Opasraportti

LuTK - Department of Mathematical Sciences (2014 - 2015)

Tutkintorakenteet

Bachelor of Science (mathematics)

Tutkintorakenteen tila: published

Lukuvuosi: 2014-15

Lukuvuoden alkamispäivämäärä: 01.08.2014

Compulsory general studies (vähintään 8 op)

902002Y: English 1 (Reading for Academic Purposes), 2 op
902004Y: English 2 (Scientific Communication), 2 op
800008Y: Orientation for New Students, 2 op
901004Y: Swedish, 2 - 3 op

Compulsory major studies (69 op)

The following studies are compulsory for everyone. In addition, on of the courses **Euclidean topology 802352A (4 op)** OR **Metric topology 802356A (5 op)**.

802155P: Continuity and limit, 4 op
802156P: Derivative, 4 op
802154P: Elementary functions, 3 op
801195P: Introduction to Probability Theory I, 5 op
806113P: Introduction to Statistics, 5 op
802151P: Introduction to mathematical deduction, 5 op
802118P: Linear Algebra I, 4 op
802119P: Linear Algebra II, 5 op
800300A: Maturity test, 0 op
800322A: Multidimensional analysis, 8 op
802354A: Number Theory and Groups, 5 op
802355A: Rings, Fields and Polynomials, 5 op
801323A: Seminar, 6 op
802353A: Series and Integrals, 6 op

Optional major studies (vähintään 4 op)

In addition to compulsory major studies, students must choose optional studies in major subject as follows:

- students planning teachers studies at least **4 cr**

- others at least **11 cr**

When choosing the optional major studies, student is adviced to take possible demands in the coming master program into account. Notice also that, in the teachers master degree, it is possible to replace (at most) 10 cr advanced courses with intermediate courses in mathematics.

Remark. If optional courses contains courses in statistics, these courses cannot be used in a possible minor subject in statistics. Note that some of the courses might not be lectured every year.

H325035: Optional intermediate studies in mathematics, 0 - 180 op
Electives
800329A: Topology, 8 op
800343A: Permutations, Fields and Galois' Theory, 8 op
800345A: Differential Equations I, 4 op
800346A: Differential Equations II, 4 op
801344A: Basic Course on Numerical Computation, 8 op
801387A: Basic Course on Numerical Analysis, 6 op
802362A: Introduction to computational inverse problems, 5 op
801386A: Complex Analysis II, 4 op
801390A: History of Mathematics, 6 op
801389A: Basic Geometry, 6 op
802328A: Basics in Number Theory, 5 op
802331A: Principles to Mathematical Modelling, 8 op
802360A: Introduction to inverse problems, 4 op
801385A: Complex Analysis I, 4 op
801396A: Introduction to Probability Theory II, 5 op
802363A: Metric Spaces, 6 op
801346A: Introduction to Cryptography, 4 op
802364A: Introduction to Mathematical Software, 6 op
802322A: Basics in mathematical modelling, 5 op
800149P: Introduction to LateX, 2 op
802157P: Mathematics in teaching, 2 op
H326635: Optional intermediate studies in statistics, 0 - 180 op
Electives
805324A: Time series analysis, 5 op
806351A: Introduction to Independent Component Analysis, 4 op
805334A: Analysis of categorical data, 9 op
805328A: Multivariate analysis, 9 op
805333A: Robust methods, 6 op
805398A: An introduction to stochastic modelling, 8 op
805380A: Clinical biostatistics, 6 op
806330A: Analysis of Market Risk, 5 op
805309A: Statistical methods in epidemiology, 9 op
805339A: The Statistical Foundation of Econometrics, 5 - 6 op
805332A: Design of experiments, 9 op
805308A: Analysis of longitudinal data, 5 op
806357A: Statistical finance, 5 op

Minor subjects (vähintään 50 op)

Bachelor studies contains also studies in major and minor subjects. The minimum requirement is that student does either two smaller minor subjects (at least 25 cr each) *OR* one larger minor subject (at least 60 cr).

Minor studies for students in teacher education

The choice of minor subjects defines how students qualify as teachers. Pedagogical studies for teachers forms a natural 30 cr minor subject for those students who are doing teachers studies. The other minor subject should be either physics, chemistry or computer sciences. Any other compinations should be applied separately from the Faculty of Sciences. Notice that when minimum requirements are fullfilled, one is free to choose other minor subjects (taking the study permissions into account).

Remark. Master studies in different programs might contain different requirements for major and minor studies. These requirements should be taken into account when choosing minor studies in Bachelor's degree. More information can be found in the Study Guide.

Physics as a minor subject

Chemistry as a minor subject

Computer sciences as a minor subject

Pedagogical studies

Other minor studies

Other studies

This part contains all courses which are not minor studies, such as, single courses in different subjects, extra language courses, etc.

Bachelor of Science (statistics)

Tutkintorakenteen tila: published

Lukuvuosi: 2014-15

Lukuvuoden alkamispäivämäärä: 01.08.2014

Compulsory general studies (vähintään 8 op)

902002Y: English 1 (Reading for Academic Purposes), 2 op
902004Y: English 2 (Scientific Communication), 2 op
800008Y: Orientation for New Students, 2 op
901004Y: Swedish, 2 - 3 op

Compulsory major studies (69 op)

The following studies are compulsory for everyone.

802155P: Continuity and limit, 4 op
802156P: Derivative, 4 op
802154P: Elementary functions, 3 op
802352A: Euclidean Topology, 4 op
801195P: Introduction to Probability Theory I, 5 op
806113P: Introduction to Statistics, 5 op
802151P: Introduction to mathematical deduction, 5 op
802118P: Linear Algebra I, 4 op
802119P: Linear Algebra II, 5 op
800300A: Maturity test, 0 op
800322A: Multidimensional analysis, 8 op
802354A: Number Theory and Groups, 5 op
805331A: Project seminar I, 6 op
802355A: Rings, Fields and Polynomials, 5 op
802353A: Series and Integrals, 6 op

Compulsory major studies

The following studies are also compulsory for students major in statistics:

806112P: Basic Methods of Data Analysis, 10 op
801396A: Introduction to Probability Theory II, 5 op
806359A: Regression modelling, 10 op
805310A: Statistical Inference I, 10 op
805340A: Statistical Software, 4 op

Optional intermediate studies in statistics (vähintään 15 op)

Other intermediate level courses in statistics (at least 15 ECTS) from the list below. Note that some of the courses are not lectured every year.

H326635: Optional intermediate studies in statistics, 0 - 180 op
- *Electives*
  - 805324A: Time series analysis, 5 op
  - 806351A: Introduction to Independent Component Analysis, 4 op
  - 805334A: Analysis of categorical data, 9 op
  - 805328A: Multivariate analysis, 9 op
  - 805333A: Robust methods, 6 op
  - 805398A: An introduction to stochastic modelling, 8 op
  - 805380A: Clinical biostatistics, 6 op
  - 806330A: Analysis of Market Risk, 5 op
  - 805309A: Statistical methods in epidemiology, 9 op
  - 805339A: The Statistical Foundation of Econometrics, 5 - 6 op
  - 805332A: Design of experiments, 9 op
  - 805308A: Analysis of longitudinal data, 5 op
  - 806357A: Statistical finance, 5 op

Optional mathematics studies

H325035: Optional intermediate studies in mathematics, 0 - 180 op
- *Electives*
  - 800329A: Topology, 8 op
  - 800343A: Permutations, Fields and Galois' Theory, 8 op
  - 800345A: Differential Equations I, 4 op
  - 800346A: Differential Equations II, 4 op
  - 801344A: Basic Course on Numerical Computation, 8 op
  - 801387A: Basic Course on Numerical Analysis, 6 op
  - 802362A: Introduction to computational inverse problems, 5 op
  - 801386A: Complex Analysis II, 4 op
  - 801390A: History of Mathematics, 6 op
  - 801389A: Basic Geometry, 6 op
  - 802328A: Basics in Number Theory, 5 op
  - 802331A: Principles to Mathematical Modelling, 8 op
  - 802360A: Introduction to inverse problems, 4 op
  - 801385A: Complex Analysis I, 4 op
  - 801396A: Introduction to Probability Theory II, 5 op
  - 802363A: Metric Spaces, 6 op
  - 801346A: Introduction to Cryptography, 4 op
  - 802364A: Introduction to Mathematical Software, 6 op
  - 802322A: Basics in mathematical modelling, 5 op
  - 800149P: Introduction to LateX, 2 op
  - 802157P: Mathematics in teaching, 2 op

Minor subjects (vähintään 50 op)

Bachelor studies contains also studies in major and minor subjects. The minimum requirement is that student does either two smaller minor subjects (at least 25 cr each) *OR* one larger minor subject (at least 60 cr).

Remark. Master studies in different programs might contain different requirements for major and minor studies. These requirements should be taken into account when choosing minor studies in Bachelor's degree. More information can be found in the Study Guide.

Other studies

This part contains all courses which are not minor studies, such as, single courses in different subjects, extra language courses, etc.

Master's degree (Subject Teacher)

Tutkintorakenteen tila: published

Lukuvuosi: 2014-15

Lukuvuoden alkamispäivämäärä: 01.08.2014

Compulsory advanced studies (vähintään 30 op)

Master's degree (line: subject teacher) contains advanced major studies 60 ECTS, which consists of master's thesis (20 ECTS), Special course for teachers of mathematics (10 op), and other advanced studies (30 ECTS). The advanced courses can be selected from the list below (See "Optional advanced studies").

The student is encouraged to discuss of the topic of the master's thesis and together with course selections with the student advisor or your supervisor.

Note. In this line, students can replace at most 10 ECTS advanced studies with intermediate level studies.

800697S: Pro Gradu Thesis, 20 op
802632S: Special course for teachers of mathematics, 10 op

Optional advanced studies (vähintään 30 op)

Choose at least 30 ECTS of advanced studies. Special courses might not be in the course list. In this case, please contact department's administrative officer.

H325003: Mathematics, optional advanced studies, 0 - 120 op
- *Electives*
  - 802653S: Lebesgue Measure and Integration Theory, 5 op
  - 801698S: Cryptography, 5 op
  - 802655S: Continued Fractions, 5 op
  - 802644S: Introduction to Functional Analysis, 10 op
  - 802636S: Information Theory, 10 op
  - 802635S: Introduction to partial differential equations, 10 op
  - 802652S: Hilbert Spaces, 5 op
  - 800651S: Functional analysis, 10 op
  - 802629S: Function estimation, 10 op
  - 800674S: Fourier transform and distributions, 10 op
  - 802647S: Fourier series and the discrete Fourier transform, 10 op
  - 802656S: Algebraic numbers, 5 op
  - 802637S: Advanced Problem Solving, 2 - 6 op
  - 802645S: Number Theory A, 5 op
  - 802646S: Number Theory B, 5 op
  - 802631S: Modern real analysis, 10 op
  - 800688S: Theory of Optimization, 10 op
  - 800660S: Group Theory, 10 op
  - 802633S: Statistical Pattern Recognition, 10 op

801643S: Topology, 10 op
802651S: Abstract Measure Theory, 5 op
802650S: Fractal Geometry, 10 op
802660S: Operator theory and integral equations, 10 op
802664S: Differential geometry, 10 op

H326603: Statistics optional advanced studies, 0 - 120 op

Electives

805609S: Statistical methods in epidemiology, 9 op
805646S: Analysis of longitudial data, 5 op
805679S: Time series analysis, 5 op
805683S: The Statistical Foundation of Econometrics, 5 - 6 op
805681S: Generalized Linear Models, 9 op
805699S: Statistical methods in epidemiology, 8 op
806618S: Computationally intensive statistical methods, 9 op
806621S: Spatial Data Analysis, 10 op
806628S: Statistical Finance, 5 op
806629S: Introduction to Sampling Methods, 4 op
806630S: Market Risk Analysis, 5 op
805651S: Stochastic processes, 10 op
806622S: Probability, 10 op
805611S: Mathematical statistics II, 10 op

Minor studies

The degree programme of subject teacher is comprised of compulsory major subject studies in mathematics and studies in the secondary teaching subject (compulsory minor subject 60 ECTS), which can be e.g. physics, chemistry or information technology. The degree must also include pedagogic studies of 60 ECTS credits (KTK - Pedagogical Studies for Teachers). Part of the pedagogical studies and minor subject studies are already included to the Bachelor degree.

Compulsory minor studies

- Pedagogical studies 60 ECTS
- Second teacher's subject 60 ECTS (e.g. physics, chemistry, computer sciences)

Other studies

Master's degree (Major in Mathematics and Computer Sciences)

Tutkintorakenteen tila: published

Lukuvuosi: 2014-15

Lukuvuoden alkamispäivämäärä: 01.08.2014

Compulsory advanced studies (vähintään 30 op)

Master's degree in mathematics contains advanced major studies 80 ECTS, which consists of master's thesis (30 ECTS) and other advanced studies (50 ECTS). The advanced courses can be selected from the list below (See "Optional advanced studies"). The student is encouraged to discuss of the topic of the master's thesis and course selections with the student advisor or supervisor.

Complement studies (if needed):

If needed, Bachelor’s degree is completed such that the following conditions hold:

1) Studies in statistics at least 10 ECTS (courses 806112P Basic methods of data analysis or 805310A Statistical interference I).

2) 60 ECTS minor subject in computer sciences.

800698S: Pro gradu thesis, 30 op

Optional advanced studies (vähintään 50 op)

Choose at least 50 ECTS of advanced studies. The student is encouraged to discuss of the topic of the master's thesis and course selections with the student advisor or supervisor. Special courses might not be in the course list. In this case, please contact department's administrative officer.

H325003: Mathematics, optional advanced studies, 0 - 120 op
- *Electives*
  - 802653S: Lebesgue Measure and Integration Theory, 5 op
  - 801698S: Cryptography, 5 op
  - 802655S: Continued Fractions, 5 op
  - 802644S: Introduction to Functional Analysis, 10 op
  - 802636S: Information Theory, 10 op
  - 802635S: Introduction to partial differential equations, 10 op
  - 802652S: Hilbert Spaces, 5 op
  - 800651S: Functional analysis, 10 op
  - 802629S: Function estimation, 10 op
  - 800674S: Fourier transform and distributions, 10 op
  - 802647S: Fourier series and the discrete Fourier transform, 10 op
  - 802656S: Algebraic numbers, 5 op
  - 802637S: Advanced Problem Solving, 2 - 6 op
  - 802645S: Number Theory A, 5 op
  - 802646S: Number Theory B, 5 op
  - 802631S: Modern real analysis, 10 op
  - 800688S: Theory of Optimization, 10 op
  - 800660S: Group Theory, 10 op
  - 802633S: Statistical Pattern Recognition, 10 op
  - 801643S: Topology, 10 op
  - 802651S: Abstract Measure Theory, 5 op
  - 802650S: Fractal Geometry, 10 op
  - 802660S: Operator theory and integral equations, 10 op
  - 802664S: Differential geometry, 10 op

H326603: Statistics optional advanced studies, 0 - 120 op
- *Electives*
  - 805609S: Statistical methods in epidemiology, 9 op
  - 805646S: Analysis of longitudial data, 5 op
  - 805679S: Time series analysis, 5 op
  - 805683S: The Statistical Foundation of Econometrics, 5 - 6 op
  - 805681S: Generalized Linear Models, 9 op
  - 805699S: Statistical methods in epidemiology, 8 op
  - 806618S: Computationally intensive statistical methods, 9 op
  - 806621S: Spatial Data Analysis, 10 op
  - 806628S: Statistical Finance, 5 op
  - 806629S: Introduction to Sampling Methods, 4 op
  - 806630S: Market Risk Analysis, 5 op
  - 805651S: Stochastic processes, 10 op
  - 806622S: Probability, 10 op
  - 805611S: Mathematical statistics II, 10 op

Minor studies

This line of expertise trains specialists in mathematical methods of information technology for both industry and research. The emphasis is on

a deep and broad grasp of mathematical methods, supported by applied courses towards the end of the studies as well as a sufficiently strong background in computer science. The graduates have found employment for example in telecommunications companies, software houses, polytechnic universities and research institutes. Suitable minor subjects include computer science (mandatory), statistics, communications engineering, economics and physics.

Other studies

Master's degree (Major in Mathematics)

Tutkintorakenteen tila: published

Lukuvuosi: 2014-15

Lukuvuoden alkamispäivämäärä: 01.08.2014

Compulsory advanced studies (vähintään 30 op)

Master's degree in mathematics contains advanced major studies 80 ECTS, which consists of master's thesis (30 ECTS) and other advanced studies (50 ECTS). The advanced courses can be selected from the list below (See "Optional advanced studies"). The student is encouraged to discuss the topic of the master's thesis with the student advisor or the supervisor. They will also help the student to choose suitable courses.

800698S: Pro gradu thesis, 30 op

Optional advanced studies (vähintään 50 op)

Choose at least 50 ECTS of advanced studies. Special courses might not be in the course list. In this case, please contact department's administrative officer.

H325003: Mathematics, optional advanced studies, 0 - 120 op

Electives

- 802653S: Lebesgue Measure and Integration Theory, 5 op
- 801698S: Cryptography, 5 op
- 802655S: Continued Fractions, 5 op
- 802644S: Introduction to Functional Analysis, 10 op
- 802636S: Information Theory, 10 op
- 802635S: Introduction to partial differential equations, 10 op
- 802652S: Hilbert Spaces, 5 op
- 800651S: Functional analysis, 10 op
- 802629S: Function estimation, 10 op
- 800674S: Fourier transform and distributions, 10 op
- 802647S: Fourier series and the discrete Fourier transform, 10 op
- 802656S: Algebraic numbers, 5 op
- 802637S: Advanced Problem Solving, 2 - 6 op
- 802645S: Number Theory A, 5 op
- 802646S: Number Theory B, 5 op
- 802631S: Modern real analysis, 10 op
- 800688S: Theory of Optimization, 10 op
- 800660S: Group Theory, 10 op
- 802633S: Statistical Pattern Recognition, 10 op
- 801643S: Topology, 10 op
- 802651S: Abstract Measure Theory, 5 op
- 802650S: Fractal Geometry, 10 op
- 802660S: Operator theory and integral equations, 10 op
- 802664S: Differential geometry, 10 op

H326603: Statistics optional advanced studies, 0 - 120 op
Electives
805609S: Statistical methods in epidemiology, 9 op
805646S: Analysis of longitudial data, 5 op
805679S: Time series analysis, 5 op
805683S: The Statistical Foundation of Econometrics, 5 - 6 op
805681S: Generalized Linear Models, 9 op
805699S: Statistical methods in epidemiology, 8 op
806618S: Computationally intensive statistical methods, 9 op
806621S: Spatial Data Analysis, 10 op
806628S: Statistical Finance, 5 op
806629S: Introduction to Sampling Methods, 4 op
806630S: Market Risk Analysis, 5 op
805651S: Stochastic processes, 10 op
806622S: Probability, 10 op
805611S: Mathematical statistics II, 10 op

Minor studies

This study line is intented, in particular, for students interested in a research career in mathematics. By selecting suitable minor subjects, student is able to work in a wide spectrum of research institutes. Suitable minor subjects are, for instance, computer sciences, statistics, economics and physics.

Other studies

Master's degree (Major in Statistics)

Tutkintorakenteen tila: published

Lukuvuosi: 2014-15

Lukuvuoden alkamispäivämäärä: 01.08.2014

Compulsory advanced studies (vähintään 63 op)

Master's degree in mathematics contains advanced major studies 80 ECTS, which consists of master's thesis (30 ECTS), mandatory advanced studies (63 or 65 ECTS, depending on the scope of Practical training) and optional advanced studies (17 or 15 ECTS, depending on the scope of practical training). The advanced course can be selected from the following list (See "Optional advanced studies"). The student is encouraged to discuss of the topic of the master's thesis and together with course selections with the student advisor or your supervisor.

Complement studies

If Bachelor's degree does not include one of the following courses, student must complete the following courses as a supplement studies.

- Statistical software (805340A, 4 ECTS)
- Basic Methods of Data Analysis (806112P, 10 ECTS)
- Statistical Inference I (805310A, 10 ECTS)
- Regression modelling (806359A, 10 ECTS)

805611S: Mathematical statistics II, 10 op
805644S: Maturity test, 0 op
806624S: Practical training/consulting, 5 - 7 op
805620S: Pro Gradu seminar, 8 op
805642S: Pro gradu thesis, 30 op
806631S: Random variables and distributions, 10 op

Optional advanced studies (vähintään 15 op)

Choose at least 17 ECTS of advanced studies (or 15 ECTS cr if the scope of Practical training is 7 ECTS cr). Special courses might not be in the course list. If the course in question is not in the list, please contact departments administrative officer.

H325003: Mathematics, optional advanced studies, 0 - 120 op
- *Electives*
  - 802653S: Lebesgue Measure and Integration Theory, 5 op
  - 801698S: Cryptography, 5 op
  - 802655S: Continued Fractions, 5 op
  - 802644S: Introduction to Functional Analysis, 10 op
  - 802636S: Information Theory, 10 op
  - 802635S: Introduction to partial differential equations, 10 op
  - 802652S: Hilbert Spaces, 5 op
  - 800651S: Functional analysis, 10 op
  - 802629S: Function estimation, 10 op
  - 800674S: Fourier transform and distributions, 10 op
  - 802647S: Fourier series and the discrete Fourier transform, 10 op
  - 802656S: Algebraic numbers, 5 op
  - 802637S: Advanced Problem Solving, 2 - 6 op
  - 802645S: Number Theory A, 5 op
  - 802646S: Number Theory B, 5 op
  - 802631S: Modern real analysis, 10 op
  - 800688S: Theory of Optimization, 10 op
  - 800660S: Group Theory, 10 op
  - 802633S: Statistical Pattern Recognition, 10 op
  - 801643S: Topology, 10 op
  - 802651S: Abstract Measure Theory, 5 op
  - 802650S: Fractal Geometry, 10 op
  - 802660S: Operator theory and integral equations, 10 op
  - 802664S: Differential geometry, 10 op

H326603: Statistics optional advanced studies, 0 - 120 op
- *Electives*
  - 805609S: Statistical methods in epidemiology, 9 op
  - 805646S: Analysis of longitudial data, 5 op
  - 805679S: Time series analysis, 5 op
  - 805683S: The Statistical Foundation of Econometrics, 5 - 6 op
  - 805681S: Generalized Linear Models, 9 op
  - 805699S: Statistical methods in epidemiology, 8 op
  - 806618S: Computationally intensive statistical methods, 9 op
  - 806621S: Spatial Data Analysis, 10 op
  - 806628S: Statistical Finance, 5 op
  - 806629S: Introduction to Sampling Methods, 4 op
  - 806630S: Market Risk Analysis, 5 op
  - 805651S: Stochastic processes, 10 op
  - 806622S: Probability, 10 op
  - 805611S: Mathematical statistics II, 10 op

Minor studies

In this line of expertise, the spread of applications is very wide. Suitable minor subjects in this line are, for instance, mathematics, computer sciences or economics. Discuss about your choices with the head of this line or with student counsellor.

Other studies

Master's degree (Major in Applied Mathematics)

Tutkintorakenteen tila: published

Lukuvuosi: 2014-15

Lukuvuoden alkamispäivämäärä: 01.08.2014

Compulsory advanced studies (vähintään 30 op)

Master's degree in mathematics contains advanced major studies 80 ECTS, which consists of master's thesis (30 ECTS) and other advanced studies (50 ECTS). The advanced course can be selected from the following list (See "Optional advanced studies"). The student is encouraged to discuss the topic of the master's thesis and course selections with the student advisor or supervisor.

Complement studies

If Bachelor's degree does not include one of the following courses, student must complete the following courses (one of the courses) as a supplement studies.

- Basic Course on Numerical Computation (801344A, 8 ECTS)
- Introduction to Mathematical Software (802364A, 6 ECTS)

800698S: Pro gradu thesis, 30 op

Optional advanced studies (vähintään 50 op)

Choose at least 50 ECTS of advanced studies. Special courses might not be in the course list. In this case, please contact department's administrative officer. The student is encouraged to discuss the topic of the master's thesis and the course selections with the student advisor or supervisor.

