I / math, 10 op

Voimassaolo: - 01.02.2013

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:

Adams, R. A.,

Opintokohteen kielet: Finnish

Leikkaavuudet:

802154P Elementary functions 3.0 op

802155P Continuity and limit 4.0 op

802156P Derivative 4.0 op

ay801111P Basic Methods in Mathematics I / math 10.0 op

ECTS Credits:

10 cr

Learning outcomes:

After completing the course the student

- knows how to deduce and prove the essential results of the course
- knows how to use different methods of proving theorems
- knows how to use different functions and complex numbers
- understands the concepts of the limit and continuity and is able to calculate limits
- understands the meaning of the derivative and knows how to use it in practice
- knows how to integrate

Contents:

The essential concepts of the course are functions, complex numbers, the concept of limit, continuity, derivative, its applications and the integral calculus. Most of the concepts are familiar from the upper secondary school because the functions are real valued. The basics of calculus and integral calculus are necessary for the subsequent studies. The main object of the course is to familiarize the student with mathematical concepts and methods, such as definitions, theorems and proving them. A new kind of outlook is required to take the step from upper secondary school to the university. The student should have the ability to make calculations and to deduce results after completing the course. Several short and easy proofs are examined to introduce different methods of proving theorems.

Person responsible:

Kari Myllylä

806109P: Basic Methods in Statistics I, 9 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Pääkkilä

Opintokohteen oppimateriaali:

Grönroos, Matti (2) , , 2003

Heikkilä, Tarja , , 1998

Helenius, Hans , , 1989

Ranta, Esa (2) , , 1991

Wild, Christopher J. , , 2000

Opintokohteen kielet: Finnish

Leikkaavuudet:

- | | | |
|-----------|--|--------|
| 806119P | A Second Course in Statistics | 5.0 op |
| 806116P | Statistics for Economic Sciences | 5.0 op |
| 806117P | Analysis of continuous response variable | 5.0 op |
| ay806109P | Basic Methods in Statistics I (OPEN UNI) | 9.0 op |

ECTS Credits:

9 cr

Learning outcomes:

On successful completion of this course, the student will be able to

- use basic methods of collecting and describing data
- apply methods of statistical inference in some simple situations
- interpret listing of some statistical software

Contents:

Principles of collecting data and describing data with suitable tables, graphs and numerical measures are treated. The basic idea of estimation and statistical tests will be presented as well as some of the most common used confidence intervals and statistical tests. One aim is also to give basic knowledge from some statistical software.

Person responsible:

Marjatta Mankinen (economics) and Jari Pääkkilä (others)

806112P: Basic Methods of Data Analysis, 10 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Pääkkilä

Opintokohteen oppimateriaali:

Armitage, P. , , 2002

Opintokohteen kielet: Finnish

Leikkaavuudet:

805305A Introduction to Regression and Analysis of Variance 5.0 op

ECTS Credits:

10 cr

Learning outcomes:

On successful completion of this course, the student will be able to

- analyze continuous and categorical response in the most common experimental and observational studies
- critically evaluate chosen model
- use some statistical software

Contents:

Skills for performing statistical analyses and inferences on the basis of data obtained in common experimental and observational studies are expanded and deepened. Topics included are e.g. (1) principles of collection, description, and modelling of, and inference on statistical data; (2) basic methods of analysing continuous outcome variables, like comparison of groups, analysis of variance, regression analysis, residuals and model diagnostics, nonparametric methods, treatment of correlated and lifetime (censored) observations; (3) and basic methods of analysing binary, categorical and count data.

Person responsible:

Esa Läärä

806110P: Basic methods in statistics II, 10 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:

Armitage, P. , , 2002

Grönroos, Matti (2) , , 2003

Ranta, Esa (2) , , 1991

Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

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Person responsible:

Marjatta Mankinen

802322A: Basics in mathematical modelling, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Erkki Laitinen

Opintokohteen kielet: Finnish

800104P: Basics of School Mathematics, 4 op

Voimassaolo: 01.03.2011 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

800347A Number systems 5.0 op

Learning outcomes:

On successful completion of this course, the student will be able to

- define the set of natural numbers, its arithmetic and order
- construct the set of integers, rational numbers and real numbers and define arithmetics and order relations of these sets.
- formulate and use the induction principle
- handle the numbers of various number systems
- determine cardinality of some sets

Contents:

The course presents the basics of arithmetic's and algebra. Special attention is paid on number sets and various number systems.

806315A: Bayesian Data Analysis, 10 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Hyon-Jung Kim-Ollila

Opintokohteen oppimateriaali:

Andrew Gelman et al., , 2004

Lee, Peter M. , , 1997

Opintokohteen kielet: English

Ei opintojaksokuvauksia.

805380A: Clinical biostatistics, 6 op

Voimassaolo: - 01.09.2012

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Läärä Esa

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

800667S: Coding Theory, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Väänänen, Keijo

Opintokohteen oppimateriaali:

Roman, Steven, , 1992

Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Learning outcomes:

After completing the course, student

- knows the basic principles of coding theory
- is familiar with important error-correcting codes
- sees how algebra and number theory can be applied in the modern information technology

Contents:

The course presents the basics of error-correcting block codes needed in modern information technology. Main idea is to consider the basic properties of finite fields and to apply this theory in constructing the codes such as cyclic codes like BCH- and RS-codes, Reed-Muller codes and Goppa codes.

Person responsible:

Keijo Väänänen

801385A: Complex Analysis I, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Arhippainen, Jorma Eemil

Opintokohteen oppimateriaali:

Lang, Serge, , 1999

Spiegel, Murray R., , 1964

Opintokohteen kielet: Finnish

ECTS Credits:

4 cr

Learning outcomes:

On successful completion of this course, the student will be able to

- know the basic properties of algebraic and topological structure of complex numbers
- know the basic properties of complex functions
- be able to apply theory of complex numbers to different fields of pure and applied mathematics

Contents:

The course deals with the basic theory of complex numbers. After a brief introduction to algebraic properties of complex numbers, such basic results as polar coordinate representation, De Moivre formulas and topology on the complex plane will be considered. For the complex functions the concepts of limit, continuity and derivative will be studied. Some basic properties of analytic functions will be considered and Cauchy-Riemann formulas will be proved. Finally the basic theory of path integral of complex functions will be studied.

Person responsible:

Jorma Arhippainen

801386A: Complex Analysis II, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:

Lang, Serge, , 1999

Spiegel, Murray R., , 1964

Opintokohteen kielet: Finnish

ECTS Credits:

4 cr

Learning outcomes:

On successful completion of this course, the student will be able to

- derive and prove core results of complex analysis
- apply theory of complex analysis to many structures of analysis

Contents:

The course deals with fundamental results on complex analysis such as Cauchy integral theorem and Cauchy integral formulas. As application some important corollaries of them will be proved such as Liouville Theorem, Fundamental theorem of algebra and Maximum principle. Further, after brief introduction to power series the presentation of analytic functions by using power series will be studied. After Laurent representation of complex functions theory of residues will be considered and as application this theory will be used to calculate certain type of definite integrals.

Person responsible:

Jorma Arhipainen

801698S: Cryptography, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapani Matala-aho

Opintokohteen oppimateriaali:

Trappe, Wade; Washington, Lawrence C., , 2005

Menezes, Alfred J.; van Oorschot, Paul C.; Vanstone, Scott A., , 1997

Opintokohteen kielet: Finnish

Learning outcomes:

As usual in my mathematical studies I shall be able to solve problems arising from the subject and to prove essential theorems starting from the given definitions using the tools applied in the course. More detailed; For example, when I pass the course with the grade 1/5, I shall recognize most definitions and I am able to solve closely related problems. Also I am able to rewrite short proofs with some understanding. When I pass the course with the grade 5/5, then I shall understand well the given definitions with the proofs of the theorems deduced from them. Further, I am able to solve challenging problems which demand independent deductions with several stages and applications of appropriate tools.

Contents:

In our lectures we study mathematical basics of encrypting, key exchange and signature systems. As examples, we mention elementary group and number theory used in primality tests and factoring, complexity estimates of computations-in particular in finite fields, repeated squaring and discrete logarithm in finite cyclic groups- applied in multiplicative groups of finite fields and addition groups of elliptic curves. Deduction of addition formulae in projective and affine Weierstrass elliptic curves. Diffie-Hellman key exchange, ElGamal encrypting and signature systems in finite cyclic groups applied in finite fields or in elliptic curves defined over finite fields. DSA, ECDSA, Massey-Omura. Some algorithms and tests: AKS, Fermat, Lenstra, Lucas, Miller-Rabin, Pohlig-Hellman, Pollard's p-1 and rho, pseudoprimes, quadratic sieve, Solovay-Strassen.

800345A: Differential Equations I, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:

Boyce, William E., , 2005

Nagle, R. Kent, , 1996

Zill, Dennis G., , 2001

Opintokohteen kielet: Finnish

Leikkaavuudet:

800320A Differential equations 5.0 op

ECTS Credits:

4 cr

Learning outcomes:

On successful completion of this course, the student will be able to

- recognize the concerning differential equation and choose the proper method and solve it
- notice the conditions that guarantee the uniqueness of the solution
- understand what implicit solution means

Contents:

The course consist ordinary differential equations. First order differential equations like separable, homogeneous, linear, exact and those that can be transform to them with suitable substitutions are studied and solved by algebraic methods (for example separation of variables). Iterative methods and numerical methods are applied in some cases to obtained an approximate solution or a numerical solution. Higher order linear differential equations with constant coefficients that appear in applications are considered and also second order linear differential equations with continuous coefficients. The basis of how to solve finite systems of differential equations is given. Power series method is applied to solve some second order linear differential equations like Legendre equation.