H325003: Mathematics, optional advanced studies, 0 - 120 op
Electives
802653S: Lebesgue Measure and Integration Theory, 5 op
801698S: Cryptography, 5 op
802655S: Continued Fractions, 5 op
802644S: Introduction to Functional Analysis, 10 op
802636S: Information Theory, 10 op
802635S: Introduction to partial differential equations, 10 op
802652S: Hilbert Spaces, 5 op
800651S: Functional analysis, 10 op
802629S: Function estimation, 10 op
800674S: Fourier transform and distributions, 10 op
802647S: Fourier series and the discrete Fourier transform, 10 op
802656S: Algebraic numbers, 5 op
802637S: Advanced Problem Solving, 2 - 6 op
802645S: Number Theory A, 5 op
802646S: Number Theory B, 5 op
802631S: Modern real analysis, 10 op
800688S: Theory of Optimization, 10 op
800660S: Group Theory, 10 op
802633S: Statistical Pattern Recognition, 10 op
801643S: Topology, 10 op
802651S: Abstract Measure Theory, 5 op
802650S: Fractal Geometry, 10 op
802660S: Operator theory and integral equations, 10 op
802664S: Differential geometry, 10 op
H326603: Statistics optional advanced studies, 0 - 120 op
Electives
805609S: Statistical methods in epidemiology, 9 op
805646S: Analysis of longitudial data, 5 op
805679S: Time series analysis, 5 op
805683S: The Statistical Foundation of Econometrics, 5 - 6 op
805681S: Generalized Linear Models, 9 op

805699S: Statistical methods in epidemiology, 8 op
806618S: Computationally intensive statistical methods, 9 op
806621S: Spatial Data Analysis, 10 op
806628S: Statistical Finance, 5 op
806629S: Introduction to Sampling Methods, 4 op
806630S: Market Risk Analysis, 5 op
805651S: Stochastic processes, 10 op
806622S: Probability, 10 op
805611S: Mathematical statistics II, 10 op

Minor studies

This line of expertise trains the student in the use mathematical modeling to solve problems that arise in the natural sciences, various fields of technology and economics. The graduates have found employment as industrial mathematicians, teachers and researchers. Suitable minor subjects include physics, computer science, statistics, information technology and economics.

Other studies

Tutkintorakenteisiin kuulumattomat opintokokonaisuudet ja -jaksot

806623S: An introduction to stochastic modelling, 8 op
806627S: Linear mixed models in the analysis of panel data, 6 op
802356A: Metric Topology, 5 op
806625S: Multivariate analysis, 6 op
806617S: Nonparametric and robust methods, 8 op
806604S: Principles of bayesian inference, 10 op
806603S: Robust methods, 6 op

Opintojaksojen kuvaukset

Tutkintorakenteisiin kuuluvien opintokohteiden kuvaukset

902002Y: English 1 (Reading for Academic Purposes), 2 op

Voimassaolo: 01.08.1995 -
Opiskelumuoto: Language and Communication Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

Proficiency level:
B2/C1 on the Common European Framework of Reference scale.
Status:

In the Faculty of Science, this course is mandatory for all degree programmes except Geography. Please consult the Faculty Study Guide to establish the language requirements for your own degree programme.

Required proficiency level:
English must have been the A1 or A2 language at school or equivalent English skills should have been acquired otherwise.

ECTS Credits:
2 ECTS credits (total work load 54 hours including classroom meetings.)

Language of instruction:
English

Timing:
Biology: 1st year spring term
Chemistry: 1st year autumn term
Geology: 1st year spring term
Information Processing Science: 1st year spring term
Mathematical Sciences: 1st year spring term
Physical Sciences: 1st year autumn term

Learning outcomes:
By the end of the course, you are expected

- to have acquired effective vocabulary learning techniques by being able to distinguish parts of words to infer meanings
- to understand and be able to construct basic grammatical structures used in formal written English
- to be able to utilize text structure and cohesion markers when reading academic texts
- to be able to apply effective reading techniques and have necessary skills to extract global and detailed information with considerable ease and speed from general texts related to Natural Sciences as well as texts /textbooks of their own field

Contents:
In this course, students improve their understanding of written academic English used in texts in Natural Sciences as well as expand their general and scientific vocabulary. Students become aware of their own role in learning and use a variety of different study methods in order to develop their own language learning strategies, which will enhance their academic English.

Mode of delivery:
Contact teaching

Learning activities and teaching methods:
Contact teaching (26 hours) and self-study 28 hours

Target group:
1 st year students of Biology, Chemistry, Geology, Information Processing Science, Physics, and Mathematics

Prerequisites and co-requisites:
-

Recommended optional programme components:
In addition to this course, students are required to take 902004Y Scientific Communication.

Recommended or required reading:
Set books for substance studies; journal articles in print and on-line.

Assessment methods and criteria:
Continuous assessment takes into account active and regular participation in classroom sessions and successful completion of all homework tasks, vocabulary quizzes, and an end of course exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:
Pass/Fail

Person responsible:
Biology, Geology, Information Processing: Karen Niskanen
Chemistry, Physics, Mathematics: Patrick Nesbitt

Working life cooperation:
-

Other information:
N.B. Students with grades *laudatur* or *eximia* in their A1 English school-leaving examination can be exempted from this course and will be granted the credits by the Faculty of Science.
Retake examinations: Two retake examinations are allowed on the dates set by the Extension School. See the dates and registration instructions at: http://www.oulu.fi/kielikoulutus

902004Y: English 2 (Scientific Communication), 2 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Leikkaavuudet:

ay902004Y English 2 (Scientific Communication) (OPEN UNI) 2.0 op

Proficiency level:
B2/C1 on the CEFR scales
Status:
This course is mandatory for all 2nd year students (except **geographers**) who will have English as their foreign language in their B.Sc. degree. This includes the students who were exempted from ‘Reading for Academic Purposes'(902002Y). Please consult the faculty study guide to establish the language requirements on your own degree programme.
Required proficiency level:
Students taking this course must have had English as the A1 or A2 language at school or the equivalent English skills should have been acquired otherwise. The course 'Reading for Academic Purposes' (902002Y) is a pre-requisite, unless exempted.
ECTS Credits:
The student workload is 53 hrs work/ 2 ECTS credits.
Language of instruction:
English
Timing:
Biology: 2nd year autumn term
Chemistry: 2nd year spring term
Geology: 2nd year spring term
Information Processing Science : 2nd year autumn term
Mathematics: 2nd year spring term
Physics: 2nd year autumn term
Learning outcomes:
By the end of the course, you are expected:

1. to have provided evidence of oral fluency in pair work communication and small group discussions.
2. to have developed effective language learning strategies through autonomous homework.
3. to have demonstrated the ability to prepare and present scientific subjects, using appropriate field-related vocabulary.
4. to have demonstrated lecture listening skills in field-related situations.

Contents:
Skills in listening, speaking, and giving presentations are practised in the course. Homework tasks include autonomous work to support the classroom learning and the task of preparing and presenting a scientific presentation.
Mode of delivery:
Contact teaching
Learning activities and teaching methods:
Contact teaching 28 hours, homework 28 hours
Target group:
2nd year students of Biology, Chemistry, Geology, Information Processing Science, Mathematics, Physics
Prerequisites and co-requisites:
-
Recommended optional programme components:
Also required: 902002Y Reading for Academic Purposes Englannin kieli 1
Recommended or required reading:
Course materials will be provided by the teacher.
Assessment methods and criteria:
Continuous assessment is based on regular attendance, active participation in all lessons and the successful completion of all homework tasks.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass / fail.
Person responsible:
Jolene Gear
Working life cooperation:
-
Other information:

Alternative method of course completion: An optional exemption test is offered twice per year. The student can only participate in the exemption exam once. See exemption exam details and schedule.

800008Y: Orientation for New Students, 2 op

Opiskelumuoto: General Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
2 ECTS
Language of instruction:
Finnish
Timing:
First year (autumn term)
Learning outcomes:
After the course, student is familiar with objectives and curriculum of the degree program. Moreover, the student is familiarized with the correct study methods and learning environment. After the course, the student is also able to search information from, for instance, university library and databases. After the course, student has planned future studies (study plan).
Contents:
The aim of the course is to familiarise the student with university studies, learning environment, provide the student with information on the history and current weight of mathematical sciences in the society as well as the objectives and curriculum of the degree programme. During the course, student makes the study plan.
Mode of delivery:
Face-to-face teaching (tutoring group)
Learning activities and teaching methods:
Group working
Target group:
Major students
Prerequisites and co-requisites:
-
Recommended optional programme components:
-
Recommended or required reading:
-
Assessment methods and criteria:
Taking part to the group meetings and making the Personal Study Plan.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass/Fail
Person responsible:
Student advisor
Working life cooperation:
-

901004Y: Swedish, 2 - 3 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Opintokohteen kielet: Swedish

Leikkaavuudet:

901035Y	Second Official Language (Swedish), Oral Skills	1.0 op
901034Y	Second Official Language (Swedish), Written Skills	1.0 op
ay901004Y	Swedish (OPEN UNI)	2.0 op

Proficiency level:

B1/B2/C1 (CEFR scale)

Status:

This course is compulsory to all students except those who have at least 60 ECTS credits of Swedish studies in their degrees. The language proficiency provided by the course unit is equivalent to the language proficiency required of a state official with an academic degree working in a bilingual municipality area (Act 424/03 and Decree 481/03).

Required proficiency level:

The required starting proficiency level for students of all faculties is a grade of 7 or higher from the Swedish studies at secondary school (B-syllabus) or matriculation examination grade A - L or a passing grade from the Brush up course in Swedish 901018Y.

If a student doesn't meet these requirements or his/her language skills are otherwise lacking, he/she must achieve the required proficiency level BEFORE taking this compulsory Swedish course

ECTS Credits:

2 ECTS credits (Biochemistry 3 ECTS credits)

Language of instruction:

Swedish

Timing:

See the study guide of your own faculty

Learning outcomes:

Upon completion of the course the student should have acquired the necessary proficiency level in Swedish to be able to manage in the most common communication situations related to his/her professional work tasks. He/she should be able to use basic grammatical structures fairly well in both speech and writing. He/she should be able to use the most common situational phrases understandably in various communication situations. He/she should be able to find the main points in general academic texts and texts related to his/her field of study and relay this information to colleagues or an audience of laymen using Swedish. He/she should be able to write short texts relating to his/her field of study.

Contents:

Communicative oral and written exercises, which aim to develop the student's Swedish proficiency in areas relevant to his/her academic field and future professional tasks. The student practises oral presentation and pronunciation. Situational oral exercises done individually and in pairs and groups. Discussions in small groups. Current texts about the student's special field. Listening comprehension exercises. Written exercises relating to the student's professional field.

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

2 ECTS credits: 28 hours of contact teaching (1 x 180 minutes per week) and related exercises, self-directed study. The course unit's total workload is 53 hours.

Target group:

Students of the Faculty of Science, students of biochemistry and students of electrical engineering.

Prerequisites and co-requisites:

See Required Porficiency Level

Recommended optional programme components:

-

Recommended or required reading:

The material, which is special field-specific, authentic and up to date, is distributed during the course. Students must pay for their course material.

Assessment methods and criteria:

The course focuses on improving both oral and written language skills and requires active attendance and participation in exercises, which also require preparation time. 100% attendance is required. The course unit tests both oral and written language skills. Students participate in the teaching in either autumn semester or spring semester.

Read more about assessment criteria at the University of Oulu webpage.

Grading:

Assessment is based on continuous assessment and exams. Approved completion of the course unit requires that the student achieves at least satisfactory oral and written language skills. The grades are based on continuous assessment and the course exams. Oral and written language skills are graded separately. The possible grades are satisfactory skills (CERF proficiency level B1) and good skills (CERF proficiency levels B2-C1). For more information on the proficiency levels of oral and written language skills, see Assessment Criteria (in Finnish).

Person responsible:

Lecturer Rauno Varonen

Working life cooperation:

-

Other information:

Teaching will begin according to the schedule

802155P: Continuity and limit, 4 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Esa Järvenpää

Opintokohteen kielet: Finnish

Leikkaavuudet:

800119P	Analysis 1	5.0 op
802162P	Continuity and Limit	5.0 op
801111P	Basic Methods in Mathematics I / math	10.0 op
800147P	Basic Methods in Mathematics I / appl.	8.0 op

ECTS Credits:
4 cr
Language of instruction:
Finnish
Timing:
1. year, 1. period
Learning outcomes:
After completing the course, student is able to
- derive and proof main results of the course
- use different types of proof techniques
- define the limit of function and the continuity of function
- derive and proof the limit using different proof techniques
- deduce the continuity of functions using different proof techniques

Contents:
The main concept of the course are the limit of a real-valued function and the continuity of real-valued function. Interrelations between these concepts are also studied.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
28h lectures, 14h exercises
Target group:
Main and minor students
Prerequisites and co-requisites:
802151P Introduction to mathematical deduction
Recommended optional programme components:
-
Recommended or required reading:
-
Assessment methods and criteria:
Final exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Esa Järvenpää.
Working life cooperation:
-

802156P: Derivative, 4 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Maarit Järvenpää

Opintokohteen kielet: Finnish

Leikkaavuudet:

800317A	Analysis 2	5.0 op
802163P	Derivative	5.0 op
801111P	Basic Methods in Mathematics I / math	10.0 op

ECTS Credits:
4 cr
Language of instruction:
Finnish
Timing:
1. year, 2. period
Learning outcomes:
After completing the course, student is able to
- derive and proof main results of the course
- use different types of proof techniques
- use and apply the concept of derivative in different types of problems

Contents:
The course considers the concept of derivative of real-valued function and applies this concept to different types oif situations.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
28h lectures, 14 h exercises
Target group:
Major and minor students
Prerequisites and co-requisites:
802151P Introduction to mathematical deduction
802154P Elementary functions
802155P Limits and continuity

Recommended optional programme components:
-
Recommended or required reading:
-
Assessment methods and criteria:
Final exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Maarit Järvenpää
Working life cooperation:
-

802154P: Elementary functions, 3 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Maarit Järvenpää

Opintokohteen kielet: Finnish

Leikkaavuudet:

802161P	Introduction to Real Functions	5.0 op
801111P	Basic Methods in Mathematics I / math	10.0 op

800147P Basic Methods in Mathematics I / appl. 8.0 op

ECTS Credits:
3 cr
Language of instruction:
Finnish
Timing:
1. year, 1. period
Learning outcomes:
After completing the course, student is able to
- prove essential result in the course
- use and apply different types of proof techniques
- handle elementary functions

Contents:
Course introduces basic concepts and definitions related to real-valued functions. Definitions and proofs are essential part of the course.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
21h luentoja, 10 h harjoituksia
Target group:
Major and minor students
Prerequisites and co-requisites:
802151P Introduction to mathematical deduction
Recommended optional programme components:
-
Recommended or required reading:
-
Assessment methods and criteria:
Final exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Maarit Järvenpää
Working life cooperation:
-

801195P: Introduction to Probability Theory I, 5 op

Voimassaolo: 01.01.2011 -

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:

Tuominen, P., , 1993

Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS credits.
Language of instruction:
Finnish.
Timing:
Fall semester, 2nd period.
Learning outcomes:
Upon completing the 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. In the beginning high school level probability is reviewed and after that axiomatic treatment of the theory starts. The central concepts discussed include probability space, conditional probability, independence, and random variable together with its distribution and expected value.

Mode of delivery:
Face-to-face teaching

Learning activities and teaching methods:
35 h of lectures, 14 h of exercises.

Target group:
Mathematics, applied mathematics and statistics majors. Other students taking mandatory or optional mathematics courses.

Prerequisites and co-requisites:
802151P Introduction to mathematical deduction
802154P Elementary functions

Recommended optional programme components:
-

Recommended or required reading:
Lectures.
Text book: Pekka Tuominen, "Todennäköisyyslaskenta I", Limes ry, Helsinki.

Assessment methods and criteria:
Two exams covering the two halves of the course are arranged during the course. Another option is to take an exam that covers the whole course.
Read more about assessment criteria at the University of Oulu webpage.

Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:
Pekka Salmi.

Working life cooperation:
-

Other information:
Level: intermediate studies.

806113P: Introduction to Statistics, 5 op

Voimassaolo: 01.01.2011 -

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Hanna Heikkinen, Läärä Esa

Opintokohteen oppimateriaali:
Wild, Christopher J. , , 2000
Grönroos, Matti (2) , , 2003

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

Language of instruction:
Finnish

Timing:
3rd period. It is recommended to complete the course at the 1st spring semester.

Learning outcomes:
Upon completion of the course, student will be
- able to identify and define the main principles of statistical research, collection of the data and analysis
- able to apply basic methods of descriptive statistics and statistical inference in simple quantitative research using a statistical software

- able to critically evaluate results of the statistical research presented in media
- prepared for teaching statistics in secondary school and high school
- prepared for participating in a group.

Contents:
- the nature and the meaning of statistics
- data and the acquisition of them: observations, variables, measuring and designs of a study
- the descriptive statistics of empirical distributions: tables, graphical presentations and descriptive measures of center, variation and dependence
- the principles and the basic methods of statistical inference: random sample, sample statistics, point estimation, confidence intervals and statistical testing of hypotheses

Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 16 h (partly compulsory) / instructed group work (28 h) / independent work 80 h. Group works will be returned. Additional independently implemented learning diary tasks. Independent work contains also preparation for group work and peer assessment.
Target group:
Students of mathematical sciences and other interested students.
Prerequisites and co-requisites:
The recommended prerequisite prior to enrolling for the course is the completion of the courses: 802151P Introduction to mathematical deduction, 802154P Elementary functions, 802155P Continuity and limit ja 801195P Introduction to Probability Theory.

Recommended optional programme components:
After the course, student is able to continue other statistics courses.
Recommended or required reading:
Lecture notes.
Assessment methods and criteria:
This course utilizes continuous assessment. Practical works and learning diaries are assessed weekly. The assessment of the course is based on the learning outcomes of the course. The more detailed assessment criteria is available in the beginning of the course. In addition one compulsory lecture and peer assessment.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Hanna Heikkinen
Working life cooperation:
No

802151P: Introduction to mathematical deduction, 5 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay802151P	Introduction to mathematical deduction (OPEN UNI)	5.0 op

ECTS Credits:
5 ECTS
Language of instruction:
Finnish
Timing:
First period at the first semester.
Learning outcomes:
After completing the course, student
- is able to use different methods proving techniques
- is able to use basic set theoretic concepts and definitions
- is able to define and apply basic definitions related to functions

Contents:

The course in an introduction to mathematical deduction and introduces different types of proof techniques. The course covers the concepts familiar from upper secondary school studies more profound way. Main concepts in this course are basic set theory and functions.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 30h, exercises 18h
Target group:
Major and minor students
Prerequisites and co-requisites:
-
Recommended optional programme components:
-
Recommended or required reading:
Lecture notes
Assessment methods and criteria:
Final exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass/Fail
Person responsible:
Tero Vedenjuoksu
Working life cooperation:
-
Other information:
Course homepage: https://noppa.oulu.fi/noppa/kurssi/802151p/etusivu

802118P: Linear Algebra I, 4 op

Voimassaolo: 16.10.2012 -

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:

Lay, David C. , , 2003

Opintokohteen kielet: Finnish

Leikkaavuudet:

802120P	Introduction to Matrices	5.0 op

ECTS Credits:
4 cr
Language of instruction:
Finnish
Timing:
First semester, 2. period
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 R^n and matrix algebra.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
35 h lectures, 21 h exercises
Target group:
Major and minor students
Prerequisites and co-requisites:
802151P Introduction to mathematical deduction

Recommended optional programme components:
-
Recommended or required reading:
Lecture notes
Assessment methods and criteria:
Midterm exams or final exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Tero Vedenjuoksu
Working life cooperation:
-

802119P: Linear Algebra II, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:

Lay, David C. , , 2003

Opintokohteen kielet: Finnish

Leikkaavuudet:

802320A Linear Algebra 5.0 op

ECTS Credits:
5 ECTS credits
Language of instruction:
Finnish
Timing:
First year, 4. period
Learning outcomes:
On successful completion of this course, the student will be able to
- basic properties of inner product spaces
- linear mappings, their matrix representation, and eigen values
- determinants and 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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
35 h lectures, 21 h exercises
Target group:
Major and minor students
Prerequisites and co-requisites:
802119P Linear algebra I
Recommended optional programme components:
-
Recommended or required reading:
Lecture notes
Assessment methods and criteria:
Midterm exam or final exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Esa Järvenpää
Working life cooperation:
-

800300A: Maturity test, 0 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
0 cr
Language of instruction:
Finnish/Swedish
Timing:
Third year
Learning outcomes:
Maturity test
Contents:
Students must take a written maturity test to demonstrate their language skills and how well they know the topic of their thesis. The maturity test is taken in the language in which the student has received his or her education in Finland. If the student has received his or her education in a language other than Finnish or Swedish, the degree programme determines the language of the maturity test. In such cases only the contents of the maturity test is evaluated, not the language.
Mode of delivery:
Maturity test written in examination room.
Learning activities and teaching methods:
Maturity test
Target group:
Major students
Prerequisites and co-requisites:
Bachelor's degree (or similar)
Recommended optional programme components:
-
Recommended or required reading:
-
Assessment methods and criteria:
Maturity test
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass/Fail
Person responsible:
Supervisor of thesis
Working life cooperation:
-

800322A: Multidimensional analysis, 8 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Pekka Salmi

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

ECTS Credits:
8 cr
Language of instruction:
Finnish

Timing:
Second year, periods 1-2
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 course provides an introduction to vector-valued functions of one variable, their derivatives and path integrals. The central notion of the course is the derivative of vector-valued function of several variables (including the gradient of a real-valued function of several variables). In the course we develop the Riemann integral of a real-valued function of two variables. The course provides basic tools for advanced courses in analysis and for applications (such as physics).
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
56 h lectures, 28 h exercises, 129 h self-study.
Target group:
Major and minor students in mathematics.
Prerequisites and co-requisites:
Linear algebra I
Linear algebra II
Euclidean topology
Series and integrals

Recommended optional programme components:
-
Recommended or required reading:
- Baxandall, Liebeck: Vector calculus, Oxford University Press, 1986.
- lecture notes.
Assessment methods and criteria:
Midterm exams or final exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
0-5
Person responsible:
Pekka Salmi.
Working life cooperation:
No

802354A: Number Theory and Groups, 5 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Myllylä

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay802354A	Number Theory and Groups (OPEN UNI)	5.0 op
800333A	Algebra I	8.0 op

ECTS Credits:
5 ECTS credits
Language of instruction:
Finnish
Timing:
1. year, 3. period
Learning outcomes:

After completing the course, student is able to
- derive and proof main results in the course
- use and apply different proof techniques
- recognize algebraic structures and the concepts
- see connections and differences between different algebraic structures

Contents:
The course includes basics in arithmetics and algebraic structures, such as, congruence, residue classes, prime numbres, Euclidean algorithm, the fundamental theorem of arithmetic, Euler-Fermat formula, groups and morphisms. The course gives an understanding of algebraic terms and concepts used in mathematics and physics.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
28h lectures, 14h exercises
Target group:
Major and minor students
Prerequisites and co-requisites:
802151P Introduction to mathematical deduction
Recommended optional programme components:
-
Recommended or required reading:
Lecture notes
Assessment methods and criteria:
Midterm exam or final exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Kari Myllylä
Working life cooperation:
-

802355A: Rings, Fields and Polynomials, 5 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Myllylä

Opintokohteen kielet: Finnish

Leikkaavuudet:

800333A	Algebra I	8.0 op

ECTS Credits:
5 ECTS credits
Language of instruction:
Finnish
Timing:
Second year, 1. period
Learning outcomes:
After completing the course, student is able to
- derive and proof main results in the course
- use and apply different proof techniques
- recognize algebraic structures and the concepts
- see connections and differences between different algebraic structures

Contents:
The course introduces algebraic structures, such as rings, polynomial rings, ideals, integral domains, fields, finite fields, field extensions and quotient field. The course gives an understanding of algebraic terms and concepts used in mathematics and physics.
Mode of delivery:
Face-to-face teaching

Learning activities and teaching methods:
28h lectures, 14h exercises
Target group:
Major students
Prerequisites and co-requisites:
802354A Number theory and groups
Recommended optional programme components:
-
Recommended or required reading:
Lecture notes
Assessment methods and criteria:
Midterm exam or final exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Kari Myllylä
Working life cooperation:
-

801323A: Seminar, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

800331A	Proseminar	10.0 op

ECTS Credits:
6 cr
Language of instruction:
Finnish (also English)
Timing:
2.-3. year of studies
Learning outcomes:
After completing the Bachelor's thesis, student
- is able to form a clear and logical
- is able to concentrate to important and essential details in the subject of thesis
- gain experience presenting mathematical concept and research studies.