Person responsible:

Martti Kumpulainen

800346A: Differential Equations II, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:

Nagle, R. Kent, , 1996

Folland, Gerald B., , 1992

Zill, Dennis G., , 2001

Opintokohteen kielet: Finnish

Leikkaavuudet:

802334A A Second Course in Differential Equations 5.0 op

ECTS Credits:

4 cr

Learning outcomes:

On successful completion of this course, the student will be able to

- apply method of Frobenius to solve second order linear differential equations
- proof the basic properties of Bessel functions, Legendre polynomials and Hermite polynomials
- calculate the Fourier-series of a given piecewise continuous function
- apply integral transformations to solve some integral equations and ordinary differential equations with constant coefficients
- recognize heat and wave equations and choose the proper method to solve them

Contents:

The course consist second order ordinary differential equation that are important in applications and partial differential equations like heat and wave equations. Method of Frobenius is introduced to solve second order ordinary differential equation. Some special functions (like Gamma function and Bessel functions) are considered and also orthogonal polynomials (Legendre polynomials and Hermite polynomials). The basics how to calculate Fourier-series for a piecewise continuous function is given. Last, basics of integral transformations (Laplace-transformation and Fourier-transformation) are studied, and how to apply them and the method of separation of variable in some cases to heat and wave equations.

Person responsible:

Martti Kumpulainen

802312A: Discrete mathematics, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Marko Rinta-aho

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

805683S: Econometrics, 5 - 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jussi Klemelä

Opintokohteen oppimateriaali:

Harvey, Andrew C. , , 1990

Hayashi, Fumio , , 2000

Gourieroux, Christian , , 1995

Gourieroux, Christian , , 1995

Opintokohteen kielet: Finnish

Leikkaavuudet:

805339A The statistical foundations of econometrics 5.0 op

ECTS Credits:

6 cr

Learning outcomes:

A student who has successfully completed the course is supposed to

- be able to build and estimate both linear and non-linear models for the interdependencies between macroeconomic variables
- be familiar with the elements of the analysis of dynamic panel data and its applications to microeconomic problems
- be familiar with co-integration theory and its potential in the analysis of long-term equilibria

Contents:

Although econometric models are quite similar to other statistical models and the principles of inference are quite the same, there are some very specific features in econometric models as well. In macroeconomic models, for instance, it is usually utmost important to take account of possible feedback relations and of possible measurement errors in the variables. The analysis of long-term equilibria and of long-term relationships between variables is often especially interesting from the economic point of view. Some excerpts from the contents of the course: Model diagnostics for linear and non-linear regression models, tests for structural change, instrumental variable estimation, simultaneous equation models, LR-, LM- and IM testing principles, VARX-models, cointegration theory and error correction models. The course can be taken either as a graduate course or as an undergraduate course. It consists of 36 hours of lectures and 27 hours of exercises in the computer lab.

Person responsible:

Markku Rahiala

805339A: Econometrics, 5 - 6 op

Voimassaolo: 01.06.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jussi Klemelä

Opintokohteen oppimateriaali:

Hayashi, Fumio , , 2000

Gourieroux, Christian , , 1995

Gourieroux, Christian , , 1995

Harvey, Andrew C. , , 1990

Opintokohteen kielet: Finnish

Leikkaavuudet:

805683S The statistical foundations of econometrics 5.0 op

ECTS Credits:

6 cr

Learning outcomes:

A student who has successfully completed the course is supposed to

- be able to build and estimate both linear and non-linear models for the interdependencies between macroeconomic variables
- be familiar with the elements of the analysis of dynamic panel data and its applications to microeconomic problems
- be familiar with co-integration theory and its potential in the analysis of long-term equilibria

Contents:

Although econometric models are quite similar to other statistical models and the principles of inference are quite the same, there are some very specific features in econometric models as well. In macroeconomic models, for instance, it is usually utmost important to take account of possible feedback relations and of possible measurement errors in the variables. The analysis of long-term equilibria and of long-term relationships between variables is often especially interesting from the economic point of view. Some excerpts from the contents of the course: Model diagnostics for linear and non-linear regression models, tests for structural change, instrumental variable estimation, simultaneous equation models, LR-, LM- and IM testing principles, VARX-models, cointegration theory and error correction models. The course can be taken either as a graduate course or as an undergraduate course. It consists of 36 hours of lectures and 27 hours of exercises in the computer lab.

Person responsible:

Markku Rahiala

802107P: Financial Mathematics, 4 op

Voimassaolo: 01.09.2011 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

802158P Mathematics for Economic Sciences 7.0 op

Learning outcomes:

On successful completion of this course, the student will be able to

- solve different problems related simple, periodic and continuous compoundings
- form different types of compound bases

- solve problems related to loans and investments
- form and apply different indices

Contents:

The course begins with the basics mathematics of interest rates, including simple, periodic and continuous compoundings. The first part also considers the differences between compounding bases and gives methods to translating different compounding periods. Related concepts to loans and investments are also included. The second part relates to the theory of indices. In this part, special kind of index types are formed, for instance, consumer price index, Laspeyres index, Paasche index, Marshall-Edgeworth index and Fisher index.

802638S: Formal Models and Quantitative Methods for Psychology, 5 - 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Peter Hästö

Opintokohteen kielet: Finnish

ECTS Credits:

5 cr or 10 cr

Learning outcomes:

On successful completion of this course, the student will be able to

- manipulate and deal with formal models from psychology.
- implement the same using appropriate computer software.

Contents:

This course is organized within an Erasmus Intensive Program of the same name. Each year there is a two week seminar in one of the countries participating in the network. The 10 credit course consists of participation in two seminars or participation in one seminar and a written assignment.

Person responsible:

Peter Hästö

800674S: Fourier-analysis and distribution theory, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:

Stein, Elias M.; Shakarchi R., , 2003

Grafakos Loukas, , 2004

Taylor, Michael E., , 1996

Stakgold, Ivar , , 1998

Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Learning outcomes:

On successful completion of this course, the student will be able to

- calculate the Fourier transform of a given integrable function on the line
- perform basic operations, such as differentiation, convolution and Fourier transformation, on distributions
- use Fourier transform to find, and provide estimates for, fundamental solutions of partial differential operators
- formulate direct and inverse scattering problems for the Schrödinger operator

Contents:

Fourier transform in Schwartz spaces, Riemann - Lebesgue lemma, Hausdorff - Young inequality, tempered distributions and their Fourier transform, Sobolev spaces, homogeneous distributions, fundamental solution of PDO, Schrödinger operator with singular potential, inverse scattering problem, Born approximation.

Person responsible:

Valeriy Serov

802629S: Function estimation, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Lasse Holmström

Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Learning outcomes:

On successful completion of this course, the student will be able to

- describe the basic characteristics of nonparametric function estimation methods
- apply these estimation methods to practical problems
- derive some of the basic theoretical results for kernel estimators

Contents:

The course is an introduction to nonparametric estimation of functions with a particular emphasis on kernel methods. The objects of estimation are the probability density function and the regression function.

Person responsible:

Lasse Holmström

800651S: Functional analysis, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Learning outcomes:

On successful completion of this course, the student will be able to

- derive and prove basic results in functional analysis.
- apply the results and methods of the course in various problems both in pure and applied mathematics.

Contents:

The course presents the theory of Banach and Hilbert spaces, Banach fixed point theorem, basic theory of operators, Baire category theorem, principle of uniform boundedness, open mapping theorem, closed graph theorem, Hahn-Banach theorem, compact operators and their spectrum.

Person responsible:

Mikael Lindström

800660S: Group Theory, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Niemenmaa Markku

Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Learning outcomes:

On successful completion of this course, the student will be able to

- use different proving techniques related to the theory
- prove the Sylow theorems and deal with their applications
- prove important results in the theory of finite solvable groups

Contents:

Aim: To provide the student with the basics of group theory and its development during the past hundred years. Basics of group theory, permutations, studies on the arithmetical

Person responsible:

Markku Niemenmaa

801390A: History of Mathematics, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Matti Lehtinen

Opintokohteen oppimateriaali:

Boyer, Carl B., , 1994

Boyer, Carl B., , 1994

Fauvel John, Gray J., , 1990

Opintokohteen kielet: Finnish

Leikkaavuudet:

800332A History of Mathematics 5.0 op

ECTS Credits:

6 cr

Contents:

The aim of the course is to provide the student a general conception of the history of mathematics. The main emphasis is on the calculations. Contents: Egyptian and Babylonian mathematics; Euclid and the Elements, Archimedes and Apollonius; Roman era; India and China; the islamic world; medieval mathematics; the rise of algebra; Descartes, Fermat; Newton and Leibniz, the beginning of calculus.

802636S: Information Theory, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Lasse Holmström

Opintokohteen oppimateriaali:

Ash, Robert, , 1990

Cover, Thomas M.; Joy, Thomas A., , 2006

Gallager, Robert G., , 1968

MacKay, David J. C., , 2003

Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Learning outcomes:

On successful completion of this course, the student will be able to

- explain the basic concepts and results of information theory
- solve mathematical information theoretic problems
- derive the central results of the theory

Contents:

The course is an introduction to Claude Shannon's mathematical theory of communication. The focus is on the information content of an information source, compression of information, coding, transmission of coded information through an information channel as well as decoding of the received message.

Person responsible:

Lasse Holmström

801346A: Introduction to Cryptography, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

802336A Introduction to Cryptography 5.0 op

ECTS Credits:

4 cr

Learning outcomes:

After completing the course, student

- knows the principles of some traditional symmetric key methods
- knows how public key methods (RSA, discrete logarithm, knapsack) work
- is familiar with the possibility to use and apply number theory in cryptography

Contents:

The course considers some traditional symmetric key methods (affine system, matrix cryptography) and three public key methods, namely RSA, discrete logarithm and knapsack.

Person responsible:

Keijo Väänänen

800149P: Introduction to LaTeX, 2 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761115P Laboratory Exercises in Physics 1 5.0 op

761115P-03 Laboratory Exercises in Physics 1, Introduction to LaTeX 0.0 op

ECTS Credits:

2 cr

Learning outcomes:

After completing the course the student

- knows the operational principle of LaTeX
- knows how to prepare basic documents using LaTeX
- knows the basic commands needed in mathematical texts
- is able to use different environments (e.g. equation environments)
- is able to recognize and repair errors
- is able to produce papers and theses using LaTeX

Contents:

The course is an introduction to LaTeX document preparation system. This course provides basic knowledge and tools for the usage of LaTeX.