Contents:
Proseminar (Bachelor's thesis) is a small mathematical study based on literature. Student is familiarized to write mathematical texts and obtain information using literature. Thesis includes a oral presentation from the subject of the thesis.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Seminars and own work
Target group:
Major students
Prerequisites and co-requisites:
Compulsory basic and intermediate studies.
Recommended optional programme components:
Maturity test is written from the topic of Bachelor's thesis.
Recommended or required reading:
-
Assessment methods and criteria:
Opinnäytetyö
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass/Fail

Person responsible:
Maarit Järvenpää
Working life cooperation:
-

802353A: Series and Integrals, 6 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Peter Hästö

Opintokohteen kielet: Finnish

Leikkaavuudet:

800318A	Analysis 3	5.0 op
802164P	Series and Integral	5.0 op

ECTS Credits:
6 ECTS credits
Language of instruction:
Finnish (possible also in English)
Timing:
First year, 4. period
Learning outcomes:
After completing the course, student is able to

- operate with real series
- separate the concept of continuity and uniform continuity
- define and calculate Riemann integrals
- derive and operate function sequences and function series
- calculate derivate and integrate function series

Contents:
The course is a continuum for the courses Limits and continuity and Derivative. Basic topological methods (presented in Euclidean Topology) are heavily used in proofs and methods involving continuous functions. The goal is the same as in the prerequisite courses, that is, to develop mathematical thinking and extend the knowledge of mathematical analysis.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
30h exercises, 14h exercises
Target group:
Major and minor students
Prerequisites and co-requisites:
802154P Elementary functions
802155P Limit and continuity
802156P Derivative
802352A Euclidean topology

Recommended optional programme components:
-
Recommended or required reading:
Lecture notes
Assessment methods and criteria:
Midterm exams or final exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Peter Hästö
Working life cooperation:

-

H325035: Optional intermediate studies in mathematics, 0 - 180 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Intermediate Studies
Laji: Study module
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Electives

800329A: Topology, 8 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Mahmoud Filali
Opintokohteen oppimateriaali:
Vala K., Suominen K., , 1990
Opintokohteen kielet: Finnish

ECTS Credits:

8 cr

Language of instruction:

English (also Finnish)

Timing:

Second year or later. Fall/spring term

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.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

56 hours lecture, 28 h exercises

Target group:

Major and minor students

Prerequisites and co-requisites:

Compulsory basic and intermediate studies in mathematics.

Recommended optional programme components:

-

Recommended or required reading:

S. Willard: General Topology;
K. Suominen & K. Vala: Topologia;
R. Engelking: Outline of General Topology.

Assessment methods and criteria:

Final exam, or mid-term exams
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Mahmoud Filali

Working life cooperation:

-

800343A: Permutations, Fields and Galois' Theory, 8 op

Opiskelumuoto: Intermediate Studies
Laji: Course
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

Language of instruction:

Finnish

Timing:

2. year or later. Periods 3-4 (Spring term)

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.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

56 h lectures, 28 h exercises

Target group:

Major- and minor students

Prerequisites and co-requisites:

Compulsory basic and intermediate studies in mathematics.

Recommended optional programme components:

-

Recommended or required reading:

I. N. Herstein: Abstract Algebra, Prentice Hall, Inc., 1996.

Assessment methods and criteria:

Final exam, mid-term exams
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Markku Niemenmaa

Working life cooperation:

-

800345A: Differential Equations I, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

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

Language of instruction:

Finnish

Timing:

2. year or later, 3. period

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.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

30 h lectures, 16 h exercises

Target group:

Major- and minor students

Prerequisites and co-requisites:

Compulsory basic and intermediate studies in mathematics.

Recommended optional programme components:

-

Recommended or required reading:

Boyce and Di Prima: Elementary Differential Equations and Boundary Value Problems, Wiley, Anton: Calculus, Wiley. R. Kent Nagle & E. B. Saff: Fundamentals of Differential Equations and Boundary Value Problems, Addison-Wesley, 1996 C. Henry & David E. Penney: : Differential Equations and Boundary Value Problems, Prenticw Hall, 2000 Dennis G. Zill & Michael R. Cullen: Differen-tial Equations with Boundary Value Prob-lems, Brooks/Cole, 2001.

Assessment methods and criteria:

Final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Martti Kumpulainen

Working life cooperation:

-

800346A: Differential Equations II, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

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

Language of instruction:

Finnish

Timing:

2. year or later, 4. period

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 eqautions. 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.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

30 h lectures, 16 h exercises.

Target group:

Major and minor students

Prerequisites and co-requisites:

Compulsory basic and intermediate studies in mathematics

Recommended optional programme components:

-

Recommended or required reading:

R. Kent Nagle & E. B. Saff, Fundamentals of Differential Equations and Boundary Value Problems, Addison-Wesley, 1996; Dennis G. Zill & Michael R. Cullen: Differential Equations with Boundary Value Problems, Brooks/Cole, 2001, Strauss: Partial Diffferential Equations. An Introduction, Wiley 1992 . Enrique A. Gonzales-Velasco, E. Gonzales-Velasco: Fourier Anaysis and Boundary Value Problems, Academic Press, 1995 Gerald B. Folland: Fourier Analysis and Its Applications, Brooks / Cole, 1996.

Assessment methods and criteria:

Final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Martti Kumpulainen

Working life cooperation:

-

801344A: Basic Course on Numerical Computation, 8 op

Voimassaolo: 01.03.2011 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Erkki Laitinen
Opintokohteen oppimateriaali:
Haataja Juha, Rahola J., Ruokolainen J., , 1998
Opintokohteen kielet: Finnish

ECTS Credits:

8 cr

Language of instruction:

Finnish

Timing:

Spring.

Learning outcomes:

On successful completion of this course, the student will be able to
- solve basic numerical problems using Fortran programmin
- exploit the Unix computers and software libraries for solving numerical problems.

Contents:

On the course students train programming of numerical algorithms using Fortran programming language in Unix (Linux) operating system. On the course, DISLIN subroutine library is used for the visualization of the numerical calculation results. The course contains following topics: Fortran95 programming language, Unix operating system, DISLIN graphical subroutine library.

Mode of delivery:

Face-to-face teaching / distance teaching.

Learning activities and teaching methods:

Lectures, Group working and practical work (Self-study) (40 h + 10 h + 20 h).

Target group:

Major and minor students

Recommended optional programme components:

-

Recommended or required reading:

Unix User guide, Fortran 2003 manual, Dislin manual, lecture notes.

Assessment methods and criteria:

This course utilizes continuous assessment and final work.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Passed / not passed.

Person responsible:

Erkki Laitinen

Working life cooperation:

-

801387A: Basic Course on Numerical Analysis, 6 op

Voimassaolo: 01.03.2011 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Erkki Laitinen
Opintokohteen oppimateriaali:
Atkinson, Kendall, , 1993
Opintokohteen kielet: Finnish

ECTS Credits:

6 cr

Language of instruction:

Finnish.

Timing:

Autumn semester.

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 and corresponding computer algorithms for solving the most common basic problems in applied mathematics. For the methods, convergence, stability and suitability for computer arithmetic are considered. The course contains iterative and direct solution methods for the following basic problems: systems of nonlinear equations, systems of linear equations, interpolation, integration, derivation and differential equations.

Mode of delivery:

As face-to-face teaching.

Learning activities and teaching methods:

Lectures 56h / Group work 24 h.

Target group:

All students.

Prerequisites and co-requisites:

No recommended prior courses.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Ward Cheney, David Kincaid: "Numerical Mathematics and Computing"
Lecture notes (in finnish).

Assessment methods and criteria:

Two intermediate exams.
Final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5.

Person responsible:

Erkki Laitinen

802362A: Introduction to computational inverse problems, 5 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Mikko Orispää
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

801386A: Complex Analysis II, 4 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Valeriy Serov
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 fundamendal 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 presentaion of analtic functions by using power series will be studied. After Laurent repsentation of complex functions theory of residues will be considered and as applicatio this theory wiil be used to calculate certain type of definite integrals.

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Valeriy Serov

801390A: History of Mathematics, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

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.

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

801389A: Basic Geometry, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

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 aries and volumes are presented.

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Martti Kumpulainen

802328A: Basics in Number Theory, 5 op

Voimassaolo: 01.06.2011 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapani Matala-aho

Opintokohteen oppimateriaali:
Hardy, G. H., , 1979
Rosen, Kenneth H., , 1993

Opintokohteen kielet: Finnish

ECTS Credits:

5 cr

Language of instruction:

Finnish/English

Timing:

2.-3. year of studies. Timing varies.

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 studing 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.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

36h lectures, 18h exercises

Target group:

Major and minor students

Prerequisites and co-requisites:

802354A Lukuteoria ja ryhmät,
802355A Rings, fields and polynomials
802118P Linear algebra I
802119P Linear algebra II
802352A Euclidean topology
802353A Series and integrals

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes,
G.H. Hardy ja E.M. Wright: An Introduction to the Theory of Numbers;
Kenneth H. Rosen: Elementary number theory and its applications.

Assessment methods and criteria:

Mid-term exams or final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Tapani Matala-aho

Working life cooperation:

-

802331A: Principles to Mathematical Modelling, 8 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

802360A: Introduction to inverse problems, 4 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Sari Lasanen
Opintokohteen kielet: Finnish

ECTS Credits:

4 cr

Language of instruction:

Finnish. Alternatively, a book examination in English.

Learning outcomes:

Upon completion, the student will be able to

- recognise several inverse problems
- describe typical properties of inverse problems
- solve simple inverse problems with accurate and inaccurate data

Contents:

1. Examples of inverse problems and their typical properties
2. Well-posed and ill-posed problems
3. Least squares solutions
4. Tikhonov regularization
5. Statistical inverse problems

Learning activities and teaching methods:

Lectures 4x45 min / week. Exercises 2x45 min /week.

Target group:

Suitable for major and minor students.

Prerequisites and co-requisites:

- 802118P Linear Algebra I
- 802119P Linear Algebra II

Also recommended:

- 800322A Multidimensional Analysis (or Analysis II)
- 801396A Introduction to Probability Theory II
- 802352A Euclidian Topology
- 800345A Differential Equations I

Assessment methods and criteria:

Exam.
Read more about assessment criteria at the University of Oulu webpage.

Other information:

This course does not contain numerical programming tasks. Computer-aided computations are contained in a separate course
802362A Introduction to Computational Inverse Problems.

801385A: Complex Analysis I, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Valeriy Serov

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 algebrai and toplogical 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 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 complex plane will be considered. For the complex functions the concepts of limit, continuity and derivate will be studied. Some basic properties of analytic functions will be considered and Cauchy-Riemann formulas will be proved. Finally basic theory of pathintegral of complex functions will be studied.

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Valeriy Serov

801396A: Introduction to Probability Theory II, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:
Tuominen, P., , 1993
Opintokohteen kielet: Finnish

ECTS Credits:

4 cr

Language of instruction:

Finnish

Timing:

2. year, Fall semester

Learning outcomes:

On successful completion of this course, the student will be able to
- understand probability theory deeper than before
- apply various stocastic 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 distibutions.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

24h lectures, 12h exercises

Target group:

Major- and minor students. Recommended for students aiming to Master's degree with major in statistics or major in mathematics and computer sciences.

Prerequisites and co-requisites:

801195P Introduction to propability I
802352A Euclidean topology
802353A Series and integrals

Assessment methods and criteria:

Final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Kenneth Nordström.

802363A: Metric Spaces, 6 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Mahmoud Filali
Opintokohteen kielet: Finnish

ECTS Credits:

5 cr

Language of instruction:

English (also in Finnish)

Timing:

2.-3. year studies. Timing varies.

Learning outcomes:

After completing the course, student is able to participate fully for more advanced courses in topology and analysis.

Contents:

Course includes basic definitions and results in metric spaces. Keywords are: interior, closure, convergence in metric spaces, continuity in metric spaces, Baire's theorem, compactness, contraction, implicit function theorem. Course takes known and classical results in real analysis and generalizes them to metric spaces.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

28h lectures, 14h exercises

Target group:

Major studies

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Mahmoud Filali

Working life cooperation:

-

801346A: Introduction to Cryptography, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapani Matala-aho

Opintokohteen kielet: Finnish

Leikkaavuudet:

802336A	Introduction to Cryptography	5.0 op

ECTS Credits:

4 cr

Language of instruction:

Finnish

Timing:

2. year or later, Fall term (1. or 2. period)

Learning outcomes:

After completeing the course, student
- knows the principles of sime traditianl 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 traditianl symmetric key methods (affine system, matrix cryptography) and three public key methods, namely RSA, discrete logarithm and knapsack.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

27 h lectures, 15 h exercises

Target group:

Major and minor students

Prerequisites and co-requisites:

Compulsory basic and intermediate studies in mathematics.

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Tapani Matala-aho

802364A: Introduction to Mathematical Software, 6 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Markus Harju

Opintokohteen kielet: Finnish

ECTS Credits:

6 cr

Language of instruction:

Lecturing language is Finnish, but the main points can be explained also in English if necessary. The software and the majority of course material is also in English.

Timing:

Autumn semester, period one.

Learning outcomes:

Upon completion of the course, the student
- knows the basics of the use of the most common mathematical software
- is able to use mathematical software in solving mathematical tasks and problems
- is able to independently deepen her knowledge of different mathematical software as necessary.

Contents:

During the course, the student learns the basics of some of commonly used mathematical software which include
- R
- Matlab
- Mathematica

Time permitting, it is also possible to learn other mathematical software depending the interests of the students.

Mode of delivery:

The course is arranged in a computer class as a series of lectures and rehearsals. On the lectures, the students have the possibility to use and try the mathematical software during the lectures. In the rehearsals, different given problems and tasks are solved together.

Learning activities and teaching methods:

Lecures 22h / Rehearsals 22h / Self-study 60h. The self-study contains the independent learning of the software and also the preparation of the final assignments.

Target group:

Anybody interested in mathematical software.

Prerequisites and co-requisites:

The required prerequisite is the completion of following courses (or corresponding knowledge of the subject):
- 802118P Linear Algebra I
- 802119P Linear Algebra II.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

The required and recommended reading consists mainly on free material (manuals/tutorial) found in the internet. More information will be given at the beginning of the course.

Assessment methods and criteria:

The course is assessed by final assignments. The student who wish to complete the course at A-level will make two separate assignments of given topics using (at least) two different mathematical software. Those who wish to complete the course in S-level will need to discuss with the lecturer about the extra work needed to pass. For example, it could be possible to do assignments of wider topics, making an assignment (s) with a software not covered in the course, or making an assignment that requires particular skills and knowledge.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course utilizes verbal grading scale “Pass/ fail”.

Person responsible:

Mikko Orispää

Working life cooperation:

-

802322A: Basics in mathematical modelling, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Erkki Laitinen
Opintokohteen kielet: Finnish

800149P: Introduction to LateX, 2 op

Opiskelumuoto: Basic Studies
Laji: Course
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

Language of instruction:

Finnish (in english if needed)

Timing:

2-3 year of studies, before making the Bachelor's thesis

Learning outcomes:

After completing the course, student

- is able to describe the principles of LaTeX document preparation system
- can form basic template of LaTeX document and modify it to his/her needs
- knows basic commands when writing mathematical text
- is able to use different environments (e.g. enumertions, equations)
- can recognize and fix errors in LaTeX code
- is able to write Bachelor's and Master's thesis using LaTeX

Contents:

Bachelor's and Master's thesis are written using LaTeX document preparation system. This course introduces basics in LaTeX by giving basic knowledge of the principles of LaTeX.

Mode of delivery:

Lectures/exercises (computer class)

Learning activities and teaching methods:

Face-to-face teaching

Target group:

Major students

Prerequisites and co-requisites:

first year math studies

Recommended optional programme components:

Must be completed before Bachelor's thesis.

Recommended or required reading:

Lecture notes
Tobias Oetiker Hubert Partl, Irene Hyna and Elisabeth Schlegl, *The Not So Short Introduction to LATEX2#* (http://tobi.oetiker.ch/lshort/lshort.pdf)
Kopka, H. and Daly, P. W., *Guide to LaTeX (4th Edition)*,Addison-Wesley Professional, 2003

Assessment methods and criteria:

Participation in lectures/exercises and home work.

Grading:

Pass/Fail

Person responsible:

Markus Harju

Working life cooperation:

-

802157P: Mathematics in teaching, 2 op

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Basic Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

800146P	Introduction to teaching	5.0 op

ECTS Credits:

2 cr

Language of instruction:

Finnish

Timing:

1st year, periods 3 and 4

Learning outcomes:

The student can reflect critically on the learning of mathematics.

Contents:

Learning and teaching mathematics are thought about and discussed.
The course consists of reflective exercises and seminar meetings where the exercises are discussed.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

16 h seminar meetings, 37 h self-study and group work.

Target group:

Mathematics teacher students

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

Active participation, learning journal

Grading:

pass/fail

Person responsible:

Pekka Salmi

H326635: Optional intermediate studies in statistics, 0 - 180 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Intermediate Studies
Laji: Study module
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Electives

805324A: Time series analysis, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
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:

5 cr

Language of instruction:

Finnish

Learning outcomes:

After finishing the course, a student can apply linear, nonlinear and nonparametric modeling of time series. A student learns how to choose between alternative time series models and can apply statistical software to fit time series models.

Contents:

1. The course covers basic concepts of time series analysis: stationarity, autocorrelation, spectral distribution and periodogram.
2. Linear time series analysis includes explanation, prediction, parameter estimation and model diagnostics in ARMA models.
3. Nonlinear time series analysis includes threshold models and heteroskedastic time series models (ARCH and GARCH).
4. Furthermore, nonlinear nonparametric smoothing is covered (time space smoothing and state space smoothing) and nonparametric estimation of spectral densities. Nonparametric function estimation includes kernel estimation, local polynomial regression and additive modeling.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are voluntary exercises.
There are 14 times 2 hour lectures and 7 times 2 hour exercises.

Target group:

Students of mathematical sciences, econometrics and finance students.

Prerequisites and co-requisites:

Basic probability theory.

Recommended optional programme components:

-

Recommended or required reading:

Fan, J. ja Yao, Q. (2005). Nonlinear Time Series, Springer.

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

Home page of the course is http://cc.oulu.fi/~jklemela/timeseries/
Recommended reading:
P. J. Brockwell and R. A. Davis: Time Series: Theory and Methods, Springer, 1991.
H. Lutkepohl: Introduction to Multiple Time Series Analysis, Springer.
J. Hamilton: Time Series, Princeton University Press The MIT Press, 1994.

806351A: Introduction to Independent Component Analysis, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

805334A: Analysis of categorical data, 9 op

Voimassaolo: - 28.02.2011
Opiskelumuoto: Intermediate Studies
Laji: Course
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 succesfully 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 excercises in the computer lab.

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Markku Rahiala

805328A: Multivariate analysis, 9 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

805333A: Robust methods, 6 op

Voimassaolo: - 31.07.2007
Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

805398A: An introduction to stochastic modelling, 8 op

Voimassaolo: - 01.09.2012
Opiskelumuoto: Intermediate Studies
Laji: Course
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

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

805380A: Clinical biostatistics, 6 op

Voimassaolo: - 01.09.2012
Opiskelumuoto: Basic Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Läärä Esa
Opintokohteen kielet: Finnish

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

806330A: Analysis of Market Risk, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Jussi Klemelä
Opintokohteen kielet: Finnish
Leikkaavuudet:

806630S	Market Risk Analysis	5.0 op

ECTS Credits:

5 cr

Language of instruction:

Finnish

Timing:

Every second year.

Learning outcomes:

The student knows how to estimate the unconditional value-at-risk using empirical quantiles, parametric modeling, semiparametric modeling, and extreme value theory. The student knows also how to estimate the conditional value-at-risk using GARCH models. Student knows how to apply statistical software to make the calculations.

Contents:

The course is an introduction to the quantitative risk management of a portfolio of stocks. The course introduces various risk measures, extreme value theory, and modeling of financial time series. The course covers:
1. Conditional and unconditional loss distribution,
2. Value-at-Risk and other risk measures,
3. standard methods of estimating Value-at-Risk: multivariate normal modeling, historical simulation /empirical quantiles, and the Monte Carlo method,
4. Modeling of distributions: multivariate distributions, normal mixture distributions, spherical and elliptical distributions, and dimension reduction,
5. Modeling of financial time series: ARMA models, GARCH models, and volatility models,
6. Copulas and measures of dependence,
7. Extreme value theory: block maxima and threshold exceedance methods.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are voluntary exercises.
There are 14 times 2 hour lectures and 7 times 2 hour exercises.

Target group:

Students of mathematical sciences, students of finance and economics.

Prerequisites and co-requisites:

Basic knowledge of statistics.

Recommended optional programme components:

The course is suitable together with the course "Statistical Finance".

Recommended or required reading:

McNeil, A. J., Frey, R., and Embrechts, P. (2005).Quantitative Risk Management: Concepts, Techniques and Tools,Princeton Series in Finance, 608 pp.

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

The home page of the course is http://cc.oulu.fi/~jklemela/marketrisk/
The course is lectured every second year.

805309A: Statistical methods in epidemiology, 9 op

Voimassaolo: 01.06.2009 -

Opiskelumuoto: Intermediate Studies

Laji: Course

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

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

805339A: The Statistical Foundation of Econometrics, 5 - 6 op

Voimassaolo: 01.06.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:
Hayashi, Fumio , , 2000
Gourieroux, Christian , , 1995
Gourieroux, Christian , , 1995
Harvey, Andrew C. , , 1990

Opintokohteen kielet: Finnish

Leikkaavuudet:

805683S The Statistical Foundation of Econometrics 5.0 op

ECTS Credits:

5/6 cr

Language of instruction:

Finnish

Timing:

Every second year.

Learning outcomes:

The course familiarizes students with applications of statistical models when inferences are made on economic phenomena. The principles of statistical inference on economic phenomena are the same as those of general statistical inference but there are some special issues that make the inference different in economics than in other application areas of statistics. After finishing the course, a student can apply both linear regression and nonlinear regression and a student is able to apply the generalized method of moments as well as the method of instrumental variables. A student can diagnose the validity of the assumptions of the linear regression model and tune his inferences accordingly.

Contents:

The course starts with the study of the linear regression model, and covers asymptotic inference related to the linear regression model, tests of the parameter restrictions and tests of a structural change. Besides linear regression, also nonlinear regression and the generalized method of moments is covered, as well as inference based on instrumental variables and problems stemming from measurement errors.
Inference under heteroscedasticity and autocorrelated disturbances is included. The basic theory of time series analysis (cointegration and autoregressive conditional heteroscedasticity) and the basic theory of panel data is included.

Learning activities and teaching methods:

Besides lectures, there are partly compulsory exercises.
There are 14 times 2 hour lectures and 7 times 2 hour exercises.

Target group:

Students of economics and mathematical sciences.

Prerequisites and co-requisites:

Basic Mathematics for Economics 1 and 2, Basic methods in statistics 1, Introduction to Econometrics.

Recommended optional programme components:

-

Recommended or required reading:

J. M. Wooldridge: Analysis of Cross Section and Panel Data (The MIT Press).

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5

Person responsible:

Jussi Klemelä

Other information:

The course is organized every second years. The course was organized at spring 2014.
The home page of the course is http://cc.oulu.fi/~jklemela/econometrics/
Recommended literature: William H. Greene: Econometric Analysis (Prentice Hall)

805332A: Design of experiments, 9 op

Voimassaolo: - 31.07.2007
Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

805308A: Analysis of longitudinal data, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
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:

5/6 cr

Language of instruction:

Finnish

Timing:

Every secon year.

Learning outcomes:

After finishing the course a student can apply pooled ordinary least squares, generalized least squares, random effects methods, and fixed effects methods.

Contents:

1. Introduction: data types, omitted variables.
2. Mathematical tools: conditional expectation, basic asymptotic theory.
3. Basics of ordinary least squares.
4. Estimating systems of equations by ordinary least squares and by generalized least squares, panel data and seemingly unrelated regression as examples, simultaneous exogeneity and strict exogeneity, consistency and asymptotic normality, homoskedasticity and heteroskedasticity.
5. Pooled ordinary least squares for panel data, aggregated time effect, dummy variables, testing serial correlation and heteroskedasticity.
6. Unobserved effects model: random effects and fixed effects.
7. Random effects methods: random effects structure of the covariance matrix.
8. Fixed effects methods: fixed effects transformation, the use of dummy variables, first differencing transformation.
9. Comparison of estimators.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are voluntary
exercises. There are 14 times 2 hour lectures and 7 times 2 hour exercises.