Person responsible:

Janne Oinas

801195P: Introduction to Probability Theory I, 5 op

Voimassaolo: 01.01.2011 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:

Tuominen, P., , 1993

Opintokohteen kielet: Finnish

ECTS Credits:

4 cr

Learning outcomes:

On successful completion of this course, the student will be able to

- solve simple practical problems associated with probability
- solve simple theoretical problems associated with probability
- derive the basic properties of probability, starting from the axioms

Contents:

The course is an introduction to Probability. After review of high school curriculum material, the axiomatic approach to Probability is introduced. The most important concepts are the probability space, conditional probability, independence, a random variable as well as its distribution and expected value.

Person responsible:

Lasse Holmström

801396A: Introduction to Probability Theory II, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Nordström Kenneth

Opintokohteen oppimateriaali:

Tuominen, P., , 1993

Opintokohteen kielet: Finnish

ECTS Credits:

4 cr

Learning outcomes:

On successful completion of this course, the student will be able to

- understand probability theory deeper than before
- apply various stochastic models
- derive the basic results associated with the new concepts introduced

Contents:

The course is a direct continuation for the course Probability Theory I. The new concepts include for instance the moments of a distribution, the probability generating function, the Law of Large Numbers, the Central Limit Theorem as well as two-dimensional distributions.

Person responsible:

Lasse Holmström

806113P: Introduction to Statistics A, 5 op

Voimassaolo: 01.01.2011 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Läärä Esa

Opintokohteen oppimateriaali:

Wild, Christopher J. , , 2000

Opintokohteen kielet: Finnish

Leikkaavuudet:

806118P Introduction to Statistics 5.0 op

806119P A Second Course in Statistics 5.0 op

806116P Statistics for Economic Sciences 5.0 op

ECTS Credits:

5 cr

Learning outcomes:

On successful completion of this course, the student will be able to

- present the dataset by using graphics, tables and statistics
- apply appropriate statistical techniques for analyzing solutions to simple real-world problems
- interpret listing of some statistical software

Contents:

The course presents probabilistic techniques for studying uncertainty, and to illustrate how such techniques can be applied to make statistical analysis and interpretation of data in simple one variable settings. Topics include descriptive statistics, basics of probability theory, random variables and their distributions, sampling distributions, estimation, confidence intervals, and hypothesis testing. One aim is also to get basic knowledge from some statistical software.

Person responsible:

Jari Pääkkilä

802635S: Introduction to partial differential equations, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Valeriy Serov

Opintokohteen oppimateriaali:

Colton, David , , 1988

Kress, Rainer , , 1999

Folland, Gerald B. , , 1995

Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Learning outcomes:

On successful completion of this course, the student will be able to

- solve linear and quasi-linear partial differential equations of first order using the method of characteristics
- apply the method of separation of variables to solve initial-boundary value problems for heat, wave and Laplace equations
- verify that a given function is a fundamental solution of a partial differential operator
- use single and double layer potentials to solve boundary value problems for Laplacian

Contents:

Linear and nonlinear equations of the first order, trigonometric Fourier series, Laplace equation in \mathbb{R}^n and in bounded domains, potential theory, Green's function, Heat equation in \mathbb{R}^n and in bounded domains, Wave equation in \mathbb{R}^n and in bounded domains, d'Alembert formula for any dimensions, Fourier method.

Person responsible:

Valeriy Serov

802118P: Linear Algebra I, 4 op

Voimassaolo: 16.10.2012 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:

Lay, David C. , , 2003

Opintokohteen kielet: Finnish

Leikkaavuudet:

802120P Introduction to Matrices 5.0 op

ECTS Credits:

5 cr

Learning outcomes:

On successful completion of this course, the student will be able to

- solve linear systems of equations ja apply them to linear algebraic problems
- know matrices and their basic properties
- know basic properties of linear spaces

Contents:

The aim is to familiarise the student with the basics of linear algebra: systems of linear equations, vector space \mathbb{R}^n and matrix algebra.

Person responsible:

Marko Rinta-aho

802119P: Linear Algebra II, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:

Lay, David C. , , 2003

Opintokohteen kielet: Finnish

Leikkaavuudet:

802320A Linear Algebra 5.0 op

ECTS Credits:

5 cr

Learning outcomes:

On successful completion of this course, the student knows

- basic properties of inner product spaces
- linear mappings, their matrix representation, and eigenvalues
- determinants and how to apply them to problems relating to matrices and linear mappings

Contents:

The aim of the course is to provide the student with the knowledge needed in almost all later courses in mathematics: Abstract vector spaces and subspaces, Linear independence and bases, Inner product spaces, Linear mappings, Determinants, Eigenvalues and Eigenvectors, Hermitian matrices and quadratic forms.