Target group:

Students of economics and mathematical sciences.

Prerequisites and co-requisites:

Basic Mathematics for Economics 1 and 2, Basic
Methods in Statistics 1, Introduction to Econometrics.

Recommended or required reading:

J. M. Wooldridge: Econometric Analysis of Cross Section and Panel Data (The MIT Press).

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

The course is organized every two years.
The home page of the course is http://cc.oulu.fi/~jklemela/panel/

806357A: Statistical finance, 5 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Jussi Klemelä
Opintokohteen kielet: Finnish

ECTS Credits:

5 cr

Language of instruction:

Finnish

Timing:

Every second year.

Learning outcomes:

On a successful completion of this course, the student is familiar with the basic concepts of derivative pricing and knows how to calculate the Black-Scholes price of a stock option. In addition, after completion of the course, the student knows how to calculate a Markowotz portfolio, how to evaluate the return and the risk of a portfolio, and knows how to calculate performance measures for a portfolio.

Contents:

1. Introduction: The main asset classes and derivative types.
2. The main concepts needed to price futures and options, arbitrage pricing and pricing with statistical arbitrage, the arbitrage free price of futures, the put-call-parity.
3. Pricing of options in the single period and multiperiod binary model, Black-Scholes pricing, and pricing in

incomplete models.
4. The basic methods for choosing and evaluating a portfolio, Markowitz theory for the portfolio choice, maximization of the expected utility, and the maximization of the conditional expected utility.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Besides lectures, there are voluntary exercises.
There are 14 times 2 hour lectures and 7 times 2 hour exercises.

Target group:

Students of mathematical sciences, students of finance and economics.

Prerequisites and co-requisites:

Basic knowledge of statistics and probability.

Recommended optional programme components:

The course is suitable together with the course "Market Risk Analysis".

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Examination

Grading:

1 - 5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

The home page of the course is http://cc.oulu.fi/~jklemela/stafin/
The course is lectured every second year.
Additional literature:
Franke, J., Härdle, W., and Hafner, C. M. (2004).
Statistics of Financial Markets, Springer.
Bouchaud, J.-P. and Potters, M. (2003).
Theory of Financial Risk and Derivative Pricing,
Cambridge University Press.
Ruppert, D. (2004). Statistics and Finance, Springer.

902002Y: English 1 (Reading for Academic Purposes), 2 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Proficiency level:
B2/C1 on the Common European Framework of Reference scale.
Status:
In the Faculty of Science, this course is mandatory for all degree programmes except Geography. Please consult the Faculty Study Guide to establish the language requirements for your own degree programme.
Required proficiency level:
English must have been the A1 or A2 language at school or equivalent English skills should have been acquired otherwise.
ECTS Credits:
2 ECTS credits (total work load 54 hours including classroom meetings.)
Language of instruction:

English
Timing:
Biology: 1st year spring term
Chemistry: 1st year autumn term
Geology: 1st year spring term
Information Processing Science: 1st year spring term
Mathematical Sciences: 1st year spring term
Physical Sciences: 1st year autumn term
Learning outcomes:
By the end of the course, you are expected

- to have acquired effective vocabulary learning techniques by being able to distinguish parts of words to infer meanings
- to understand and be able to construct basic grammatical structures used in formal written English
- to be able to utilize text structure and cohesion markers when reading academic texts
- to be able to apply effective reading techniques and have necessary skills to extract global and detailed information with considerable ease and speed from general texts related to Natural Sciences as well as texts /textbooks of their own field

Contents:
In this course, students improve their understanding of written academic English used in texts in Natural Sciences as well as expand their general and scientific vocabulary. Students become aware of their own role in learning and use a variety of different study methods in order to develop their own language learning strategies, which will enhance their academic English.
Mode of delivery:
Contact teaching
Learning activities and teaching methods:
Contact teaching (26 hours) and self-study 28 hours
Target group:
1 st year students of Biology, Chemistry, Geology, Information Processing Science, Physics, and Mathematics
Prerequisites and co-requisites:
-
Recommended optional programme components:
In addition to this course, students are required to take 902004Y Scientific Communication.
Recommended or required reading:
Set books for substance studies; journal articles in print and on-line.
Assessment methods and criteria:
Continuous assessment takes into account active and regular participation in classroom sessions and successful completion of all homework tasks, vocabulary quizzes, and an end of course exam.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass/Fail
Person responsible:
Biology, Geology, Information Processing: Karen Niskanen
Chemistry, Physics, Mathematics: Patrick Nesbitt
Working life cooperation:
-
Other information:
N.B. Students with grades *laudatur* or *eximia* in their A1 English school-leaving examination can be exempted from this course and will be granted the credits by the Faculty of Science.
Retake examinations: Two retake examinations are allowed on the dates set by the Extension School. See the dates and registration instructions at: http://www.oulu.fi/kielikoulutus

902004Y: English 2 (Scientific Communication), 2 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Leikkaavuudet:

ay902004Y	English 2 (Scientific Communication) (OPEN UNI)	2.0 op

Proficiency level:
B2/C1 on the CEFR scales
Status:
This course is mandatory for all 2nd year students (except **geographers**) who will have English as their foreign language in their B.Sc. degree. This includes the students who were exempted from ‘Reading for Academic Purposes'(902002Y). Please consult the faculty study guide to establish the language requirements on your own degree programme.
Required proficiency level:
Students taking this course must have had English as the A1 or A2 language at school or the equivalent English skills should have been acquired otherwise. The course 'Reading for Academic Purposes' (902002Y) is a pre-requisite, unless exempted.
ECTS Credits:
The student workload is 53 hrs work/ 2 ECTS credits.
Language of instruction:
English
Timing:
Biology: 2nd year autumn term
Chemistry: 2nd year spring term
Geology: 2nd year spring term
Information Processing Science : 2nd year autumn term
Mathematics: 2nd year spring term
Physics: 2nd year autumn term
Learning outcomes:
By the end of the course, you are expected:

1. to have provided evidence of oral fluency in pair work communication and small group discussions.
2. to have developed effective language learning strategies through autonomous homework.
3. to have demonstrated the ability to prepare and present scientific subjects, using appropriate field-related vocabulary.
4. to have demonstrated lecture listening skills in field-related situations.

Contents:
Skills in listening, speaking, and giving presentations are practised in the course. Homework tasks include autonomous work to support the classroom learning and the task of preparing and presenting a scientific presentation.
Mode of delivery:
Contact teaching
Learning activities and teaching methods:
Contact teaching 28 hours, homework 28 hours
Target group:
2nd year students of Biology, Chemistry, Geology, Information Processing Science, Mathematics, Physics
Prerequisites and co-requisites:
-
Recommended optional programme components:
Also required: 902002Y Reading for Academic Purposes Englannin kieli 1
Recommended or required reading:
Course materials will be provided by the teacher.
Assessment methods and criteria:
Continuous assessment is based on regular attendance, active participation in all lessons and the successful completion of all homework tasks.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass / fail.
Person responsible:
Jolene Gear
Working life cooperation:
-
Other information:
Alternative method of course completion: An optional exemption test is offered twice per year. The student can only participate in the exemption exam once. See exemption exam details and schedule.

800008Y: Orientation for New Students, 2 op

Opiskelumuoto: General Studies
Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
2 ECTS
Language of instruction:
Finnish
Timing:
First year (autumn term)
Learning outcomes:
After the course, student is familiar with objectives and curriculum of the degree program. Moreover, the student is familiarized with the correct study methods and learning environment. After the course, the student is also able to search information from, for instance, university library and databases. After the course, student has planned future studies (study plan).
Contents:
The aim of the course is to familiarise the student with university studies, learning environment, provide the student with information on the history and current weight of mathematical sciences in the society as well as the objectives and curriculum of the degree programme. During the course, student makes the study plan.
Mode of delivery:
Face-to-face teaching (tutoring group)
Learning activities and teaching methods:
Group working
Target group:
Major students
Prerequisites and co-requisites:
-
Recommended optional programme components:
-
Recommended or required reading:
-
Assessment methods and criteria:
Taking part to the group meetings and making the Personal Study Plan.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass/Fail
Person responsible:
Student advisor
Working life cooperation:
-

901004Y: Swedish, 2 - 3 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Opintokohteen kielet: Swedish

Leikkaavuudet:

901035Y	Second Official Language (Swedish), Oral Skills	1.0 op
901034Y	Second Official Language (Swedish), Written Skills	1.0 op
ay901004Y	Swedish (OPEN UNI)	2.0 op

Proficiency level:
B1/B2/C1 (CEFR scale)
Status:
This course is compulsory to all students except those who have at least 60 ECTS credits of Swedish studies in their degrees. The language proficiency provided by the course unit is equivalent to the language proficiency required of a state official with an academic degree working in a bilingual municipality area (Act 424/03 and Decree 481/03).
Required proficiency level:

The required starting proficiency level for students of all faculties is a grade of 7 or higher from the Swedish studies at secondary school (B-syllabus) or matriculation examination grade A - L or a passing grade from the Brush up course in Swedish 901018Y.
If a student doesn't meet these requirements or his/her language skills are otherwise lacking, he/she must achieve the required proficiency level BEFORE taking this compulsory Swedish course

ECTS Credits:
2 ECTS credits (Biochemistry 3 ECTS credits)

Language of instruction:
Swedish

Timing:
See the study guide of your own faculty

Learning outcomes:
Upon completion of the course the student should have acquired the necessary proficiency level in Swedish to be able to manage in the most common communication situations related to his/her professional work tasks. He/she should be able to use basic grammatical structures fairly well in both speech and writing. He/she should be able to use the most common situational phrases understandably in various communication situations. He/she should be able to find the main points in general academic texts and texts related to his/her field of study and relay this information to colleagues or an audience of laymen using Swedish. He/she should be able to write short texts relating to his/her field of study.

Contents:
Communicative oral and written exercises, which aim to develop the student's Swedish proficiency in areas relevant to his/her academic field and future professional tasks. The student practises oral presentation and pronunciation. Situational oral exercises done individually and in pairs and groups. Discussions in small groups. Current texts about the student's special field. Listening comprehension exercises. Written exercises relating to the student's professional field.

Mode of delivery:
Contact teaching

Learning activities and teaching methods:
2 ECTS credits: 28 hours of contact teaching (1 x 180 minutes per week) and related exercises, self-directed study. The course unit's total workload is 53 hours.

Target group:
Students of the Faculty of Science, students of biochemistry and students of electrical engineering.

Prerequisites and co-requisites:
See Required Porficiency Level

Recommended optional programme components:
-

Recommended or required reading:
The material, which is special field-specific, authentic and up to date, is distributed during the course. Students must pay for their course material.

Assessment methods and criteria:
The course focuses on improving both oral and written language skills and requires active attendance and participation in exercises, which also require preparation time. 100% attendance is required. The course unit tests both oral and written language skills. Students participate in the teaching in either autumn semester or spring semester.

Read more about assessment criteria at the University of Oulu webpage.

Grading:
Assessment is based on continuous assessment and exams. Approved completion of the course unit requires that the student achieves at least satisfactory oral and written language skills. The grades are based on continuous assessment and the course exams. Oral and written language skills are graded separately. The possible grades are satisfactory skills (CERF proficiency level B1) and good skills (CERF proficiency levels B2-C1). For more information on the proficiency levels of oral and written language skills, see Assessment Criteria (in Finnish).

Person responsible:
Lecturer Rauno Varonen

Working life cooperation:
-

Other information:
Teaching will begin according to the schedule

802155P: Continuity and limit, 4 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Esa Järvenpää

Opintokohteen kielet: Finnish

Leikkaavuudet:

800119P	Analysis 1	5.0 op
802162P	Continuity and Limit	5.0 op
801111P	Basic Methods in Mathematics I / math	10.0 op
800147P	Basic Methods in Mathematics I / appl.	8.0 op

ECTS Credits:
4 cr
Language of instruction:
Finnish
Timing:
1. year, 1. period
Learning outcomes:
After completing the course, student is able to

- derive and proof main results of the course
- use different types of proof techniques
- define the limit of function and the continuity of function
- derive and proof the limit using different proof techniques
- deduce the continuity of functions using different proof techniques

Contents:
The main concept of the course are the limit of a real-valued function and the continuity of real-valued function. Interrelations between these concepts are also studied.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
28h lectures, 14h exercises
Target group:
Main and minor students
Prerequisites and co-requisites:
802151P Introduction to mathematical deduction
Recommended optional programme components:
-
Recommended or required reading:
-
Assessment methods and criteria:
Final exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Esa Järvenpää.
Working life cooperation:
-

802156P: Derivative, 4 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Maarit Järvenpää

Opintokohteen kielet: Finnish

Leikkaavuudet:

800317A	Analysis 2	5.0 op
802163P	Derivative	5.0 op
801111P	Basic Methods in Mathematics I / math	10.0 op

ECTS Credits:
4 cr
Language of instruction:
Finnish
Timing:
1. year, 2. period
Learning outcomes:
After completing the course, student is able to
- derive and proof main results of the course
- use different types of proof techniques
- use and apply the concept of derivative in different types of problems

Contents:
The course considers the concept of derivative of real-valued function and applies this concept to different types oif situations.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
28h lectures, 14 h exercises
Target group:
Major and minor students
Prerequisites and co-requisites:
802151P Introduction to mathematical deduction
802154P Elementary functions
802155P Limits and continuity

Recommended optional programme components:
-
Recommended or required reading:
-
Assessment methods and criteria:
Final exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Maarit Järvenpää
Working life cooperation:
-

802154P: Elementary functions, 3 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Maarit Järvenpää

Opintokohteen kielet: Finnish

Leikkaavuudet:

802161P	Introduction to Real Functions	5.0 op
801111P	Basic Methods in Mathematics I / math	10.0 op
800147P	Basic Methods in Mathematics I / appl.	8.0 op

ECTS Credits:
3 cr
Language of instruction:
Finnish

Timing:
1. year, 1. period
Learning outcomes:
After completing the course, student is able to
- prove essential result in the course
- use and apply different types of proof techniques
- handle elementary functions

Contents:
Course introduces basic concepts and definitions related to real-valued functions. Definitions and proofs are essential part of the course.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
21h luentoja, 10 h harjoituksia
Target group:
Major and minor students
Prerequisites and co-requisites:
802151P Introduction to mathematical deduction
Recommended optional programme components:
-
Recommended or required reading:
-
Assessment methods and criteria:
Final exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Maarit Järvenpää
Working life cooperation:
-

802352A: Euclidean Topology, 4 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Maarit Järvenpää

Opintokohteen kielet: Finnish

Leikkaavuudet:

802357A	Euclidean Spaces	5.0 op
802356A	Metric Topology	5.0 op

ECTS Credits:
4 ECTS credits
Language of instruction:
Finnish
Timing:
First year, 3. period
Learning outcomes:
After the course student is able to
- define elementary topological concepts (open and closed sets, accumulation point, etc)
- handle sequences of real numbers
- proof fundamental theorems related to continuous functions

Contents:
The courses goal is to expand students knowledge and understanding of continuous functions. Course considers basic topology of n-dimensional Euclidean space. Important concepts are, for instance, open and closed sets, compactness and completeness.
Mode of delivery:

Face-to-face teaching
Learning activities and teaching methods:
28h lectures, 14h exercises
Target group:
Major and minor students
Prerequisites and co-requisites:
802154P Elementary functions
802155P Limit and continuity
802156P Derivative
Recommended optional programme components:
-
Recommended or required reading:
-
Assessment methods and criteria:
Midterm exam or final exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Maarit Järvenpää
Working life cooperation:
-

801195P: Introduction to Probability Theory I, 5 op

Voimassaolo: 01.01.2011 -

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:

Tuominen, P., , 1993

Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS credits.
Language of instruction:
Finnish.
Timing:
Fall semester, 2nd period.
Learning outcomes:
Upon completing the 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. In the beginning high school level probability is reviewed and after that axiomatic treatment of the theory starts. The central concepts discussed include probability space, conditional probability, independence, and random variable together with its distribution and expected value.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
35 h of lectures, 14 h of exercises.
Target group:
Mathematics, applied mathematics and statistics majors. Other students taking mandatory or optional mathematics courses.
Prerequisites and co-requisites:
802151P Introduction to mathematical deduction
802154P Elementary functions
Recommended optional programme components:
-
Recommended or required reading:

Lectures.
Text book: Pekka Tuominen, "Todennäköisyyslaskenta I", Limes ry, Helsinki.
Assessment methods and criteria:
Two exams covering the two halves of the course are arranged during the course. Another option is to take an exam that covers the whole course.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Pekka Salmi.
Working life cooperation:
-
Other information:
Level: intermediate studies.

806113P: Introduction to Statistics, 5 op

Voimassaolo: 01.01.2011 -

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Hanna Heikkinen, Läärä Esa

Opintokohteen oppimateriaali:
Wild, Christopher J. , , 2000
Grönroos, Matti (2) , , 2003
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
Language of instruction:
Finnish
Timing:
3rd period. It is recommended to complete the course at the 1st spring semester.
Learning outcomes:
Upon completion of the course, student will be
- able to identify and define the main principles of statistical research, collection of the data and analysis
- able to apply basic methods of descriptive statistics and statistical inference in simple quantitative research using a statistical software
- able to critically evaluate results of the statistical research presented in media
- prepared for teaching statistics in secondary school and high school
- prepared for participating in a group.
Contents:
- the nature and the meaning of statistics
- data and the acquisition of them: observations, variables, measuring and designs of a study
- the descriptive statistics of empirical distributions: tables, graphical presentations and descriptive measures of center, variation and dependence
- the principles and the basic methods of statistical inference: random sample, sample statistics, point estimation, confidence intervals and statistical testing of hypotheses
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 16 h (partly compulsory) / instructed group work (28 h) / independent work 80 h. Group works will be returned. Additional independently implemented learning diary tasks. Independent work contains also preparation for group work and peer assessment.
Target group:
Students of mathematical sciences and other interested students.

Prerequisites and co-requisites:
The recommended prerequisite prior to enrolling for the course is the completion of the courses: 802151P Introduction to mathematical deduction, 802154P Elementary functions, 802155P Continuity and limit ja 801195P Introduction to Probability Theory.

Recommended optional programme components:
After the course, student is able to continue other statistics courses.
Recommended or required reading:
Lecture notes.
Assessment methods and criteria:
This course utilizes continuous assessment. Practical works and learning diaries are assessed weekly. The assessment of the course is based on the learning outcomes of the course. The more detailed assessment criteria is available in the beginning of the course. In addition one compulsory lecture and peer assessment.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Hanna Heikkinen
Working life cooperation:
No

802151P: Introduction to mathematical deduction, 5 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay802151P	Introduction to mathematical deduction (OPEN UNI)	5.0 op

ECTS Credits:
5 ECTS
Language of instruction:
Finnish
Timing:
First period at the first semester.
Learning outcomes:
After completing the course, student
- is able to use different methods proving techniques
- is able to use basic set theoretic concepts and definitions
- is able to define and apply basic definitions related to functions

Contents:
The course in an introduction to mathematical deduction and introduces different types of proof techniques. The course covers the concepts familiar from upper secondary school studies more profound way. Main concepts in this course are basic set theory and functions.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 30h, exercises 18h
Target group:
Major and minor students
Prerequisites and co-requisites:
-
Recommended optional programme components:
-
Recommended or required reading:
Lecture notes
Assessment methods and criteria:
Final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:
Pass/Fail
Person responsible:
Tero Vedenjuoksu
Working life cooperation:
-
Other information:
Course homepage: https://noppa.oulu.fi/noppa/kurssi/802151p/etusivu

802118P: Linear Algebra I, 4 op

Voimassaolo: 16.10.2012 -

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:

Lay, David C. , , 2003

Opintokohteen kielet: Finnish

Leikkaavuudet:

802120P Introduction to Matrices 5.0 op

ECTS Credits:
4 cr
Language of instruction:
Finnish
Timing:
First semester, 2. period
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 R^n and matrix algebra.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
35 h lectures, 21 h exercises
Target group:
Major and minor students
Prerequisites and co-requisites:
802151P Introduction to mathematical deduction
Recommended optional programme components:
-
Recommended or required reading:
Lecture notes
Assessment methods and criteria:
Midterm exams or final exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Tero Vedenjuoksu
Working life cooperation:
-

802119P: Linear Algebra II, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:

Lay, David C. , , 2003

Opintokohteen kielet: Finnish

Leikkaavuudet:

802320A Linear Algebra 5.0 op

ECTS Credits:
5 ECTS credits
Language of instruction:
Finnish
Timing:
First year, 4. period
Learning outcomes:
On successful completion of this course, the student will be able to
- basic properties of inner product spaces
- linear mappings, their matrix representation, and eigen values
- determinants and 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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
35 h lectures, 21 h exercises
Target group:
Major and minor students
Prerequisites and co-requisites:
802119P Linear algebra I
Recommended optional programme components:
-
Recommended or required reading:
Lecture notes
Assessment methods and criteria:
Midterm exam or final exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Esa Järvenpää
Working life cooperation:
-

800300A: Maturity test, 0 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
0 cr
Language of instruction:
Finnish/Swedish
Timing:
Third year
Learning outcomes:

Maturity test
Contents:
Students must take a written maturity test to demonstrate their language skills and how well they know the topic of their thesis. The maturity test is taken in the language in which the student has received his or her education in Finland. If the student has received his or her education in a language other than Finnish or Swedish, the degree programme determines the language of the maturity test. In such cases only the contents of the maturity test is evaluated, not the language.
Mode of delivery:
Maturity test written in examination room.
Learning activities and teaching methods:
Maturity test
Target group:
Major students
Prerequisites and co-requisites:
Bachelor's degree (or similar)
Recommended optional programme components:
-
Recommended or required reading:
-
Assessment methods and criteria:
Maturity test
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass/Fail
Person responsible:
Supervisor of thesis
Working life cooperation:
-

800322A: Multidimensional analysis, 8 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Pekka Salmi

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

ECTS Credits:
8 cr
Language of instruction:
Finnish
Timing:
Second year, periods 1-2
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 course provides an introduction to vector-valued functions of one variable, their derivatives and path integrals. The central notion of the course is the derivative of vector-valued function of several variables (including the gradient of a real-valued function of several variables). In the course we develop the Riemann integral of a real-valued function of two variables. The course provides basic tools for advanced courses in analysis and for applications (such as physics).
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:

56 h lectures, 28 h exercises, 129 h self-study.
Target group:
Major and minor students in mathematics.
Prerequisites and co-requisites:
Linear algebra I
Linear algebra II
Euclidean topology
Series and integrals

Recommended optional programme components:
-
Recommended or required reading:
- Baxandall, Liebeck: Vector calculus, Oxford University Press, 1986.
- lecture notes.
Assessment methods and criteria:
Midterm exams or final exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
0-5
Person responsible:
Pekka Salmi.
Working life cooperation:
No

802354A: Number Theory and Groups, 5 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Myllylä

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay802354A	Number Theory and Groups (OPEN UNI)	5.0 op
800333A	Algebra I	8.0 op

ECTS Credits:
5 ECTS credits
Language of instruction:
Finnish
Timing:
1. year, 3. period
Learning outcomes:
After completing the course, student is able to
- derive and proof main results in the course
- use and apply different proof techniques
- recognize algebraic structures and the concepts
- see connections and differences between different algebraic structures

Contents:
The course includes basics in arithmetics and algebraic structures, such as, congruence, residue classes, prime numbres, Euclidean algorithm, the fundamental theorem of arithmetic, Euler-Fermat formula, groups and morphisms. The course gives an understanding of algebraic terms and concepts used in mathematics and physics.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
28h lectures, 14h exercises
Target group:
Major and minor students
Prerequisites and co-requisites:
802151P Introduction to mathematical deduction

Recommended optional programme components:
-
Recommended or required reading:
Lecture notes
Assessment methods and criteria:
Midterm exam or final exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Kari Myllylä
Working life cooperation:
-

805331A: Project seminar I, 6 op

Voimassaolo: 23.04.2007 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 cr
Language of instruction:
Finnish
Timing:
3. year of studies (fall or spring)
Learning outcomes:
After successful completion of the project seminar the student is able to conduct a small scale statistical investigation and report it both in written form and orally.
Contents:
Under supervision of the leader of the seminar each student conducts a small-scale statistical investigation on a given empirical topic and material, makes a writtenh report from it and presents it orally in seminar sessions. The written report is the B.Sc. thesis, when statistics is the major subject of the student.
Mode of delivery:
Seminars
Learning activities and teaching methods:
Seminar sessions (20 h) and independent work.
Target group:
Major and minor students
Prerequisites and co-requisites:
Basic methods of data-analysis
Recommended optional programme components:
Maturity test is written of the subject of proseminar.
Recommended or required reading:
-
Assessment methods and criteria:
Seminar (written) and presentation
Grading:
Pass/Fail
Person responsible:
Jari Päkkilä
Working life cooperation:
-

802355A: Rings, Fields and Polynomials, 5 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Myllylä

Opintokohteen kielet: Finnish

Leikkaavuudet:

800333A	Algebra I	8.0 op

ECTS Credits:
5 ECTS credits
Language of instruction:
Finnish
Timing:
Second year, 1. period
Learning outcomes:
After completing the course, student is able to

- derive and proof main results in the course
- use and apply different proof techniques
- recognize algebraic structures and the concepts
- see connections and differences between different algebraic structures

Contents:
The course introduces algebraic structures, such as rings, polynomial rings, ideals, integral domains, fields, finite fields, field extensions and quotient field. The course gives an understanding of algebraic terms and concepts used in mathematics and physics.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
28h lectures, 14h exercises
Target group:
Major students
Prerequisites and co-requisites:
802354A Number theory and groups
Recommended optional programme components:
-
Recommended or required reading:
Lecture notes
Assessment methods and criteria:
Midterm exam or final exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Kari Myllylä
Working life cooperation:
-

802353A: Series and Integrals, 6 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Peter Hästö

Opintokohteen kielet: Finnish

Leikkaavuudet:

800318A	Analysis 3	5.0 op
802164P	Series and Integral	5.0 op

ECTS Credits:

6 ECTS credits
Language of instruction:
Finnish (possible also in English)
Timing:
First year, 4. period
Learning outcomes:
After completing the course, student is able to

- operate with real series
- separate the concept of continuity and uniform continuity
- define and calculate Riemann integrals
- derive and operate function sequences and function series
- calculate derivate and integrate function series

Contents:
The course is a continuum for the courses Limits and continuity and Derivative. Basic topological methods (presented in Euclidean Topology) are heavily used in proofs and methods involving continuous functions. The goal is the same as in the prerequisite courses, that is, to develop mathematical thinking and extend the knowledge of mathematical analysis.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
30h exercises, 14h exercises
Target group:
Major and minor students
Prerequisites and co-requisites:
802154P Elementary functions
802155P Limit and continuity
802156P Derivative
802352A Euclidean topology

Recommended optional programme components:
-
Recommended or required reading:
Lecture notes
Assessment methods and criteria:
Midterm exams or final exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Peter Hästö
Working life cooperation:
-

806112P: Basic Methods of Data Analysis, 10 op

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Päkkilä

Opintokohteen oppimateriaali:
Armitage, P. , , 2002
Opintokohteen kielet: Finnish

Leikkaavuudet:

805305A	Introduction to Regression and Analysis of Variance	5.0 op

ECTS Credits:
10 cr
Language of instruction:
Finnish
Timing:

The course is held in the autumn semester, during periods 1 and 2.
Learning outcomes:
On successful completion of this course, the student will be able to
- analyze continuous and categorial 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.
Mode of delivery:
Face-to-face teaching.
Learning activities and teaching methods:
56h lectures, 42h exercises, self-study.
Target group:
Major and minor students.
Prerequisites and co-requisites:
For major students:
801195P Introduction to Probability Theory I, 806113P Introduction to statistics, 802118P Linear algebra I, 802154P Elementary functions, 802155P Limits and continuity,
802156P Derivative
For minor students: 806109P Basic Methods in Statistics I
Recommended optional programme components:
To be completed before 805310A Statistical inference I, 806359A Regression modelling and other studies in statistics.
Recommended or required reading:
Lecture notes.