Person responsible:

Marko Rinta-aho

806308A: Linear Models, 10 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Leena Ruha

Opintokohteen oppimateriaali:

Draper, Norman Richard , , 1980

Cook, R. Dennis , , 1999

Sen, Ashish , , 1997

Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Learning outcomes:

On successful completion of this course, the student will be able to

- understand both the potentials and the limitations of regression models
- apply regression models as well as variance and covariance analyses while studying continuous dependent variables
- diagnose specification errors in linear models

Contents:

The course starts with an introduction to models postulating conditional distributions for continuous dependent variables and to the expectations of these conditional distributions, the so-called regression functions. Special attention will be paid to families of models that allow a meaningful formulation in terms of regression functions, linear with respect to the parameters. The estimation and testing theory concerning these models will be presented fairly thoroughly, but the main emphasis of the course still lies on the practical side: The limitations in the applicability of regression models will be made very clear and the use of both graphics and tests in model diagnostics get very much attention. Other graphical representations, helpful in understanding the information content of the data are also presented. Much time will also be devoted to cases, where the observational units can be divided into groups or categories according to some qualitative factors ("analysis of variance" and "analysis of covariance"). The course is compulsory for a curriculum in statistics and consists of 52 hours of lectures and 42 hours of exercises in the computer lab.

Person responsible:

Markku Rahiala

801344A: Mathematical Programming, 8 op

Voimassaolo: 01.03.2011 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:

Haataja Juha, Rahola J., Ruokolainen J. , , 1998

Opintokohteen kielet: Finnish

ECTS Credits:

8 cr

Learning outcomes:

On successful completion of this course, the student will be able to

- program using Fortran the basic numerical problems
- exploit the libraries of the University's IT center for solving numerical problems

Contents:

The lecture course is focused to methods how to program and solve numerical problems by computer. The lectures consist of following topics: Fortran95 programming language related to numeric, basics of Unix operating system, numerical and graphical libraries in solving numerical problems.

Person responsible:

Erkki Laitinen

805611S: Mathematical statistics II, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jussi Klemelä

Opintokohteen oppimateriaali:

Lehmann, E. L. , , 2001

Migon, H. S. , , 1999

Opintokohteen kielet: Finnish

Leikkaavuudet:

805627S Theory of Statistical Inference 5.0 op

Ei opintojaksokuvauksia.

800653S: Matrix Theory, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:

Lancaster, Peter , , 1985

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

802631S: Modern real analysis, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

800657S: Number Theory, 10 op

Voimassaolo: - 31.07.2010

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Väänänen, Keijo

Opintokohteen oppimateriaali:

Ian Stewart, David Tall , , 1987

Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Learning outcomes:

On successful completion of this course, the student will be able to

- knows most important ways to present real numbers
- understands the basic of algebraic number fields
- sees how to consider basic properties of rational integers more generally

Contents:

First, the course considers different ways of presenting real numbers. Then the course continues to the basic properties of algebraic number fields, in particular quadratic and cyclotomic fields, ideal theory in quadratic fields and finally to some basic results on transcendental numbers.

Person responsible:

Keijo Väänänen

802328A: Number Theory I, 5 op

Voimassaolo: 01.06.2011 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapani Matala-aho

Opintokohteen oppimateriaali:

Hardy, G. H., , 1979

Rosen, Kenneth H., , 1993

Opintokohteen kielet: Finnish

Learning outcomes:

As usual in my mathematical studies I shall be able to solve problems arising from the subject and to prove essential theorems starting from the given definitions using the tools applied in the course. More detailed; For example, when I pass the course with the grade 1/5, I shall recognize most definitions and I am able to solve closely related problems. Also I am able to rewrite short proofs with some understanding. When I pass the course with the grade 5/5, then I shall understand well the given definitions with the proofs of the theorems deduced from them. Further, I am able to solve challenging problems which demand independent deductions with several stages and applications of appropriate tools.

Contents:

In our lectures we consider arithmetical properties of the common numbers involved in studying mathematics and in particular number theory. Also the methods will get a special interest. Examples of the numbers under the research will be binomials, continued fractions, sums of powers and some numbers sharing a name with the mathematicians Bernoulli, Euler, Fermat, Fibonacci, Heron, Lucas, Mersenne, Neper, Pythagoras, Stirling, Wilson and Wolstenholme. From the tools we mention congruences of rational numbers and polynomials, difference operators, generating series, irrationality considerations, matrix presentations, recurrences and telescopes.

806604S: Principles of bayesian inference, 10 op

Voimassaolo: - 01.09.2012

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Hyon-Jung Kim-Ollila

Opintokohteen oppimateriaali:

Andrew Gelman et al., , 2004

Lee, Peter M., , 1997

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

800697S: Pro Gradu Thesis, 20 op

Opiskelumuoto: Advanced Studies

Laji: Diploma thesis

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

800698S: Pro gradu thesis, 30 op

Opiskelumuoto: Advanced Studies

Laji: Diploma thesis

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

805642S: Pro gradu thesis, 30 op

Opiskelumuoto: Advanced Studies

Laji: Diploma thesis

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

805331A: Project seminar I, 6 op

Voimassaolo: 23.04.2007 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

801323A: Seminar, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

800331A Proseminar 10.0 op

Ei opintojaksokuvauksia.

801645S: Special Work in Applied Mathematics, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

802632S: Special course for teachers of mathematics, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

- | | | |
|---------|---|--------|
| 802641S | Special Course for Teachers of Mathematics: Training | 2.0 op |
| 802640S | Special Course for Teachers of Mathematics: High School Mathematics | 3.0 op |
| 802639S | Special Course for Teachers of Mathematics: Content Planning | 5.0 op |

ECTS Credits:

10 cr

Learning outcomes:

On successful completion of this course, the student will be able to

- combine mathematical thinking and teaching
- plan mathematical tasks which support profound mathematical understanding rather than computational procedures

Contents:

This module aims at bridging the gap between the mathematical content in the BSc with the skills needed for teaching at schools. It consists of the following parts:

Content planning (4 cr)

This part involves planning and implementing tutorials for conceptual understanding for freshmen. The planning is done as group work and it is supported by a seminar.

Matriculation exam questions (3 cr)

This part is delivered by the normal school teachers. It covers scoring of the national exam's questions.

Other (3 cr)

This part contains practical experience of working as a teacher of mathematics, e.g. as a tutor.

Person responsible:

Peter Hästö

802632S-02: Special course for teachers of mathematics / Correcting tests in mathematics, 3 op

Opiskelumuoto: Advanced Studies

Laji: Partial credit

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

- | | | |
|---------|---|--------|
| 802640S | Special Course for Teachers of Mathematics: High School Mathematics | 3.0 op |
|---------|---|--------|

- 802641S Special Course for Teachers of Mathematics: Training 2.0 op
 802639S Special Course for Teachers of Mathematics: Content Planning 5.0 op

Ei opintojaksokuvauksia.

802632S-01: Special course for teachers of mathematics / Lesson plans for teaching mathematics, 4 op

Opiskelumuoto: Advanced Studies

Laji: Partial credit

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

- 802639S Special Course for Teachers of Mathematics: Content Planning 5.0 op
 802640S Special Course for Teachers of Mathematics: High School Mathematics 3.0 op
 802641S Special Course for Teachers of Mathematics: Training 2.0 op

Ei opintojaksokuvauksia.

802632S-03: Special course for teachers of mathematics / Other training, 3 op

Opiskelumuoto: Advanced Studies

Laji: Partial credit

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

- 802641S Special Course for Teachers of Mathematics: Training 2.0 op
 802640S Special Course for Teachers of Mathematics: High School Mathematics 3.0 op
 802639S Special Course for Teachers of Mathematics: Content Planning 5.0 op

Ei opintojaksokuvauksia.

805310A: Statistical Inference I, 10 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:

Pawitan, Yudi , , 2001

Sprott, D. A. , , 2000

Kalbfleisch, J. G. , , 1985

Opintokohteen kielet: Finnish

Leikkaavuudet:

- 805349A Likelihood Inference 5.0 op
 805350A Estimation and Test Theory 5.0 op

Ei opintojaksokuvauksia.

802633S: Statistical Pattern Recognition, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Lasse Holmström

Opintokohteen oppimateriaali:

Duda, Richard O. , , 2001

Theodoridis, Sergios , , 2002

Webb, A. R. , , 2002

Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Learning outcomes:

On successful completion of this course, the student will be able to

- describe the most important classical classification and feature extraction methods that are based on continuous distributions.

- apply these methods to practical problems.

- derive the mathematical results that motivate some of the classification and feature extraction methods.

Contents:

Pattern recognition consists of measuring and observing natural objects, analysis of these measurements and recognition of objects on the basis this analysis. The course is an introduction to the concepts and theory of statistical pattern recognition which focuses on the automatic, probability theory based classification of objects based on features derived from the measurements.

Person responsible:

Lasse Holmström

805609S: Statistical methods in epidemiology, 9 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Läärä Esa

Opintokohteen oppimateriaali:

Santos Silva, Isabel dos , , 1999

Clayton, David , , 1993

Rothman, Kenneth J. , , 1998

Opintokohteen kielet: Finnish

805309A: Statistical methods in epidemiology, 9 op

Voimassaolo: 01.06.2009 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Läärä Esa

Opintokohteen oppimateriaali:

Santos Silva, Isabel dos , , 1999

Clayton, David , , 1993

Rothman, Kenneth J. , , 1998

Opintokohteen kielet: Finnish

800688S: Theory of Optimization, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Erkki Laitinen

Opintokohteen oppimateriaali:

Luenberger, David G. , , 1984

Peressini, Anthony L. , , 1988

Opintokohteen kielet: Finnish

Leikkaavuudet:

802666S Linear Optimization 5.0 op

ECTS Credits:

10 cr

Learning outcomes:

On successful completion of this course, the student will be able to

- identify the correct methods for solving the conventional optimization problems
- implement the most typical numerical algorithms for solving linear and nonlinear optimization problems

Contents:

The lecture course is focused to methods, which can apply for solving essential optimization problems of technical and economical sciences. The lectures consist of following topics: Linear programming, convex sets and functions and nonlinear convex optimization. The topics are considered theoretically and also numerical algorithms for problem solution are presented.