Assessment methods and criteria:
Intermediate (2) or final exam.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course utilizes a numerical grading scale 1-5 / fail.
Person responsible:
Jari Päkkilä
Working life cooperation:
-

801396A: Introduction to Probability Theory II, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:

Tuominen, P., , 1993

Opintokohteen kielet: Finnish

ECTS Credits:
4 cr
Language of instruction:
Finnish
Timing:
2. year, Fall semester
Learning outcomes:
On successful completion of this course, the student will be able to
- understand probability theory deeper than before
- apply various stocastic 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 distibutions.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
24h lectures, 12h exercises
Target group:
Major- and minor students. Recommended for students aiming to Master's degree with major in statistics or major in mathematics and computer sciences.
Prerequisites and co-requisites:
801195P Introduction to propability I
802352A Euclidean topology
802353A Series and integrals
Assessment methods and criteria:
Final exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Kenneth Nordström.

806359A: Regression modelling, 10 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Läärä Esa

Opintokohteen kielet: Finnish

Leikkaavuudet:

805351A	Linear Regression	5.0 op
805352A	Generalized Linear Models	5.0 op

ECTS Credits:
10 cr
Language of instruction:
Finnish
Timing:
2. year, periods 2-3
Learning outcomes:
After successful completion of the course the student is able to describe the basic concepts and assumptions of generalized linear models, as well as main principles of regression modelling, and is also able to apply these methods in the analysis of experimental or observational data.
Contents:
Generalized linear regression models for continuous, binary and count responses; model formulation, selection of variables and interpretation of parameters; fitting of models, estimation of parameters and prediction by the method of maximum likelihood; model criticism and diagnostics; use of R environment and SAS software in modelling.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures (56 h), calculation and computation practicals (28 h), independent work.
Target group:
Major and minor students
Prerequisites and co-requisites:
Compulsory basic and intermediate studies in mathemtics (core studies), 801396A Introduction to propability II, 806112P Basic methods of data-analysis, and 805310A Statistical inference I
Assessment methods and criteria:
Final exam

Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Esa Läärä
Working life cooperation:
-

805310A: Statistical Inference I, 10 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:
Pawitan, Yudi , , 2001
Sprott, D. A. , , 2000
Kalbfleisch, J. G. , , 1985

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

ECTS Credits:
10 cr
Language of instruction:
Finnish
Timing:
2. or 3. year spring semester (periods 3-4).
Learning outcomes:
After successful completion of the course the student is able to describe the main principles of frequentist statistical inference, derive likelihood functions and from these compute point and interval estimates, test statistics and P-values for models with few parameters, as well as to interpret results such obtained.

Contents:
Statistical model and observed data; likelihood function, log-likelihood, score and information; construction and properties of point and interval estimates; likelihood ratio, score and Wald statistics and their asymptotic sampling distributions; jackknife and bootstrap methods; elements of Bayesian inference; Use of R environment in inferential tasks.

Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures (56 h), calculation and computation practicals (28 h), and independent work.
Target group:
Major and minor students
Prerequisites and co-requisites:
Introduction to propability I
Basic methods of data-analysis
Recommended optional programme components:
Requirement for further studies in statistics.
Assessment methods and criteria:
Mid-term exams or final exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Hyon-Jung Kim-Ollila
Working life cooperation:
-

805340A: Statistical Software, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

805353A Statistical Software 5.0 op

ECTS Credits:
4 cr
Language of instruction:
English
Timing:
3. year studies. Fall semester. Timing varies.
Learning outcomes:
After successful completion of the course the student can use independently major statistical software needed in data analysis.
Contents:
The course covers R, SAS and SPSS, and their most important tools for data management, statistical computation, graphics and programming will be introduced and proficiency for their fluent use is acquired.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
34 h lectures and computer class exercises.
Target group:
Major and minor students
Prerequisites and co-requisites:
Basic methods of data-analysis
Recommended optional programme components:
-
Recommended or required reading:
-
Assessment methods and criteria:
Home work
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Hyon-Jung Kim-Ollila
Working life cooperation:
-

H326635: Optional intermediate studies in statistics, 0 - 180 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Study module

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Electives

805324A: Time series analysis, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

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:

5 cr

Language of instruction:

Finnish

Learning outcomes:

After finishing the course, a student can apply linear, nonlinear and nonparametric modeling of time series. A student learns how to choose between alternative time series models and can apply statistical software to fit time series models.

Contents:

1. The course covers basic concepts of time series analysis: stationarity, autocorrelation, spectral distribution and periodogram.
2. Linear time series analysis includes explanation, prediction, parameter estimation and model diagnostics in ARMA models.
3. Nonlinear time series analysis includes threshold models and heteroskedastic time series models (ARCH and GARCH).
4. Furthermore, nonlinear nonparametric smoothing is covered (time space smoothing and state space smoothing) and nonparametric estimation of spectral densities. Nonparametric function estimation includes kernel estimation, local polynomial regression and additive modeling.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are voluntary exercises.
There are 14 times 2 hour lectures and 7 times 2 hour exercises.

Target group:

Students of mathematical sciences, econometrics and finance students.

Prerequisites and co-requisites:

Basic probability theory.

Recommended optional programme components:

-

Recommended or required reading:

Fan, J. ja Yao, Q. (2005). Nonlinear Time Series, Springer.

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

Home page of the course is http://cc.oulu.fi/~jklemela/timeseries/
Recommended reading:

P. J. Brockwell and R. A. Davis: Time Series: Theory and Methods, Springer, 1991.
H. Lutkepohl: Introduction to Multiple Time Series Analysis, Springer.
J. Hamilton: Time Series, Princeton University Press The MIT Press, 1994.

806351A: Introduction to Independent Component Analysis, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

805334A: Analysis of categorical data, 9 op

Voimassaolo: - 28.02.2011

Opiskelumuoto: Intermediate Studies

Laji: Course

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 succesfully 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 excercises in the computer lab.

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Markku Rahiala

805328A: Multivariate analysis, 9 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

805333A: Robust methods, 6 op

Voimassaolo: - 31.07.2007
Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

805398A: An introduction to stochastic modelling, 8 op

Voimassaolo: - 01.09.2012
Opiskelumuoto: Intermediate Studies
Laji: Course
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

Assessment methods and criteria:
Read more about assessment criteria at the University of Oulu webpage.

805380A: Clinical biostatistics, 6 op

Voimassaolo: - 01.09.2012
Opiskelumuoto: Basic Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Läärä Esa
Opintokohteen kielet: Finnish

Assessment methods and criteria:
Read more about assessment criteria at the University of Oulu webpage.

806330A: Analysis of Market Risk, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Jussi Klemelä
Opintokohteen kielet: Finnish
Leikkaavuudet:

806630S	Market Risk Analysis	5.0 op

ECTS Credits:
5 cr
Language of instruction:
Finnish

Timing:

Every second year.

Learning outcomes:

The student knows how to estimate the unconditional value-at-risk using empirical quantiles, parametric modeling, semiparametric modeling, and extreme value theory. The student knows also how to estimate the conditional value-at-risk using GARCH models. Student knows how to apply statistical software to make the calculations.

Contents:

The course is an introduction to the quantitative risk management of a portfolio of stocks. The course introduces various risk measures, extreme value theory, and modeling of financial time series. The course covers:
1. Conditional and unconditional loss distribution,
2. Value-at-Risk and other risk measures,
3. standard methods of estimating Value-at-Risk: multivariate normal modeling, historical simulation /empirical quantiles, and the Monte Carlo method,
4. Modeling of distributions: multivariate distributions, normal mixture distributions, spherical and elliptical distributions, and dimension reduction,
5. Modeling of financial time series: ARMA models, GARCH models, and volatility models,
6. Copulas and measures of dependence,
7. Extreme value theory: block maxima and threshold exceedance methods.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are voluntary exercises.
There are 14 times 2 hour lectures and 7 times 2 hour exercises.

Target group:

Students of mathematical sciences, students of finance and economics.

Prerequisites and co-requisites:

Basic knowledge of statistics.

Recommended optional programme components:

The course is suitable together with the course "Statistical Finance".

Recommended or required reading:

McNeil, A. J., Frey, R., and Embrechts, P. (2005).Quantitative Risk Management: Concepts, Techniques and Tools,Princeton Series in Finance, 608 pp.

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

The home page of the course is http://cc.oulu.fi/~jklemela/marketrisk/
The course is lectured every second year.

805309A: Statistical methods in epidemiology, 9 op

Voimassaolo: 01.06.2009 -

Opiskelumuoto: Intermediate Studies

Laji: Course

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

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

805339A: The Statistical Foundation of Econometrics, 5 - 6 op

Voimassaolo: 01.06.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:

Hayashi, Fumio , , 2000
Gourieroux, Christian , , 1995
Gourieroux, Christian , , 1995
Harvey, Andrew C. , , 1990

Opintokohteen kielet: Finnish

Leikkaavuudet:

805683S	The Statistical Foundation of Econometrics	5.0 op

ECTS Credits:

5/6 cr

Language of instruction:

Finnish

Timing:

Every second year.

Learning outcomes:

The course familiarizes students with applications of statistical models when inferences are made on economic phenomena. The principles of statistical inference on economic phenomena are the same as those of general statistical inference but there are some special issues that make the inference different in economics than in other application areas of statistics. After finishing the course, a student can apply both linear regression and nonlinear regression and a student is able to apply the generalized method of moments as well as the method of instrumental variables. A student can diagnose the validity of the assumptions of the linear regression model and tune his inferences accordingly.

Contents:

The course starts with the study of the linear regression model, and covers asymptotic inference related to the linear regression model, tests of the parameter restrictions and tests of a structural change. Besides linear regression, also nonlinear regression and the generalized method of moments is covered, as well as inference based on instrumental variables and problems stemming from measurement errors.
Inference under heteroscedasticity and autocorrelated disturbances is included. The basic theory of time series analysis (cointegration and autoregressive conditional heteroscedasticity) and the basic theory of panel data is included.

Learning activities and teaching methods:

Besides lectures, there are partly compulsory exercises.
There are 14 times 2 hour lectures and 7 times 2 hour exercises.

Target group:

Students of economics and mathematical sciences.

Prerequisites and co-requisites:

Basic Mathematics for Economics 1 and 2, Basic methods in statistics 1, Introduction to Econometrics.

Recommended optional programme components:

-

Recommended or required reading:

J. M. Wooldridge: Analysis of Cross Section and Panel Data (The MIT Press).

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5

Person responsible:

Jussi Klemelä

Other information:

The course is organized every second years. The course was organized at spring 2014.
The home page of the course is http://cc.oulu.fi/~jklemela/econometrics/
Recommended literature: William H. Greene: Econometric Analysis (Prentice Hall)

805332A: Design of experiments, 9 op

Voimassaolo: - 31.07.2007
Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

805308A: Analysis of longitudinal data, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
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:

5/6 cr

Language of instruction:

Finnish

Timing:

Every secon year.

Learning outcomes:

After finishing the course a student can apply pooled ordinary least squares, generalized least squares, random effects methods, and fixed effects methods.

Contents:

1. Introduction: data types, omitted variables.
2. Mathematical tools: conditional expectation, basic asymptotic theory.
3. Basics of ordinary least squares.
4. Estimating systems of equations by ordinary least squares and by generalized least squares, panel data

and seemingly unrelated regression as examples, simultaneous exogeneity and strict exogeneity, consistency and asymptotic normality, homoskedasticity and heteroskedasticity.
5. Pooled ordinary least squares for panel data, aggregated time effect, dummy variables, testing serial correlation and heteroskedasticity.
6. Unobserved effects model: random effects and fixed effects.
7. Random effects methods: random effects structure of the covariance matrix.
8. Fixed effects methods: fixed effects transformation, the use of dummy variables, first differencing transformation.
9. Comparison of estimators.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are voluntary
exercises. There are 14 times 2 hour lectures and 7 times 2 hour exercises.

Target group:

Students of economics and mathematical sciences.

Prerequisites and co-requisites:

Basic Mathematics for Economics 1 and 2, Basic
Methods in Statistics 1, Introduction to Econometrics.

Recommended or required reading:

J. M. Wooldridge: Econometric Analysis of Cross Section and Panel Data (The MIT Press).

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

The course is organized every two years.
The home page of the course is http://cc.oulu.fi/~jklemela/panel/

806357A: Statistical finance, 5 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Jussi Klemelä
Opintokohteen kielet: Finnish

ECTS Credits:

5 cr

Language of instruction:

Finnish

Timing:

Every second year.

Learning outcomes:

On a successful completion of this course, the student is familiar with the basic concepts of derivative pricing and knows how to calculate the Black-Scholes price of a stock option. In addition, after completion

of the course, the student knows how to calculate a Markowotz portfolio, how to evaluate the return and the risk of a portfolio, and knows how to calculate performance measures for a portfolio.

Contents:

1. Introduction: The main asset classes and derivative types.
2. The main concepts needed to price futures and options, arbitrage pricing and pricing with statistical arbitrage, the arbitrage free price of futures, the put-call-parity.
3. Pricing of options in the single period and multiperiod binary model, Black-Scholes pricing, and pricing in incomplete models.
4. The basic methods for choosing and evaluating a portfolio, Markowitz theory for the portfolio choice, maximization of the expected utility, and the maximization of the conditional expected utility.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Besides lectures, there are voluntary exercises.
There are 14 times 2 hour lectures and 7 times 2 hour exercises.

Target group:

Students of mathematical sciences, students of finance and economics.

Prerequisites and co-requisites:

Basic knowledge of statistics and probability.

Recommended optional programme components:

The course is suitable together with the course "Market Risk Analysis".

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Examination

Grading:

1 - 5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

The home page of the course is http://cc.oulu.fi/~jklemela/stafin/
The course is lectured every second year.
Additional literature:
Franke, J., Härdle, W., and Hafner, C. M. (2004).
Statistics of Financial Markets, Springer.
Bouchaud, J.-P. and Potters, M. (2003).
Theory of Financial Risk and Derivative Pricing,
Cambridge University Press.
Ruppert, D. (2004). Statistics and Finance, Springer.

H325035: Optional intermediate studies in mathematics, 0 - 180 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Intermediate Studies
Laji: Study module
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Electives

800329A: Topology, 8 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Mahmoud Filali

Opintokohteen oppimateriaali:
Vala K., Suominen K., , 1990
Opintokohteen kielet: Finnish

ECTS Credits:

8 cr

Language of instruction:

English (also Finnish)

Timing:

Second year or later. Fall/spring term

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.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

56 hours lecture, 28 h exercises

Target group:

Major and minor students

Prerequisites and co-requisites:

Compulsory basic and intermediate studies in mathematics.

Recommended optional programme components:

-

Recommended or required reading:

S. Willard: General Topology;
K. Suominen & K. Vala: Topologia;
R. Engelking: Outline of General Topology.

Assessment methods and criteria:

Final exam, or mid-term exams
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Mahmoud Filali

Working life cooperation:

-

800343A: Permutations, Fields and Galois' Theory, 8 op

Opiskelumuoto: Intermediate Studies

Laji: Course

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

Language of instruction:

Finnish

Timing:

2. year or later. Periods 3-4 (Spring term)

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.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

56 h lectures, 28 h exercises

Target group:

Major- and minor students

Prerequisites and co-requisites:

Compulsory basic and intermediate studies in mathematics.

Recommended optional programme components:

-

Recommended or required reading:

I. N. Herstein: Abstract Algebra, Prentice Hall, Inc., 1996.

Assessment methods and criteria:

Final exam, mid-term exams
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Markku Niemenmaa

Working life cooperation:

-

800345A: Differential Equations I, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

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

Language of instruction:

Finnish

Timing:

2. year or later, 3. period

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.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

30 h lectures, 16 h exercises

Target group:

Major- and minor students

Prerequisites and co-requisites:

Compulsory basic and intermediate studies in mathematics.

Recommended optional programme components:

-

Recommended or required reading:

Boyce and Di Prima: Elementary Differential Equations and Boundary Value Problems, Wiley, Anton: Calculus, Wiley. R. Kent Nagle & E. B. Saff: Fundamentals of Differential Equations and Boundary Value Problems, Addison-Wesley, 1996 C. Henry & David E. Penney: : Differential Equations and Boundary Value Problems, Prenticw Hall, 2000 Dennis G. Zill & Michael R. Cullen: Differen-tial Equations with Boundary Value Prob-lems, Brooks/Cole, 2001.

Assessment methods and criteria:

Final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Martti Kumpulainen

Working life cooperation:

-

800346A: Differential Equations II, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

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

Language of instruction:

Finnish

Timing:

2. year or later, 4. period

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 eqautions. 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.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

30 h lectures, 16 h exercises.

Target group:

Major and minor students

Prerequisites and co-requisites:

Compulsory basic and intermediate studies in mathematics

Recommended optional programme components:

-

Recommended or required reading:

R. Kent Nagle & E. B. Saff, Fundamentals of Differential Equations and Boundary Value Problems, Addison-Wesley, 1996; Dennis G. Zill & Michael R. Cullen: Differential Equations with Boundary Value Problems, Brooks/Cole, 2001, Strauss: Partial Diffferential Equations. An Introduction, Wiley 1992 .

Enrique A. Gonzales-Velasco, E. Gonzales-Velasco: Fourier Anaysis and Boundary Value Problems, Academic Press, 1995 Gerald B. Folland: Fourier Analysis and Its Applications, Brooks / Cole, 1996.

Assessment methods and criteria:

Final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Martti Kumpulainen

Working life cooperation:

-

801344A: Basic Course on Numerical Computation, 8 op

Voimassaolo: 01.03.2011 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Erkki Laitinen
Opintokohteen oppimateriaali:
Haataja Juha, Rahola J., Ruokolainen J., , 1998
Opintokohteen kielet: Finnish

ECTS Credits:

8 cr

Language of instruction:

Finnish

Timing:

Spring.

Learning outcomes:

On successful completion of this course, the student will be able to
- solve basic numerical problems using Fortran programmin
- exploit the Unix computers and software libraries for solving numerical problems.

Contents:

On the course students train programming of numerical algorithms using Fortran programming language in Unix (Linux) operating system. On the course, DISLIN subroutine library is used for the visualization of the numerical calculation results. The course contains following topics: Fortran95 programming language, Unix operating system, DISLIN graphical subroutine library.

Mode of delivery:

Face-to-face teaching / distance teaching.

Learning activities and teaching methods:

Lectures, Group working and practical work (Self-study) (40 h + 10 h + 20 h).

Target group:

Major and minor students

Recommended optional programme components:

-

Recommended or required reading:

Unix User guide, Fortran 2003 manual, Dislin manual, lecture notes.

Assessment methods and criteria:

This course utilizes continuous assessment and final work.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Passed / not passed.

Person responsible:

Erkki Laitinen

Working life cooperation:

-

801387A: Basic Course on Numerical Analysis, 6 op

Voimassaolo: 01.03.2011 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Erkki Laitinen
Opintokohteen oppimateriaali:
Atkinson, Kendall, , 1993
Opintokohteen kielet: Finnish

ECTS Credits:

6 cr

Language of instruction:

Finnish.

Timing:

Autumn semester.

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 and corresponding computer algorithms for solving the most common basic problems in applied mathematics. For the methods, convergence, stability and suitability for computer arithmetic are considered. The course contains iterative and direct solution methods for the following basic problems: systems of nonlinear equations, systems of linear equations, interpolation, integration, derivation and differential equations.

Mode of delivery:

As face-to-face teaching.

Learning activities and teaching methods:

Lectures 56h / Group work 24 h.

Target group:

All students.

Prerequisites and co-requisites:

No recommended prior courses.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Ward Cheney, David Kincaid: "Numerical Mathematics and Computing"
Lecture notes (in finnish).

Assessment methods and criteria:

Two intermediate exams.
Final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5.

Person responsible:

Erkki Laitinen

802362A: Introduction to computational inverse problems, 5 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Mikko Orispää
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

801386A: Complex Analysis II, 4 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Valeriy Serov
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 fundamendal 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 presentaion of analtic functions by using power series will be studied. After Laurent repsentation of complex functions theory of residues will be considered and as applicatio this theory wiil be used to calculate certain type of definite integrals.

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Valeriy Serov

801390A: History of Mathematics, 6 op

Opiskelumuoto: Intermediate Studies
Laji: Course
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.

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

801389A: Basic Geometry, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

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 aries and volumes are presented.

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Martti Kumpulainen

802328A: Basics in Number Theory, 5 op

Voimassaolo: 01.06.2011 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapani Matala-aho

Opintokohteen oppimateriaali:

Hardy, G. H., , 1979
Rosen, Kenneth H., , 1993
Opintokohteen kielet: Finnish

ECTS Credits:

5 cr

Language of instruction:

Finnish/English

Timing:

2.-3. year of studies. Timing varies.

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 studing 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.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

36h lectures, 18h exercises

Target group:

Major and minor students

Prerequisites and co-requisites:

802354A Lukuteoria ja ryhmät,
802355A Rings, fields and polynomials
802118P Linear algebra I
802119P Linear algebra II
802352A Euclidean topology
802353A Series and integrals

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes,
G.H. Hardy ja E.M. Wright: An Introduction to the Theory of Numbers;
Kenneth H. Rosen: Elementary number theory and its applications.

Assessment methods and criteria:

Mid-term exams or final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Tapani Matala-aho

Working life cooperation:

-

802331A: Principles to Mathematical Modelling, 8 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

802360A: Introduction to inverse problems, 4 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Sari Lasanen
Opintokohteen kielet: Finnish

ECTS Credits:

4 cr

Language of instruction:

Finnish. Alternatively, a book examination in English.

Learning outcomes:

Upon completion, the student will be able to

- recognise several inverse problems
- describe typical properties of inverse problems
- solve simple inverse problems with accurate and inaccurate data

Contents:

1. Examples of inverse problems and their typical properties
2. Well-posed and ill-posed problems
3. Least squares solutions
4. Tikhonov regularization
5. Statistical inverse problems

Learning activities and teaching methods:

Lectures 4x45 min / week. Exercises 2x45 min /week.

Target group:

Suitable for major and minor students.

Prerequisites and co-requisites:

- 802118P Linear Algebra I
- 802119P Linear Algebra II

Also recommended:

- 800322A Multidimensional Analysis (or Analysis II)
- 801396A Introduction to Probability Theory II
- 802352A Euclidian Topology
- 800345A Differential Equations I

Assessment methods and criteria:

Exam.
Read more about assessment criteria at the University of Oulu webpage.

Other information:

This course does not contain numerical programming tasks. Computer-aided computations are contained in a separate course

802362A Introduction to Computational Inverse Problems.

801385A: Complex Analysis I, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Valeriy Serov

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 algebrai and toplogical 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 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 complex plane will be considered. For the complex functions the concepts of limit, continuity and derivate will be studied. Some basic properties of analytic functions will be considered and Cauchy-Riemann formulas will be proved. Finally basic theory of pathintegral of complex functions will be studied.

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Valeriy Serov

801396A: Introduction to Probability Theory II, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:
Tuominen, P., , 1993

Opintokohteen kielet: Finnish

ECTS Credits:

4 cr

Language of instruction:

Finnish

Timing:

2. year, Fall semester

Learning outcomes:

On successful completion of this course, the student will be able to
- understand probability theory deeper than before
- apply various stocastic 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 distibutions.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

24h lectures, 12h exercises

Target group:

Major- and minor students. Recommended for students aiming to Master's degree with major in statistics or major in mathematics and computer sciences.

Prerequisites and co-requisites:

801195P Introduction to propability I
802352A Euclidean topology
802353A Series and integrals

Assessment methods and criteria:

Final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Kenneth Nordström.

802363A: Metric Spaces, 6 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Mahmoud Filali
Opintokohteen kielet: Finnish

ECTS Credits:

5 cr

Language of instruction:

English (also in Finnish)

Timing:

2.-3. year studies. Timing varies.

Learning outcomes:

After completing the course, student is able to participate fully for more advanced courses in topology and analysis.

Contents:

Course includes basic definitions and results in metric spaces. Keywords are: interior, closure, convergence in metric spaces, continuity in metric spaces, Baire's theorem, compactness, contraction, implicit function theorem. Course takes known and classical results in real analysis and generalizes them to metric spaces.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

28h lectures, 14h exercises

Target group:

Major studies

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Mahmoud Filali

Working life cooperation:

-

801346A: Introduction to Cryptography, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapani Matala-aho

Opintokohteen kielet: Finnish

Leikkaavuudet:

802336A	Introduction to Cryptography	5.0 op

ECTS Credits:

4 cr

Language of instruction:

Finnish

Timing:

2. year or later, Fall term (1. or 2. period)

Learning outcomes:

After completeing the course, student
- knows the principles of sime traditianl 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 traditianl symmetric key methods (affine system, matrix cryptography) and three public key methods, namely RSA, discrete logarithm and knapsack.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

27 h lectures, 15 h exercises

Target group:

Major and minor students

Prerequisites and co-requisites:

Compulsory basic and intermediate studies in mathematics.

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Final exam

Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Tapani Matala-aho

802364A: Introduction to Mathematical Software, 6 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Markus Harju
Opintokohteen kielet: Finnish

ECTS Credits:

6 cr

Language of instruction:

Lecturing language is Finnish, but the main points can be explained also in English if necessary. The software and the majority of course material is also in English.

Timing:

Autumn semester, period one.

Learning outcomes:

Upon completion of the course, the student
- knows the basics of the use of the most common mathematical software
- is able to use mathematical software in solving mathematical tasks and problems
- is able to independently deepen her knowledge of different mathematical software as necessary.

Contents:

During the course, the student learns the basics of some of commonly used mathematical software which include
- R
- Matlab
- Mathematica

Time permitting, it is also possible to learn other mathematical software depending the interests of the students.

Mode of delivery:

The course is arranged in a computer class as a series of lectures and rehearsals. On the lectures, the students have the possibility to use and try the mathematical software during the lectures. In the rehearsals, different given problems and tasks are solved together.

Learning activities and teaching methods:

Lecures 22h / Rehearsals 22h / Self-study 60h. The self-study contains the independent learning of the software and also the preparation of the final assignments.

Target group:

Anybody interested in mathematical software.

Prerequisites and co-requisites:

The required prerequisite is the completion of following courses (or corresponding knowledge of the subject):
- 802118P Linear Algebra I
- 802119P Linear Algebra II.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

The required and recommended reading consists mainly on free material (manuals/tutorial) found in the internet. More information will be given at the beginning of the course.

Assessment methods and criteria:

The course is assessed by final assignments. The student who wish to complete the course at A-level will make two separate assignments of given topics using (at least) two different mathematical software. Those who wish to complete the course in S-level will need to discuss with the lecturer about the extra work needed to pass. For example, it could be possible to do assignments of wider topics, making an assignment (s) with a software not covered in the course, or making an assignment that requires particular skills and knowledge.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course utilizes verbal grading scale “Pass/ fail”.

Person responsible:

Mikko Orispää

Working life cooperation:

-

802322A: Basics in mathematical modelling, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Erkki Laitinen
Opintokohteen kielet: Finnish

800149P: Introduction to LateX, 2 op

Opiskelumuoto: Basic Studies
Laji: Course
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

Language of instruction:

Finnish (in english if needed)

Timing:

2-3 year of studies, before making the Bachelor's thesis

Learning outcomes:

After completing the course, student

- is able to describe the principles of LaTeX document preparation system
- can form basic template of LaTeX document and modify it to his/her needs
- knows basic commands when writing mathematical text
- is able to use different environments (e.g. enumertions, equations)
- can recognize and fix errors in LaTeX code
- is able to write Bachelor's and Master's thesis using LaTeX

Contents:

Bachelor's and Master's thesis are written using LaTeX document preparation system. This course introduces basics in LaTeX by giving basic knowledge of the principles of LaTeX.

Mode of delivery:

Lectures/exercises (computer class)

Learning activities and teaching methods:

Face-to-face teaching

Target group:

Major students

Prerequisites and co-requisites:

first year math studies

Recommended optional programme components:

Must be completed before Bachelor's thesis.

Recommended or required reading:

Lecture notes
Tobias Oetiker Hubert Partl, Irene Hyna and Elisabeth Schlegl, *The Not So Short Introduction to LATEX2#* (http://tobi.oetiker.ch/lshort/lshort.pdf)
Kopka, H. and Daly, P. W., *Guide to LaTeX (4th Edition)*,Addison-Wesley Professional, 2003

Assessment methods and criteria:

Participation in lectures/exercises and home work.

Grading:

Pass/Fail

Person responsible:

Markus Harju

Working life cooperation:

-

802157P: Mathematics in teaching, 2 op

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Basic Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

800146P	Introduction to teaching	5.0 op

ECTS Credits:

2 cr

Language of instruction:

Finnish

Timing:

1st year, periods 3 and 4

Learning outcomes:

The student can reflect critically on the learning of mathematics.

Contents:

Learning and teaching mathematics are thought about and discussed.
The course consists of reflective exercises and seminar meetings where the exercises are discussed.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

16 h seminar meetings, 37 h self-study and group work.

Target group:

Mathematics teacher students

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

Active participation, learning journal

Grading:

pass/fail

Person responsible:

Pekka Salmi

800697S: Pro Gradu Thesis, 20 op

Opiskelumuoto: Advanced Studies

Laji: Diploma thesis

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
20 cr
Language of instruction:
Finnish (also English)
Timing:
5. year of studies
Learning outcomes:
After writing the Master's degree, student has written an analytical and logical study of a problem or theory in a field of mathematics, applied mathematics or statistics. Completing the thesis succesfully, student is able to write scientific articles and texts in mathematics.
Contents:
The scope of the Master's thesis is 20 cr for Teacher students and 30 cr in other disciplines. In Master's thesis, the student engages in researching a specific mathematical area or problem in the field of mathematics, appliead mathematics or statistics.
Mode of delivery:
Thesis
Learning activities and teaching methods:
Own work, meetings with the supervisor
Target group:
Major students
Prerequisites and co-requisites:
Bachelor's degree (or equivalent), 20-50 cr advanced studies
Recommended optional programme components:
-
Recommended or required reading:
-
Assessment methods and criteria:
Thesis
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Professors and other teaching personnel
Working life cooperation:
-

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

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Pekka Salmi

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
Language of instruction:
Finnish
Timing:
4.-5. year of studies, periods 3 and 4.
Learning outcomes:
After completing the course the student can combine a mathematical way of thinking to hers/his teaching.
Contents:
This module aims at bridging the gap between the mathematical content in the BSc with the skills needed for teaching at schools. The course consists of the following three parts:
Content planning (4 credits)
In this part the students plan and execute teaching samples about specific topics in school mathematics.
In addition we examine research in didactics of mathematics. Teaching samples and presentations of research articles are discussed in a seminar, active participation is mandatory. The students also write reporst about their works.
High school mathematics courses and marking of matriculation exam (3 credits)
This part is executed in the Oulu university teacher training school. In this part the student study the contents of the high school courses and the principles of marking the matriculation exam. During this part the students mark answers from earlier exams. The part consists of 28 hours of meeting which are mandatory.
Other training (3 op)
This part includes (by the choice of the students) 3 credits consisting of tutoring and/or teaching experience (which is not part of some other course) or equivalent.
Mode of delivery:
Seminar, face-to-face teaching and other work.
Learning activities and teaching methods:
30 h seminar (Content planning), 28 h lectures and exercises (High school mathematics courses and marking of matriculation exam).
Target group:
Mathematics subject teachers.
Prerequisites and co-requisites:
Bachelor degree in Mathematics or equivalent studies.
Recommended optional programme components:
-
Recommended or required reading:
-
Assessment methods and criteria:
Active participation in the seminars, written reports, training.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass/Fail
Person responsible:
Pekka Salmi
Working life cooperation:
-

H325003: Mathematics, optional advanced studies, 0 - 120 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Advanced Studies
Laji: Study module
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Electives

802653S: Lebesgue Measure and Integration Theory, 5 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Mikael Lindström
Opintokohteen kielet: Finnish

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

801698S: Cryptography, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
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

Language of instruction:

Finnish/English

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-Srassen.

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

802655S: Continued Fractions, 5 op

Voimassaolo: 01.01.2011 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Language of instruction:

FI/EN

Recommended or required reading:

G.H. Hardy & E.M. Wright: An Introduction to the Theory of Numbers.
Kenneth H. Rosen: Elementary number theory and its applications.
Lisa Lorentzen and Haakon Waadeland: Continued Fractions with Applications (1992).
Oskar Perron: Die Lehre von den Kettenbruchen (1913).

Course material: http://cc.oulu.fi/~tma/OPETUS.html

802644S: Introduction to Functional Analysis, 10 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Mahmoud Filali
Opintokohteen kielet: Finnish

Learning outcomes:

If we think of functional analysis as infinite dimensional linear algebra, then the course offers the tools and the ways to handle this infinite dimension. After completing the course successfully, the student will be able to follow almost any material on functional analysis.

Contents:

After recalling some basic definitions on linear algebra and giving the basic definitions concerning normed spaces, we present the uniform boundedness principle and the open mapping theorem. In this first part of the course, the relative compactness of the unit ball in a normed space is studied under the norm topology. Hahn-Banach Theorem is presented in its various forms: algebraic, analytic and geometric, and followed by Krein-Milman Theorem. We end up with the weak topology on normed spaces and the weak* topology on Banach duals. The relative compactness of the unit ball is studied with respect to these two topologies.

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Mahmoud Filali

802636S: Information Theory, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
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

Language of instruction:

Finnish.

Timing:

Spring semester, 3rd and 4th periods.

Learning outcomes:

Upon completing the course the student will
- be familiar with the central concepts and results of information theory
- be able to solve mathematical problems that arise in information theory
- be able to derive the central results of information theory

Contents:

The course introduces Claude Shannons' mathematical theory of communication, its basic concepts and results. The questions discussed include quantification of the amount of information of an information source, compression of information, coding, communication of coded information through a communication channel and decoding of received messages.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

56 h of lectures, 28 h of exercises.

Target group:

Mathematics, applied mathematics and statistics majors. Other students with a sufficient mathematical background.

Prerequisites and co-requisites:

Calculus in one and several dimensions, linear algebra I and II. Probability theory I. Probability theory II or Random variables and distributions.

Recommended or required reading:

Lecture notes written by the instructor.

Assessment methods and criteria:

Final exam. In the first exam following the course the student gets credit for the homework problems he /she has solved during the course.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Lasse Holmström

Working life cooperation:

-

Other information:

Level: advanced studies.

802635S: Introduction to partial differential equations, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
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 R^n and in bounded domains, potential theory, Green's function, Heat equation in R^n and in bounded domains, Wave equation in R^n and in bounded domans, d'Alembert formula for any dimensions, Fourier method.

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Valeriy Serov

802652S: Hilbert Spaces, 5 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

800624S	Analysis III	10.0 op

ECTS Credits:

5 ECTS credits

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

800651S: Functional analysis, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Language of instruction:

Finnish (English if neede)

Timing:

4-5 year of studies. Timig varies.

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.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

56h lectures, 24h exercises

Target group:

Major students

Prerequisites and co-requisites:

Compulsory basic and intermediate studies.

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes
E. Kreyszig: Introductory Functional Analysis with Applications, Wiley Classics Library, 1989
K. Astala, P. Piiroinen, H.-O. Tylli, Funktionaalianalyysin peruskurssi, Helsingin yliopisto, luentomoniste 2008.

Assessment methods and criteria:

Final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Mikael Lindström

Working life cooperation:

-

802629S: Function estimation, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Lasse Holmström
Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Language of instruction:

Finnish

Timing:

Spring semester, 3rd and 4th periods

Learning outcomes:

Upon completing the course the student will be able to
- characterise the basic features non-parametric function estimation methods
- apply such estimation methods to practical problems
- derive some of the basic results of non-parametric function estimation for kernel estimators

Contents:

The course focuses on the theory and practice of non-parametric function estimation with a special emphasis on kernel methods. The particular functions considered are a probability density function and a regression function.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

42 h of lectures, 28 h of exercises

Target group:

Mathematics, applied mathematics and statistics majors. Other students with a sufficient mathematical background.

Prerequisites and co-requisites:

Calculus in one and several dimensions. Probability theory I. Probability theory II or Random variables and distributions.

Recommended optional programme components:

No

Recommended or required reading:

Lecture notes written by the instructor.

Assessment methods and criteria:

Final exam. In the first exam following the course the student gets credit for the homework problems he /she has solved during the course. This is agreed in the beginning of the course.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Lasse Holmström

Working life cooperation:

No

Other information:

No

800674S: Fourier transform and distributions, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Valeriy Serov
Opintokohteen oppimateriaali:
Stein, Elias M.; Shakarchi R., , 2003
Taylor, Michael E., , 1996
Grafakos Loukas, , 2004
Stakgold, Ivar , , 1998
Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Language of instruction:

English

Timing:

4.-5. year of studies. Timing varies.

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.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

56h lectures, 28h exercises

Target group:

Major students

Prerequisites and co-requisites:

Euclidiean topology, Series and integrals, Multidimensional analysis, Complex analysis I and II, and Linear algebra I and II.

Recommended optional programme components:

-

Recommended or required reading:

Luentomoniste
E.M. Stein & R. Shakarchi: Fourier Analysis (an Introduction), Princeton University Press, 2003;
L. Grafakos: Classical and Modern Fourier Analysis, Pearson Education, 2004;
I. Stakgold: Green's Functions and Boundary Value Problems, 2nd edition, Wiley, 1998;
M. Taylor: Partial Differential Equations (Basic Theory), Springer, 1996.

Assessment methods and criteria:

Final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Valeriy Serov

Working life cooperation:

-

802647S: Fourier series and the discrete Fourier transform, 10 op

Voimassaolo: 01.01.2010 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Valeriy Serov
Opintokohteen kielet: English

Ei opintojaksokuvauksia.

802656S: Algebraic numbers, 5 op

Voimassaolo: 01.01.2012 -
Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Language of instruction:

FI/EN

Learning outcomes:

As usual in my mathematical studies I shall be ableto solve problems arising from the subject andto 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:

First we revise some basics of rings and fieldswhich are needed to proceed ahead field extensions. In particular, divisibility in an integral domain is carefully studied yielding to applications in the theory of polynomial algebra and algebraic integers.
The theory of algebraic numbers is strongly based on polynomial algebra, where the properties of zeros and divisibility of polynomials are considered.
The definition of an algebraic number will be generalized to the algebraic elements of field extensions going forward to algebraic fields.Considered as most important algebraic fields we get number fields which are finitely generated subfields of the field A of all complex algebraic numbers. In particular, we study quadratic number fields.
Further, we shall consider the divisibility and factorization of algebraic integers with some applications to Diophantine equations.

Prerequisites and co-requisites:

Algebra I and II, Linear algebra I and II, Basics in Number Theory (Number theory I)

Recommended or required reading:

I.N. Stewart and D.O. Tall: Algebraic number theory.
Daniel Marcus: Number fields.
J.B. Fraleigh: Abstract algebra.
Michael Artin: Algebra.

Course material: http://cc.oulu.fi/~tma/OPETUS.html

802637S: Advanced Problem Solving, 2 - 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Peter Hästö

Opintokohteen kielet: English

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

802645S: Number Theory A, 5 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapani Matala-aho

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

802646S: Number Theory B, 5 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Tapani Matala-aho
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

802631S: Modern real analysis, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Learning outcomes:

On successful completion of this course, the student will be able to
- derive and prove basic results of modern real analysis.
- apply the results and methods of modern real analysis in different topics of mathematics, like in the theory of partial differential equations.

Contents:

The course presents Lebesgue spaces (Hölder's and Minkowski's inequalities, completeness, dual spaces), the Vitali covering theorem, the Hardy-Littlewood maximal function, approximation with smooth functions using convolution, Lebesgue's density theorem, Sobolev's inequalities.

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

800688S: Theory of Optimization, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
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

Language of instruction:

Finnish

Timing:

Autumn.

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.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 56 h / Group work 24 h.

Target group:

All

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Luenberger D.G.: introduction to Linear and Nonlinear Programming, Peressini A.L., Sullivan F.E. and Uhl, J.J.Jr.: The Mathematics of Nonlinear Pro-gramming, Lecture Notes.

Assessment methods and criteria:

During the course, there are two intermediate exams.
Final exam ater the course.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Erkki Laitinen

Working life cooperation:

-

800660S: Group Theory, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Niemenmaa Markku
Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Language of instruction:

Finnish

Timing:

4-5 year of studies. Timing varies.

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 56 h, exercises 28 h.

Target group:

Major students

Prerequisites and co-requisites:

802355A Number theory and groups
802355A Rings, Fields and polynomials
800343A Permutations, fields and Galois' theory

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Mid-term exam or final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Markku Niemenmaa

Working life cooperation:

-

802633S: Statistical Pattern Recognition, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

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

Language of instruction:

Finnish

Timing:

Spring semester, 3rd and 4th periods.

Learning outcomes:

Upon completing the course the student will
-be familiar with the most common classifiers used in pattern recognition
-be able to apply pattern recognition methods to practical problems
-be able derive some of the basic mathematical results of pattern recognition theory

Contents:

The course focuses on the theory and practice of pattern recognition with emphasis on classifiers and feature extraction

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

42 h of lectures, 28 h of exercises

Target group:

Mathematics, applied mathematics and statistics majors. Other students with a sufficient mathematical background.

Prerequisites and co-requisites:

Calculus in one and several dimensions, linear algebra I and II. Probability theory I. Probability theory II or Random variables and distributions.

Recommended or required reading:

Lecture notes.
Optional reading:
R. O. Duda, P. E. Hart, and D. G. Stork. Pattern Classification. Wiley-Interscience, second edition, 2000.
S. Theodoridis and K. Koutroumbas. Pattern Recognition. Academic Press, 1999.
A. Webb. Statistical Pattern Recognition. Arnold, 1999 (Second edition: John Wiley & Sons Ltd, 2002).

Assessment methods and criteria:

Final exam. In the first exam following the course the student gets credit for the (possible) homework problems he/she has solved during the course.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Lasse Holmström

Working life cooperation:

No

Other information:

No

801643S: Topology, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Mahmoud Filali
Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Language of instruction:

English (also Finnish)

Timing:

3.-5. year of studies. Timing varies.

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

56h lectures, 28h exercises

Target group:

Major students

Prerequisites and co-requisites:

Compulsory basic and intermediate studies in mathematics, 800329A Topologia I

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Mid-term exams or final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Mahmoud Filai

802651S: Abstract Measure Theory, 5 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Ville Suomala
Opintokohteen kielet: Finnish

ECTS Credits:

5 cr

Language of instruction:

Finnish

Timing:

Spring

Learning outcomes:

After completing the course, the students know the basics of abstract measure and integration theory and are able to apply the main theorems in concrete situations.

Contents:

Basic concepts of measure theory: outer measure, sigma-algebra, measure, measurability, Lebesgue measure, integral, product measure.
Basic theorems: Convergence theorems, Fubini's theorem.

Mode of delivery:

Lectures, Exercises.

Prerequisites and co-requisites:

Basic knowledge of analysis in Euclidean spaces, set theory and topology. The course 800322A.

Recommended or required reading:

Bruckner, Bruckner, Thomson: Real Analysis; Cohn: Measure Theory; Purmonen: Mitta- ja integraaliteoria; ...

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Ville Suomala

802650S: Fractal Geometry, 10 op

Voimassaolo: 01.01.2010 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Esa Järvenpää
Opintokohteen kielet: Finnish

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

802660S: Operator theory and integral equations, 10 op

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Valeriy Serov
Opintokohteen kielet: English

ECTS Credits:

10 cr

Language of instruction:

English

Timing:

The course is held in the whole autumn semester 2014/2015, during periods I and II. It is recommended to complete the course at the end of autumn semester.

Learning outcomes:

Upon completion the student should be able to:

- Operate with self-adjoint operators in the Hilbert spaces.
- Operate with compact operators in the Hilbert spaces.
- Operator with one-dimensional integral equations of the first and second order.

Contents:

1. Inner product spaces and Hilbert spaces.
2. Symmetric operators in the Hilbert space. J. von Neumann's theorems about symmetric operators. Basic criterion of self-adjointness.
3. Orthogonal projection operators. J. von Neumann's spectral theorem.
4. Spectrum of self-adjoint operator.
5. Riesz theory of compact operators.
6. Quadratic forms. Friedrichs extension of symmetric operators.
7. Elliptic differential operators in bounded domains.
8. Spectral function of self - adjoint operators. Green's function.
9. Integral operators with weak singularities. Integral equations of the first and second kind.
10. Volterra integral equations.

11. Singular integral equations.
12. Nyström's method for equation of second kind.
13. The Galerkin method for integral equations.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 56 h / Group work 24 h / Self-study 24 h. The exercises are completed as group work. (N.B. This must show all the course hours, which means that total 104 hours = 10 ECTS credits).

Target group:

Major students in mathematics, physics and engineering.

Prerequisites and co-requisites:

The required (or recommended) prerequisite is the completion of the following courses prior to enrolling for the course: Linear Algebra, Ordinary differential equations (I), Complex analysis (I), Analysis (I) and (II).

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

They following books are recommended (the course based on these books):
1) R. Kress, Linear integral equations, Springer-Verlag New York, 1999.
2) F. Riesz and B. Sz-Nagy, Functional analysis, Ungar, 1978.
3) A.N. Kolmogorov and S.V. Fomin, Elements of the theory of functions and functional analysis, DaverPublications, 1999.