Person responsible:

Erkki Laitinen

805679S: Time series analysis, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jussi Klemelä

Opintokohteen oppimateriaali:

Harvey, Andrew C. , , 1993

Lütkepohl, Helmut , , 1991

Hamilton, James D. , , 1994

Opintokohteen kielet: Finnish

ECTS Credits:

9 cr

Learning outcomes:

A student who has successfully completed the course is supposed to

- be able to build and estimate parametric models for the dynamic interrelationships between several time series
- be able to study these interrelationships also by means of some non-parametric methods, e.g. by cross-spectral analysis
- be familiar with so-called multi-regime time series models capable of mimicking structurally changing interrelationships

Contents:

The course concentrates on studying and modelling interrelationships between observed time series and on the evaluation of the realism of these models. Because time series are usually modelled by stochastic processes, the

course starts with a brief introduction to the theory of stochastic processes. Some headlines of the contents of the course: Specification and estimation of dynamic regression models and of transfer function models; Model diagnostics; Dynamic system models for analysing feedback relations between variables; Kalman filtering; Models for heteroskedasticity; Multiregime models. The course can be taken either as a graduate course or as an undergraduate course. It consists of 52 hours of lectures and 36 hours of exercises in the computer lab.

Person responsible:

Markku Rahiala

805324A: Time series analysis, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jussi Klemelä

Opintokohteen oppimateriaali:

Harvey, Andrew C. , , 1993

Lütkepohl, Helmut , , 1991

Hamilton, James D. , , 1994

Opintokohteen kielet: Finnish

ECTS Credits:

9 cr

Learning outcomes:

A student who has successfully completed the course is supposed to

- be able to build and estimate parametric models for the dynamic interrelationships between several time series
- be able to study these interrelationships also by means of some non-parametric methods, e.g. by cross-spectral analysis
- be familiar with so-called multi-regime time series models capable of mimicking structurally changing interrelationships

Contents:

The course concentrates on studying and modelling interrelationships between observed time series and on the evaluation of the realism of these models. Because time series are usually modelled by stochastic processes, the course starts with a brief introduction to the theory of stochastic processes. Some headlines of the contents of the course: Specification and estimation of dynamic regression models and of transfer function models; Model diagnostics; Dynamic system models for analysing feedback relations between variables; Kalman filtering; Models for heteroskedasticity; Multiregime models. The course can be taken either as a graduate course or as an undergraduate course. It consists of 52 hours of lectures and 36 hours of exercises in the computer lab.

Recommended or required reading:

A. Harvey: Time Series Models, Philip Allan (2. painos); H. Lutkepohl: Introduction to Multiple Time Series Analysis, Springer (2. painos); J. Hamilton: Time Series, Princeton University Press.

Person responsible:

Markku Rahiala

801643S: Topology, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Mahmoud Filali

Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Learning outcomes:

After completion of the course, the student should be able to follow more advanced courses or seminars on abstract harmonic analysis.

Contents:

This is an advanced course, aimed to final year students and to postgraduate students. The course covers topological groups and their uniform structures; subgroups, Quotient groups and product groups; and invariant pseudo-metrics on groups. The last part of the course presents some basics on compact semigroups with some examples such as Ellis group and semigroup compactifications

Person responsible:

Mahmoud Filali

800329A: Topology, 8 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Mahmoud Filali

Opintokohteen oppimateriaali:

Vala K., Suominen K., , 1990

Opintokohteen kielet: Finnish

ECTS Credits:

8 cr

Learning outcomes:

On successful completion of this course, the student will be able to follow more advanced topology and analysis.

Contents:

The course presents the very basics of topology that mathematics students should know. It starts with elementary set theory, then it goes on covering metric spaces including Baire's theorem; topological spaces and convergence in topological spaces; separation axioms including Urysohn's lemma and Tietze extension theorem; compact spaces including Tyconoff theorem; and ends with connected spaces.

Person responsible:

Mahmoud Filali

805667S: Training report, 5,5 op

Voimassaolo: - 01.09.2012

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

802327A: Tutoring, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Myllylä

Opintokohteen kielet: Finnish

Leikkaavuudet:

800324A Practical training 5.0 op

ECTS Credits:

4 op

Learning outcomes:

After completing the course the student

- understands that the teacher needs to have an excellent competence in the subject he or she is teaching
- has achieved some experience in teaching and counseling mathematics
- is able to handle various different situations related with teaching

Contents:

Tutoring is a method of student counselling in the Department of Mathematical Sciences. The students acting as tutors are on duty in a tutoring room which is located in the Department. They help younger students with their problems that are related to courses. An important task for the tutors is to help the 1st year students with the exercises of the basic courses (Basic methods in Mathematics I, Linear Algebra I, Analysis I). Some of the tutors have been deputy teachers on the course Algebra I. Their duty was to help other students to solve the exercises independently.

Person responsible:

Kari Myllylä