Assessment methods and criteria:

The assessment criteria are based on the learning outcomes of the course. The final exam is required only.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Professor, Valery Serov
vserov@cc.oulu.fi

802664S: Differential geometry, 10 op

Voimassaolo: 01.06.2014 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

ECTS Credits:

10 cr

Language of instruction:

English (if foreign participants)

Timing:

Master's or PhD-studies

Learning outcomes:

The knowledge of basic concepts and results in differential geometry.

Contents:

Differentiable manifold, tangent space, derivative.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

56 h lectures, 28 h exercises.

Target group:
Mathematics and other interested students
Prerequisites and co-requisites:
Analysis of several variables
Grading:
1 - 5, fail
Person responsible:
Esa Järvenpää

H326603: Statistics optional advanced studies, 0 - 120 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Advanced Studies
Laji: Study module
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Electives

805609S: Statistical methods in epidemiology, 9 op

Opiskelumuoto: Advanced Studies
Laji: Course
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

Assessment methods and criteria:
Read more about assessment criteria at the University of Oulu webpage.

805646S: Analysis of longitudial data, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
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:
5/6 cr
Language of instruction:
Finnish

Timing:

Every secon year.

Learning outcomes:

After finishing the course a student can apply pooled ordinary least squares, generalized least squares, random effects methods, and fixed effects methods.

Contents:

1. Introduction: data types, omitted variables.
2. Mathematical tools: conditional expectation, basic asymptotic theory.
3. Basics of ordinary least squares.
4. Estimating systems of equations by ordinary least squares and by generalized least squares, panel data and seemingly unrelated regression as examples, simultaneous exogeneity and strict exogeneity, consistency and asymptotic normality, homoskedasticity and heteroskedasticity.
5. Pooled ordinary least squares for panel data, aggregated time effect, dummy variables, testing serial correlation and heteroskedasticity.
6. Unobserved effects model: random effects and fixed effects.
7. Random effects methods: random effects structure of the covariance matrix.
8. Fixed effects methods: fixed effects transformation, the use of dummy variables, first differencing transformation.
9. Comparison of estimators.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are voluntary
exercises. There are 14 times 2 hour lectures and 7 times 2 hour exercises.

Target group:

Students of economics and mathematical sciences.

Prerequisites and co-requisites:

Basic Mathematics for Economics 1 and 2, Basic
Methods in Statistics 1, Introduction to Econometrics.

Recommended or required reading:

J. M. Wooldridge: Econometric Analysis of Cross Section and Panel Data (The MIT Press).

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

The course is organized every two years.
The home page of the course is http://cc.oulu.fi/~jklemela/panel/

805679S: Time series analysis, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

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:

5 cr

Language of instruction:

Finnish

Learning outcomes:

After finishing the course, a student can apply linear, nonlinear and nonparametric modeling of time series. A student learns how to choose between alternative time series models and can apply statistical software to fit time series models.

Contents:

1. The course covers basic concepts of time series analysis: stationarity, autocorrelation, spectral distribution and periodogram.
2. Linear time series analysis includes explanation, prediction, parameter estimation and model diagnostics in ARMA models.
3. Nonlinear time series analysis includes threshold models and heteroskedastic time series models (ARCH and GARCH).
4. Furthermore, nonlinear nonparametric smoothing is covered (time space smoothing and state space smoothing) and nonparametric estimation of spectral densities. Nonparametric function estimation includes kernel estimation, local polynomial regression and additive modeling.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are voluntary exercises.
There are 14 times 2 hour lectures and 7 times 2 hour exercises.

Target group:

Students of mathematical sciences, econometrics and finance students.

Prerequisites and co-requisites:

Basic probability theory.

Recommended optional programme components:

-

Recommended or required reading:

Fan, J. ja Yao, Q. (2005). Nonlinear Time Series, Springer.

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

Home page of the course is http://cc.oulu.fi/~jklemela/timeseries/
Recommended reading:
P. J. Brockwell and R. A. Davis: Time Series: Theory and Methods, Springer, 1991.
H. Lutkepohl: Introduction to Multiple Time Series Analysis, Springer.
J. Hamilton: Time Series, Princeton University Press The MIT Press, 1994.

805683S: The Statistical Foundation of Econometrics, 5 - 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

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 Foundation of Econometrics 5.0 op

ECTS Credits:

5/6 cr

Language of instruction:

Finnish

Timing:

Every second year.

Learning outcomes:

The course familiarizes students with applications of statistical models when inferences are made on economic phenomena. The principles of statistical inference on economic phenomena are the same as those of general
statistical inference but there are some special issues that make the inference different in economics than in other application areas of statistics. After finishing the course, a student can apply linear regression and a student is able to apply the method of instrumental variables. A student can diagnose the validity of the assumptions of the linear regression models and tune his inferences accordingly.

Contents:

1. Introduction: causal relationships and ceteris paribus analysis, data structures, stochastic explanatory variables.
2. Matrix algebra and the least squares estimator.
3. Conditional expectation.
4. Basic asymptotic theory: the weak law of large numbers, the central limit theorem, consistency and asymptotic normality of estimators.
5. The single-equation linear model: endogeneity and exogeneity, consistency and asymptotic normality of the ordinary least squares estimator, homoskedasticity and heteroskedasticity, identifiability of parameters, t-test, Wald's test, F-test, Lagrange multiplier test, omitted variables problem, proxy variables solution to the omitted variables problem, measurement errors.
6. Instrumental variables: two-stage least squares estimator, consistency and asymptotic normality, asymptotic efficiency, indicator variables solution.
7. Newey-West estimator of covariance matrix, generalized method of moments and instrumental variables,
testing for endogeneity (Hausman test), testing for heteroskedasticity (Breusch-Pagan test, White's test), testing for autocorrelation (Durbin-Watson test, Box-Pierce test).

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are partly compulsory exercises.
There are 14 times 2 hour lectures and 7 times 2 hour exercises.

Target group:

Students of economics and mathematical sciences.

Prerequisites and co-requisites:

Basic Mathematics for Economics 1 and 2, Basic methods in statistics 1, Introduction to Econometrics.

Recommended or required reading:

J. M. Wooldridge: Econometric Analysis of Cross Section and Panel Data (The MIT Press)

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5

Person responsible:

Jussi Klemelä.

Other information:

The course is organized every two years. The course was organized at spring 2014.
The home page of the course is http://cc.oulu.fi/~jklemela/econometrics/
Recommended literature: William H. Greene: Econometric Analysis (Prentice Hall).

805681S: Generalized Linear Models, 9 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

805699S: Statistical methods in epidemiology, 8 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

806618S: Computationally intensive statistical methods, 9 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

806621S: Spatial Data Analysis, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

806628S: Statistical Finance, 5 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Jussi Klemelä

Opintokohteen kielet: Finnish

ECTS Credits:

5 cr

Language of instruction:

Finnish

Timing:

Every second year.

Learning outcomes:

On a successful completion of this course, the student is familiar with the basic concepts of derivative pricing and knows how to calculate the Black-Scholes price of a stock option. In addition, after completion of the course, the student knows how to calculate a Markowotz portfolio, how to evaluate the return and the risk of a portfolio, and knows how to calculate performance measures for a portfolio.

Contents:

1. Introduction: The main asset classes and derivative types.
2. The main concepts needed to price futures and options, arbitrage pricing and pricing with statistical arbitrage, the arbitrage free price of futures, the put-call-parity.
3. Pricing of options in the single period and multiperiod binary model, Black-Scholes pricing, and pricing in incomplete models.
4. The basic methods for choosing and evaluating a portfolio, Markowitz theory for the portfolio choice, maximization of the expected utility, and the maximization of the conditional expected utility.

Mode of delivery:

Face-to-face teachin

Learning activities and teaching methods:

Besides lectures, there are voluntary exercises.
There are 14 times 2 hour lectures and 7 times 2 hour exercises.

Target group:

Students of mathematical sciences, students of finance and economics.

Prerequisites and co-requisites:

Basic knowledge of statistics and probability.

Recommended optional programme components:

The course is suitable together with the course "Market Risk Analysis".

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Examination

Grading:

1 - 5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

The home page of the course is http://cc.oulu.fi/~jklemela/stafin/
The course is lectured every second year.
Additional literature:
Franke, J., Härdle, W., and Hafner, C. M. (2004).
Statistics of Financial Markets, Springer.
Bouchaud, J.-P. and Potters, M. (2003).
Theory of Financial Risk and Derivative Pricing,
Cambridge University Press.
Ruppert, D. (2004). Statistics and Finance, Springer.

806629S: Introduction to Sampling Methods, 4 op

Voimassaolo: 01.01.2010 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Läärä Esa
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

806630S: Market Risk Analysis, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Jussi Klemelä
Opintokohteen kielet: Finnish
Leikkaavuudet:

806330A Analysis of Market Risk 5.0 op

ECTS Credits:

5 cr

Language of instruction:

Finnish

Timing:

Every second year.

Learning outcomes:

The student knows how to estimate the unconditional value-at-risk using empirical quantiles, parametric modeling, semiparametric modeling, and extreme value theory. The student knows also how to estimate the conditional value-at-risk using GARCH models. Student knows how to apply statistical software to make the calculations.

Contents:

The course is an introduction to the quantitative risk management of a portfolio of stocks. The course introduces various risk measures, extreme value theory, and modeling of financial time series. The course covers:
1. Conditional and unconditional loss distribution,
2. Value-at-Risk and other risk measures,
3. standard methods of estimating Value-at-Risk: multivariate normal modeling, historical simulation /empirical quantiles, and the Monte Carlo method,
4. Modeling of distributions: multivariate distributions, normal mixture distributions, spherical and elliptical distributions, and dimension reduction,
5. Modeling of financial time series: ARMA models, GARCH models, and volatility models,
6. Copulas and measures of dependence,
7. Extreme value theory: block maxima and threshold exceedance methods.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are voluntary exercises.
There are 14 times 2 hour lectures and 7 times 2 hour exercises

Target group:

Students of mathematical sciences, students of finance and economics.

Prerequisites and co-requisites:

Basic knowledge of statistics.

Recommended optional programme components:

The course is suitable together with the course "Statistical Finance".

Recommended or required reading:

McNeil, A. J., Frey, R., and Embrechts, P. (2005).Quantitative Risk Management: Concepts, Techniques and Tools,Princeton Series in Finance, 608 pp.

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

The home page of the course is http://cc.oulu.fi/~jklemela/marketrisk/
The course is lectured every second year.

805651S: Stochastic processes, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

806622S: Probability, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

805611S: Mathematical statistics II, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
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

ECTS Credits:

10 cr

Language of instruction:

Finnish

Timing:

Every second year.

Learning outcomes:

On a successful completion of this course, the student can derive asymptotic distributions of estimators and test statistics in regular parametric models and can derive confidence intervals and p-values ot statistical tests based on these asymptotic distributions.

Contents:

The course covers statistical inference in finite dimensional parametric models:
1. asymptotic theory (convergence of random variables, weak law of large numbers and the central limit theorem),
2. likelihood inference (consistency and asymptotic normality, exponential families),
3. least squares method and the method of moments (consistency and asymptotic normality),
4. test theory (testing based on likelihood function and testing in linear models).
Furthermore, the course covers efficiency in parametric and nonparametric models, resampling, nonparametric function estimation, and adaptive estimation.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are voluntary exercises.
There are 28 times 2 hour lectures and 14 times 2 hour exercises.

Target group:

Master's students of statistics, students of mathematical sciences.

Prerequisites and co-requisites:

Statistical Inference I

Recommended optional programme components:

-

Recommended or required reading:

Davison, A. C. (2003).
Statistical Models, Cambridge Series in Statistical and Probabilistic Mathematics.

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

The home page of the course is http://cc.oulu.fi/~jklemela/stainf/
The course is organized every two year.
Additional literature:
Lehmann, E. ja Casella, G. Theory of Point Estimation.

800698S: Pro gradu thesis, 30 op

Opiskelumuoto: Advanced Studies

Laji: Diploma thesis

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
30 cr
Language of instruction:
Finnish (also English)
Learning outcomes:
After writing the Master's degree, student has written an analytical and logical study of a problem or theory in a field of mathematics, applied mathematics or statistics. Completing the thesis succesfully, student is able to write scientific articles and texts in mathematics.
Contents:
The scope of the Master's thesis is 20 cr for Teacher students and 30 cr in other disciplines. In Master's thesis, the student engages in researching a specific mathematical area or problem in the field of mathematics, appliead mathematics or statistics.
Mode of delivery:
Thesis
Learning activities and teaching methods:
Own work, meetings with the supervisor
Target group:
Major students
Prerequisites and co-requisites:
Bachelor's degree (or equivalent), 20-50 cr advanced studies
Recommended optional programme components:
-
Recommended or required reading:
-
Assessment methods and criteria:
Thesis
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Professors and other teaching personnel
Working life cooperation:
-

H325003: Mathematics, optional advanced studies, 0 - 120 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Advanced Studies
Laji: Study module
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Electives

802653S: Lebesgue Measure and Integration Theory, 5 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Mikael Lindström
Opintokohteen kielet: Finnish

Assessment methods and criteria:
Read more about assessment criteria at the University of Oulu webpage.

801698S: Cryptography, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

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

Language of instruction:

Finnish/English

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-Srassen.

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

802655S: Continued Fractions, 5 op

Voimassaolo: 01.01.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Language of instruction:

FI/EN

Recommended or required reading:

G.H. Hardy & E.M. Wright: An Introduction to the Theory of Numbers.
Kenneth H. Rosen: Elementary number theory and its applications.
Lisa Lorentzen and Haakon Waadeland: Continued Fractions with Applications (1992).
Oskar Perron: Die Lehre von den Kettenbruchen (1913).

Course material: http://cc.oulu.fi/~tma/OPETUS.html

802644S: Introduction to Functional Analysis, 10 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Mahmoud Filali

Opintokohteen kielet: Finnish

Learning outcomes:

If we think of functional analysis as infinite dimensional linear algebra, then the course offers the tools and the ways to handle this infinite dimension. After completing the course successfully, the student will be able to follow almost any material on functional analysis.

Contents:

After recalling some basic definitions on linear algebra and giving the basic definitions concerning normed spaces, we present the uniform boundedness principle and the open mapping theorem. In this first part of the course, the relative compactness of the unit ball in a normed space is studied under the norm topology. Hahn-Banach Theorem is presented in its various forms: algebraic, analytic and geometric, and followed by Krein-Milman Theorem. We end up with the weak topology on normed spaces and the weak* topology on Banach duals. The relative compactness of the unit ball is studied with respect to these two topologies.

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Mahmoud Filali

802636S: Information Theory, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

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

Language of instruction:

Finnish.

Timing:

Spring semester, 3rd and 4th periods.

Learning outcomes:

Upon completing the course the student will
- be familiar with the central concepts and results of information theory
- be able to solve mathematical problems that arise in information theory
- be able to derive the central results of information theory

Contents:

The course introduces Claude Shannons' mathematical theory of communication, its basic concepts and results. The questions discussed include quantification of the amount of information of an information source, compression of information, coding, communication of coded information through a communication channel and decoding of received messages.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

56 h of lectures, 28 h of exercises.

Target group:

Mathematics, applied mathematics and statistics majors. Other students with a sufficient mathematical background.

Prerequisites and co-requisites:

Calculus in one and several dimensions, linear algebra I and II. Probability theory I. Probability theory II or Random variables and distributions.

Recommended or required reading:

Lecture notes written by the instructor.

Assessment methods and criteria:

Final exam. In the first exam following the course the student gets credit for the homework problems he /she has solved during the course.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Lasse Holmström

Working life cooperation:

-

Other information:

Level: advanced studies.

802635S: Introduction to partial differential equations, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
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 R^n and in bounded domains, potential theory, Green's function, Heat equation in R^n and in bounded domains, Wave equation in R^n and in bounded domans, d'Alembert formula for any dimensions, Fourier method.

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Valeriy Serov

802652S: Hilbert Spaces, 5 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

800624S Analysis III 10.0 op

ECTS Credits:

5 ECTS credits

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

800651S: Functional analysis, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Language of instruction:

Finnish (English if neede)

Timing:

4-5 year of studies. Timig varies.

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.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

56h lectures, 24h exercises

Target group:

Major students

Prerequisites and co-requisites:

Compulsory basic and intermediate studies.

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes
E. Kreyszig: Introductory Functional Analysis with Applications, Wiley Classics Library, 1989
K. Astala, P. Piiroinen, H.-O. Tylli, Funktionaalianalyysin peruskurssi, Helsingin yliopisto, luentomoniste 2008.

Assessment methods and criteria:

Final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Mikael Lindström

Working life cooperation:

-

802629S: Function estimation, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Lasse Holmström
Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Language of instruction:

Finnish

Timing:

Spring semester, 3rd and 4th periods

Learning outcomes:

Upon completing the course the student will be able to
- characterise the basic features non-parametric function estimation methods
- apply such estimation methods to practical problems
- derive some of the basic results of non-parametric function estimation for kernel estimators

Contents:

The course focuses on the theory and practice of non-parametric function estimation with a special emphasis on kernel methods. The particular functions considered are a probability density function and a regression function.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

42 h of lectures, 28 h of exercises

Target group:

Mathematics, applied mathematics and statistics majors. Other students with a sufficient mathematical background.

Prerequisites and co-requisites:

Calculus in one and several dimensions. Probability theory I. Probability theory II or Random variables and distributions.

Recommended optional programme components:

No

Recommended or required reading:

Lecture notes written by the instructor.

Assessment methods and criteria:

Final exam. In the first exam following the course the student gets credit for the homework problems he /she has solved during the course. This is agreed in the beginning of the course.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Lasse Holmström

Working life cooperation:

No

Other information:

No

800674S: Fourier transform and distributions, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Valeriy Serov
Opintokohteen oppimateriaali:
Stein, Elias M.; Shakarchi R., , 2003
Taylor, Michael E., , 1996
Grafakos Loukas, , 2004
Stakgold, Ivar , , 1998
Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Language of instruction:

English

Timing:

4.-5. year of studies. Timing varies.

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.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

56h lectures, 28h exercises

Target group:

Major students

Prerequisites and co-requisites:

Euclidiean topology, Series and integrals, Multidimensional analysis, Complex analysis I and II, and Linear algebra I and II.

Recommended optional programme components:

-

Recommended or required reading:

Luentomoniste
E.M. Stein & R. Shakarchi: Fourier Analysis (an Introduction), Princeton University Press, 2003;

L. Grafakos: Classical and Modern Fourier Analysis, Pearson Education, 2004;
I. Stakgold: Green's Functions and Boundary Value Problems, 2nd edition, Wiley, 1998;
M. Taylor: Partial Differential Equations (Basic Theory), Springer, 1996.

Assessment methods and criteria:

Final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Valeriy Serov

Working life cooperation:

-

802647S: Fourier series and the discrete Fourier transform, 10 op

Voimassaolo: 01.01.2010 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Valeriy Serov
Opintokohteen kielet: English

Ei opintojaksokuvauksia.

802656S: Algebraic numbers, 5 op

Voimassaolo: 01.01.2012 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Language of instruction:

FI/EN

Learning outcomes:

As usual in my mathematical studies I shall be ableto solve problems arising from the subject andto 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:

First we revise some basics of rings and fieldswhich are needed to proceed ahead field extensions. In particular, divisibility in an integral domain is carefully studied yielding to applications in the theory of polynomial algebra and algebraic integers.
The theory of algebraic numbers is strongly based on polynomial algebra, where the properties of zeros and divisibility of polynomials are considered.
The definition of an algebraic number will be generalized to the algebraic elements of field extensions going forward to algebraic fields.Considered as most important algebraic fields we get number fields which are finitely generated subfields of the field A of all complex algebraic numbers. In particular, we study quadratic number fields.
Further, we shall consider the divisibility and factorization of algebraic integers with some applications to Diophantine equations.

Prerequisites and co-requisites:

Algebra I and II, Linear algebra I and II, Basics in Number Theory (Number theory I)

Recommended or required reading:

I.N. Stewart and D.O. Tall: Algebraic number theory.
Daniel Marcus: Number fields.
J.B. Fraleigh: Abstract algebra.
Michael Artin: Algebra.

Course material: http://cc.oulu.fi/~tma/OPETUS.html

802637S: Advanced Problem Solving, 2 - 6 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Peter Hästö
Opintokohteen kielet: English

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

802645S: Number Theory A, 5 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Tapani Matala-aho
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

802646S: Number Theory B, 5 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Tapani Matala-aho
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

802631S: Modern real analysis, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Learning outcomes:

On successful completion of this course, the student will be able to
- derive and prove basic results of modern real analysis.

- apply the results and methods of modern real analysis in different topics of mathematics, like in the theory of partial differential equations.

Contents:

The course presents Lebesgue spaces (Hölder's and Minkowski's inequalities, completeness, dual spaces), the Vitali covering theorem, the Hardy-Littlewood maximal function, approximation with smooth functions using convolution, Lebesgue's density theorem, Sobolev's inequalities.

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

800688S: Theory of Optimization, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

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

Language of instruction:

Finnish

Timing:

Autumn.

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.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 56 h / Group work 24 h.

Target group:

All

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Luenberger D.G.: introduction to Linear and Nonlinear Programming, Peressini A.L., Sullivan F.E. and Uhl, J.J.Jr.: The Mathematics of Nonlinear Pro-gramming, Lecture Notes.

Assessment methods and criteria:

During the course, there are two intermediate exams.
Final exam ater the course.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Erkki Laitinen

Working life cooperation:

-

800660S: Group Theory, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Niemenmaa Markku
Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Language of instruction:

Finnish

Timing:

4-5 year of studies. Timing varies.

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 56 h, exercises 28 h.

Target group:

Major students

Prerequisites and co-requisites:

802355A Number theory and groups
802355A Rings, Fields and polynomials
800343A Permutations, fields and Galois' theory

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Mid-term exam or final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Markku Niemenmaa

Working life cooperation:

-

802633S: Statistical Pattern Recognition, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

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

Language of instruction:

Finnish

Timing:

Spring semester, 3rd and 4th periods.

Learning outcomes:

Upon completing the course the student will
-be familiar with the most common classifiers used in pattern recognition
-be able to apply pattern recognition methods to practical problems
-be able derive some of the basic mathematical results of pattern recognition theory

Contents:

The course focuses on the theory and practice of pattern recognition with emphasis on classifiers and feature extraction

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

42 h of lectures, 28 h of exercises

Target group:

Mathematics, applied mathematics and statistics majors. Other students with a sufficient mathematical background.

Prerequisites and co-requisites:

Calculus in one and several dimensions, linear algebra I and II. Probability theory I. Probability theory II or Random variables and distributions.

Recommended or required reading:

Lecture notes.
Optional reading:
R. O. Duda, P. E. Hart, and D. G. Stork. Pattern Classification. Wiley-Interscience, second edition, 2000.
S. Theodoridis and K. Koutroumbas. Pattern Recognition. Academic Press, 1999.
A. Webb. Statistical Pattern Recognition. Arnold, 1999 (Second edition: John Wiley & Sons Ltd, 2002).

Assessment methods and criteria:

Final exam. In the first exam following the course the student gets credit for the (possible) homework problems he/she has solved during the course.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Lasse Holmström

Working life cooperation:

No

Other information:

No

801643S: Topology, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Mahmoud Filali
Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Language of instruction:

English (also Finnish)

Timing:

3.-5. year of studies. Timing varies.

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

56h lectures, 28h exercises

Target group:

Major students

Prerequisites and co-requisites:

Compulsory basic and intermediate studies in mathematics, 800329A Topologia I

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Mid-term exams or final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Mahmoud Filai

802651S: Abstract Measure Theory, 5 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Ville Suomala
Opintokohteen kielet: Finnish

ECTS Credits:

5 cr

Language of instruction:

Finnish

Timing:

Spring

Learning outcomes:

After completing the course, the students know the basics of abstract measure and integration theory and are able to apply the main theorems in concrete situations.

Contents:

Basic concepts of measure theory: outer measure, sigma-algebra, measure, measurability, Lebesgue measure, integral, product measure.
Basic theorems: Convergence theorems, Fubini's theorem.

Mode of delivery:

Lectures, Exercises.

Prerequisites and co-requisites:

Basic knowledge of analysis in Euclidean spaces, set theory and topology. The course 800322A.

Recommended or required reading:

Bruckner, Bruckner, Thomson: Real Analysis; Cohn: Measure Theory; Purmonen: Mitta- ja integraaliteoria; ...

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Ville Suomala

802650S: Fractal Geometry, 10 op

Voimassaolo: 01.01.2010 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Esa Järvenpää
Opintokohteen kielet: Finnish

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

802660S: Operator theory and integral equations, 10 op

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Valeriy Serov
Opintokohteen kielet: English

ECTS Credits:

10 cr

Language of instruction:

English

Timing:

The course is held in the whole autumn semester 2014/2015, during periods I and II. It is recommended to complete the course at the end of autumn semester.

Learning outcomes:

Upon completion the student should be able to:
- Operate with self-adjoint operators in the Hilbert spaces.
- Operate with compact operators in the Hilbert spaces.
- Operator with one-dimensional integral equations of the first and second order.

Contents:

1. Inner product spaces and Hilbert spaces.
2. Symmetric operators in the Hilbert space. J. von Neumann's theorems about symmetric operators. Basic criterion of self-adjointness.
3. Orthogonal projection operators. J. von Neumann's spectral theorem.
4. Spectrum of self-adjoint operator.
5. Riesz theory of compact operators.
6. Quadratic forms. Friedrichs extension of symmetric operators.
7. Elliptic differential operators in bounded domains.
8. Spectral function of self - adjoint operators. Green's function.
9. Integral operators with weak singularities. Integral equations of the first and second kind.
10. Volterra integral equations.
11. Singular integral equations.
12. Nyström's method for equation of second kind.
13. The Galerkin method for integral equations.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 56 h / Group work 24 h / Self-study 24 h. The exercises are completed as group work. (N.B. This must show all the course hours, which means that total 104 hours = 10 ECTS credits).

Target group:

Major students in mathematics, physics and engineering.

Prerequisites and co-requisites:

The required (or recommended) prerequisite is the completion of the following courses prior to enrolling for the course: Linear Algebra, Ordinary differential equations (I), Complex analysis (I), Analysis (I) and (II).

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

They following books are recommended (the course based on these books):
1) R. Kress, Linear integral equations, Springer-Verlag New York, 1999.
2) F. Riesz and B. Sz-Nagy, Functional analysis, Ungar, 1978.
3) A.N. Kolmogorov and S.V. Fomin, Elements of the theory of functions and functional analysis, DaverPublications, 1999.

Assessment methods and criteria:

The assessment criteria are based on the learning outcomes of the course. The final exam is required only.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Professor, Valery Serov
vserov@cc.oulu.fi

802664S: Differential geometry, 10 op

Voimassaolo: 01.06.2014 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

ECTS Credits:
10 cr
Language of instruction:
English (if foreign participants)
Timing:
Master's or PhD-studies
Learning outcomes:
The knowledge of basic concepts and results in differential geometry.
Contents:
Differentiable manifold, tangent space, derivative.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
56 h lectures, 28 h exercises.
Target group:
Mathematics and other interested students
Prerequisites and co-requisites:
Analysis of several variables
Grading:
1 - 5, fail
Person responsible:
Esa Järvenpää

H326603: Statistics optional advanced studies, 0 - 120 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Advanced Studies
Laji: Study module
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Electives

805609S: Statistical methods in epidemiology, 9 op

Opiskelumuoto: Advanced Studies
Laji: Course
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

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

805646S: Analysis of longitudial data, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

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:

5/6 cr

Language of instruction:

Finnish

Timing:

Every secon year.

Learning outcomes:

After finishing the course a student can apply pooled ordinary least squares, generalized least squares, random effects methods, and fixed effects methods.

Contents:

1. Introduction: data types, omitted variables.
2. Mathematical tools: conditional expectation, basic asymptotic theory.
3. Basics of ordinary least squares.
4. Estimating systems of equations by ordinary least squares and by generalized least squares, panel data and seemingly unrelated regression as examples, simultaneous exogeneity and strict exogeneity, consistency and asymptotic normality, homoskedasticity and heteroskedasticity.
5. Pooled ordinary least squares for panel data, aggregated time effect, dummy variables, testing serial correlation and heteroskedasticity.
6. Unobserved effects model: random effects and fixed effects.
7. Random effects methods: random effects structure of the covariance matrix.
8. Fixed effects methods: fixed effects transformation, the use of dummy variables, first differencing transformation.
9. Comparison of estimators.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are voluntary
exercises. There are 14 times 2 hour lectures and 7 times 2 hour exercises.

Target group:

Students of economics and mathematical sciences.

Prerequisites and co-requisites:

Basic Mathematics for Economics 1 and 2, Basic
Methods in Statistics 1, Introduction to Econometrics.

Recommended or required reading:

J. M. Wooldridge: Econometric Analysis of Cross Section and Panel Data (The MIT Press).

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

The course is organized every two years.
The home page of the course is http://cc.oulu.fi/~jklemela/panel/

805679S: Time series analysis, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
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:

5 cr

Language of instruction:

Finnish

Learning outcomes:

After finishing the course, a student can apply linear, nonlinear and nonparametric modeling of time series. A student learns how to choose between alternative time series models and can apply statistical software to fit time series models.

Contents:

1. The course covers basic concepts of time series analysis: stationarity, autocorrelation, spectral distribution and periodogram.
2. Linear time series analysis includes explanation, prediction, parameter estimation and model diagnostics in ARMA models.
3. Nonlinear time series analysis includes threshold models and heteroskedastic time series models (ARCH and GARCH).
4. Furthermore, nonlinear nonparametric smoothing is covered (time space smoothing and state space smoothing) and nonparametric estimation of spectral densities. Nonparametric function estimation includes kernel estimation, local polynomial regression and additive modeling.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are voluntary exercises.
There are 14 times 2 hour lectures and 7 times 2 hour exercises.

Target group:

Students of mathematical sciences, econometrics and finance students.

Prerequisites and co-requisites:

Basic probability theory.

Recommended optional programme components:

-

Recommended or required reading:

Fan, J. ja Yao, Q. (2005). Nonlinear Time Series, Springer.

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

Home page of the course is http://cc.oulu.fi/~jklemela/timeseries/
Recommended reading:
P. J. Brockwell and R. A. Davis: Time Series: Theory and Methods, Springer, 1991.
H. Lutkepohl: Introduction to Multiple Time Series Analysis, Springer.
J. Hamilton: Time Series, Princeton University Press The MIT Press, 1994.

805683S: The Statistical Foundation of Econometrics, 5 - 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

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 Foundation of Econometrics	5.0 op

ECTS Credits:

5/6 cr

Language of instruction:

Finnish

Timing:

Every second year.

Learning outcomes:

The course familiarizes students with applications of statistical models when inferences are made on economic phenomena. The principles of statistical inference on economic phenomena are the same as those of general
statistical inference but there are some special issues that make the inference different in economics than in other application areas of statistics. After finishing the course, a student can apply linear regression and a student is able to apply the method of instrumental variables. A student can diagnose the validity of the assumptions of the linear regression models and tune his inferences accordingly.

Contents:

1. Introduction: causal relationships and ceteris paribus analysis, data structures, stochastic explanatory variables.
2. Matrix algebra and the least squares estimator.
3. Conditional expectation.
4. Basic asymptotic theory: the weak law of large numbers, the central limit theorem, consistency and asymptotic normality of estimators.
5. The single-equation linear model: endogeneity and exogeneity, consistency and asymptotic normality of the ordinary least squares estimator, homoskedasticity and heteroskedasticity, identifiability of parameters, t-test, Wald's test, F-test, Lagrange multiplier test, omitted variables problem, proxy variables solution to the omitted variables problem, measurement errors.
6. Instrumental variables: two-stage least squares estimator, consistency and asymptotic normality, asymptotic efficiency, indicator variables solution.
7. Newey-West estimator of covariance matrix, generalized method of moments and instrumental variables,
testing for endogeneity (Hausman test), testing for heteroskedasticity (Breusch-Pagan test, White's test), testing for autocorrelation (Durbin-Watson test, Box-Pierce test).

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are partly compulsory exercises.
There are 14 times 2 hour lectures and 7 times 2 hour exercises.

Target group:

Students of economics and mathematical sciences.

Prerequisites and co-requisites:

Basic Mathematics for Economics 1 and 2, Basic methods in statistics 1, Introduction to Econometrics.

Recommended or required reading:

J. M. Wooldridge: Econometric Analysis of Cross Section and Panel Data (The MIT Press)

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5

Person responsible:

Jussi Klemelä.

Other information:

The course is organized every two years. The course was organized at spring 2014.
The home page of the course is http://cc.oulu.fi/~jklemela/econometrics/
Recommended literature: William H. Greene: Econometric Analysis (Prentice Hall).

805681S: Generalized Linear Models, 9 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

805699S: Statistical methods in epidemiology, 8 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

806618S: Computationally intensive statistical methods, 9 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

806621S: Spatial Data Analysis, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

806628S: Statistical Finance, 5 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Jussi Klemelä
Opintokohteen kielet: Finnish

ECTS Credits:

5 cr

Language of instruction:

Finnish

Timing:

Every second year.

Learning outcomes:

On a successful completion of this course, the student is familiar with the basic concepts of derivative pricing and knows how to calculate the Black-Scholes price of a stock option. In addition, after completion of the course, the student knows how to calculate a Markowotz portfolio, how to evaluate the return and the risk of a portfolio, and knows how to calculate performance measures for a portfolio.

Contents:

1. Introduction: The main asset classes and derivative types.
2. The main concepts needed to price futures and options, arbitrage pricing and pricing with statistical arbitrage, the arbitrage free price of futures, the put-call-parity.
3. Pricing of options in the single period and multiperiod binary model, Black-Scholes pricing, and pricing in incomplete models.
4. The basic methods for choosing and evaluating a portfolio, Markowitz theory for the portfolio choice, maximization of the expected utility, and the maximization of the conditional expected utility.

Mode of delivery:

Face-to-face teachin

Learning activities and teaching methods:

Besides lectures, there are voluntary exercises.
There are 14 times 2 hour lectures and 7 times 2 hour exercises.

Target group:

Students of mathematical sciences, students of finance and economics.

Prerequisites and co-requisites:

Basic knowledge of statistics and probability.

Recommended optional programme components:

The course is suitable together with the course "Market Risk Analysis".

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Examination

Grading:

1 - 5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

The home page of the course is http://cc.oulu.fi/~jklemela/stafin/
The course is lectured every second year.
Additional literature:
Franke, J., Härdle, W., and Hafner, C. M. (2004).
Statistics of Financial Markets, Springer.
Bouchaud, J.-P. and Potters, M. (2003).
Theory of Financial Risk and Derivative Pricing,
Cambridge University Press.
Ruppert, D. (2004). Statistics and Finance, Springer.

806629S: Introduction to Sampling Methods, 4 op

Voimassaolo: 01.01.2010 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Läärä Esa
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

806630S: Market Risk Analysis, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Jussi Klemelä
Opintokohteen kielet: Finnish
Leikkaavuudet:

806330A	Analysis of Market Risk	5.0 op

ECTS Credits:

5 cr

Language of instruction:

Finnish

Timing:

Every second year.

Learning outcomes:

The student knows how to estimate the unconditional value-at-risk using empirical quantiles, parametric modeling, semiparametric modeling, and extreme value theory. The student knows also how to estimate the conditional value-at-risk using GARCH models. Student knows how to apply statistical software to make the calculations.

Contents:

The course is an introduction to the quantitative risk management of a portfolio of stocks. The course introduces various risk measures, extreme value theory, and modeling of financial time series. The course covers:
1. Conditional and unconditional loss distribution,
2. Value-at-Risk and other risk measures,
3. standard methods of estimating Value-at-Risk: multivariate normal modeling, historical simulation /empirical quantiles, and the Monte Carlo method,
4. Modeling of distributions: multivariate distributions, normal mixture distributions, spherical and elliptical distributions, and dimension reduction,
5. Modeling of financial time series: ARMA models, GARCH models, and volatility models,
6. Copulas and measures of dependence,
7. Extreme value theory: block maxima and threshold exceedance methods.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are voluntary exercises.
There are 14 times 2 hour lectures and 7 times 2 hour exercises

Target group:

Students of mathematical sciences, students of finance and economics.

Prerequisites and co-requisites:

Basic knowledge of statistics.

Recommended optional programme components:

The course is suitable together with the course "Statistical Finance".

Recommended or required reading:

McNeil, A. J., Frey, R., and Embrechts, P. (2005).Quantitative Risk Management: Concepts, Techniques and Tools,Princeton Series in Finance, 608 pp.

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

The home page of the course is http://cc.oulu.fi/~jklemela/marketrisk/
The course is lectured every second year.

805651S: Stochastic processes, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

806622S: Probability, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

805611S: Mathematical statistics II, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
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

ECTS Credits:

10 cr

Language of instruction:

Finnish

Timing:

Every second year.

Learning outcomes:

On a successful completion of this course, the student can derive asymptotic distributions of estimators and test statistics in regular parametric models and can derive confidence intervals and p-values ot statistical tests based on these asymptotic distributions.

Contents:

The course covers statistical inference in finite dimensional parametric models:
1. asymptotic theory (convergence of random variables, weak law of large numbers and the central limit theorem),
2. likelihood inference (consistency and asymptotic normality, exponential families),
3. least squares method and the method of moments (consistency and asymptotic normality),
4. test theory (testing based on likelihood function and testing in linear models).
Furthermore, the course covers efficiency in parametric and nonparametric models, resampling, nonparametric function estimation, and adaptive estimation.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are voluntary exercises.
There are 28 times 2 hour lectures and 14 times 2 hour exercises.

Target group:

Master's students of statistics, students of mathematical sciences.

Prerequisites and co-requisites:

Statistical Inference I

Recommended optional programme components:

-

Recommended or required reading:

Davison, A. C. (2003).
Statistical Models, Cambridge Series in Statistical and Probabilistic Mathematics.

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

The home page of the course is http://cc.oulu.fi/~jklemela/stainf/
The course is organized every two year.
Additional literature:
Lehmann, E. ja Casella, G. Theory of Point Estimation.

800698S: Pro gradu thesis, 30 op

Opiskelumuoto: Advanced Studies

Laji: Diploma thesis

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
30 cr
Language of instruction:
Finnish (also English)
Learning outcomes:
After writing the Master's degree, student has written an analytical and logical study of a problem or theory in a field of mathematics, applied mathematics or statistics. Completing the thesis succesfully, student is able to write scientific articles and texts in mathematics.
Contents:
The scope of the Master's thesis is 20 cr for Teacher students and 30 cr in other disciplines. In Master's thesis, the student engages in researching a specific mathematical area or problem in the field of mathematics, appliead mathematics or statistics.
Mode of delivery:
Thesis
Learning activities and teaching methods:
Own work, meetings with the supervisor
Target group:
Major students
Prerequisites and co-requisites:
Bachelor's degree (or equivalent), 20-50 cr advanced studies
Recommended optional programme components:
-
Recommended or required reading:
-
Assessment methods and criteria:
Thesis
Read more about assessment criteria at the University of Oulu webpage.

Grading:
1-5
Person responsible:
Professors and other teaching personnel
Working life cooperation:
-

H325003: Mathematics, optional advanced studies, 0 - 120 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Advanced Studies
Laji: Study module
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Electives

802653S: Lebesgue Measure and Integration Theory, 5 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Mikael Lindström
Opintokohteen kielet: Finnish

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

801698S: Cryptography, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
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

Language of instruction:

Finnish/English

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-Srassen.

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

802655S: Continued Fractions, 5 op

Voimassaolo: 01.01.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Language of instruction:

FI/EN

Recommended or required reading:

G.H. Hardy & E.M. Wright: An Introduction to the Theory of Numbers.
Kenneth H. Rosen: Elementary number theory and its applications.
Lisa Lorentzen and Haakon Waadeland: Continued Fractions with Applications (1992).
Oskar Perron: Die Lehre von den Kettenbruchen (1913).

Course material: http://cc.oulu.fi/~tma/OPETUS.html

802644S: Introduction to Functional Analysis, 10 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Mahmoud Filali

Opintokohteen kielet: Finnish

Learning outcomes:

If we think of functional analysis as infinite dimensional linear algebra, then the course offers the tools and the ways to handle this infinite dimension. After completing the course successfully, the student will be able to follow almost any material on functional analysis.

Contents:

After recalling some basic definitions on linear algebra and giving the basic definitions concerning normed spaces, we present the uniform boundedness principle and the open mapping theorem. In this first part of the course, the relative compactness of the unit ball in a normed space is studied under the norm topology. Hahn-Banach Theorem is presented in its various forms: algebraic, analytic and geometric, and followed by Krein-Milman Theorem. We end up with the weak topology on normed spaces and the weak* topology on Banach duals. The relative compactness of the unit ball is studied with respect to these two topologies.

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Mahmoud Filali

802636S: Information Theory, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

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

Language of instruction:

Finnish.

Timing:

Spring semester, 3rd and 4th periods.

Learning outcomes:

Upon completing the course the student will
- be familiar with the central concepts and results of information theory
- be able to solve mathematical problems that arise in information theory
- be able to derive the central results of information theory

Contents:

The course introduces Claude Shannons' mathematical theory of communication, its basic concepts and results. The questions discussed include quantification of the amount of information of an information source, compression of information, coding, communication of coded information through a communication channel and decoding of received messages.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

56 h of lectures, 28 h of exercises.

Target group:

Mathematics, applied mathematics and statistics majors. Other students with a sufficient mathematical background.

Prerequisites and co-requisites:

Calculus in one and several dimensions, linear algebra I and II. Probability theory I. Probability theory II or Random variables and distributions.

Recommended or required reading:

Lecture notes written by the instructor.

Assessment methods and criteria:

Final exam. In the first exam following the course the student gets credit for the homework problems he /she has solved during the course.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Lasse Holmström

Working life cooperation:

-

Other information:

Level: advanced studies.

802635S: Introduction to partial differential equations, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

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 R^n and in bounded domains, potential theory, Green's function, Heat equation in R^n and in bounded domains, Wave equation in R^n and in bounded domans, d'Alembert formula for any dimensions, Fourier method.

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Valeriy Serov

802652S: Hilbert Spaces, 5 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

800624S	Analysis III	10.0 op

ECTS Credits:

5 ECTS credits

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

800651S: Functional analysis, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Language of instruction:

Finnish (English if neede)

Timing:

4-5 year of studies. Timig varies.

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.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

56h lectures, 24h exercises

Target group:

Major students

Prerequisites and co-requisites:

Compulsory basic and intermediate studies.

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes
E. Kreyszig: Introductory Functional Analysis with Applications, Wiley Classics Library, 1989
K. Astala, P. Piiroinen, H.-O. Tylli, Funktionaalianalyysin peruskurssi, Helsingin yliopisto, luentomoniste 2008.

Assessment methods and criteria:

Final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Mikael Lindström

Working life cooperation:

-

802629S: Function estimation, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Lasse Holmström
Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Language of instruction:

Finnish

Timing:

Spring semester, 3rd and 4th periods

Learning outcomes:

Upon completing the course the student will be able to
- characterise the basic features non-parametric function estimation methods
- apply such estimation methods to practical problems
- derive some of the basic results of non-parametric function estimation for kernel estimators

Contents:

The course focuses on the theory and practice of non-parametric function estimation with a special emphasis on kernel methods. The particular functions considered are a probability density function and a regression function.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

42 h of lectures, 28 h of exercises

Target group:

Mathematics, applied mathematics and statistics majors. Other students with a sufficient mathematical background.

Prerequisites and co-requisites:

Calculus in one and several dimensions. Probability theory I. Probability theory II or Random variables and distributions.

Recommended optional programme components:

No

Recommended or required reading:

Lecture notes written by the instructor.

Assessment methods and criteria:

Final exam. In the first exam following the course the student gets credit for the homework problems he /she has solved during the course. This is agreed in the beginning of the course.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Lasse Holmström

Working life cooperation:

No

Other information:

No

800674S: Fourier transform and distributions, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Valeriy Serov

Opintokohteen oppimateriaali:

Stein, Elias M.; Shakarchi R., , 2003
Taylor, Michael E., , 1996
Grafakos Loukas, , 2004
Stakgold, Ivar , , 1998

Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Language of instruction:

English

Timing:

4.-5. year of studies. Timing varies.

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.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

56h lectures, 28h exercises

Target group:

Major students

Prerequisites and co-requisites:

Euclidiean topology, Series and integrals, Multidimensional analysis, Complex analysis I and II, and Linear algebra I and II.

Recommended optional programme components:

-

Recommended or required reading:

Luentomoniste
E.M. Stein & R. Shakarchi: Fourier Analysis (an Introduction), Princeton University Press, 2003;
L. Grafakos: Classical and Modern Fourier Analysis, Pearson Education, 2004;
I. Stakgold: Green's Functions and Boundary Value Problems, 2nd edition, Wiley, 1998;
M. Taylor: Partial Differential Equations (Basic Theory), Springer, 1996.

Assessment methods and criteria:

Final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Valeriy Serov

Working life cooperation:

-

802647S: Fourier series and the discrete Fourier transform, 10 op

Voimassaolo: 01.01.2010 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Valeriy Serov

Opintokohteen kielet: English

Ei opintojaksokuvauksia.

802656S: Algebraic numbers, 5 op

Voimassaolo: 01.01.2012 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Language of instruction:

FI/EN

Learning outcomes:

As usual in my mathematical studies I shall be ableto solve problems arising from the subject andto 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:

First we revise some basics of rings and fieldswhich are needed to proceed ahead field extensions. In particular, divisibility in an integral domain is carefully studied yielding to applications in the theory of polynomial algebra and algebraic integers.
The theory of algebraic numbers is strongly based on polynomial algebra, where the properties of zeros and divisibility of polynomials are considered.
The definition of an algebraic number will be generalized to the algebraic elements of field extensions going forward to algebraic fields.Considered as most important algebraic fields we get number fields which are finitely generated subfields of the field A of all complex algebraic numbers. In particular, we study quadratic number fields.
Further, we shall consider the divisibility and factorization of algebraic integers with some applications to Diophantine equations.

Prerequisites and co-requisites:

Algebra I and II, Linear algebra I and II, Basics in Number Theory (Number theory I)

Recommended or required reading:

I.N. Stewart and D.O. Tall: Algebraic number theory.
Daniel Marcus: Number fields.
J.B. Fraleigh: Abstract algebra.
Michael Artin: Algebra.

Course material: http://cc.oulu.fi/~tma/OPETUS.html

802637S: Advanced Problem Solving, 2 - 6 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Peter Hästö
Opintokohteen kielet: English

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

802645S: Number Theory A, 5 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Tapani Matala-aho
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

802646S: Number Theory B, 5 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Tapani Matala-aho
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

802631S: Modern real analysis, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Learning outcomes:

On successful completion of this course, the student will be able to
- derive and prove basic results of modern real analysis.
- apply the results and methods of modern real analysis in different topics of mathematics, like in the theory of partial differential equations.

Contents:

The course presents Lebesgue spaces (Hölder's and Minkowski's inequalities, completeness, dual spaces), the Vitali covering theorem, the Hardy-Littlewood maximal function, approximation with smooth functions using convolution, Lebesgue's density theorem, Sobolev's inequalities.

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

800688S: Theory of Optimization, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
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

Language of instruction:

Finnish

Timing:

Autumn.

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.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 56 h / Group work 24 h.

Target group:

All

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Luenberger D.G.: introduction to Linear and Nonlinear Programming, Peressini A.L., Sullivan F.E. and Uhl, J.J.Jr.: The Mathematics of Nonlinear Pro-gramming, Lecture Notes.

Assessment methods and criteria:

During the course, there are two intermediate exams.
Final exam ater the course.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Erkki Laitinen

Working life cooperation:

-

800660S: Group Theory, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Niemenmaa Markku
Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Language of instruction:

Finnish

Timing:

4-5 year of studies. Timing varies.

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 56 h, exercises 28 h.

Target group:

Major students

Prerequisites and co-requisites:

802355A Number theory and groups
802355A Rings, Fields and polynomials
800343A Permutations, fields and Galois' theory

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Mid-term exam or final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Markku Niemenmaa

Working life cooperation:

-

802633S: Statistical Pattern Recognition, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
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

Language of instruction:

Finnish

Timing:

Spring semester, 3rd and 4th periods.

Learning outcomes:

Upon completing the course the student will
-be familiar with the most common classifiers used in pattern recognition
-be able to apply pattern recognition methods to practical problems
-be able derive some of the basic mathematical results of pattern recognition theory

Contents:

The course focuses on the theory and practice of pattern recognition with emphasis on classifiers and feature extraction

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

42 h of lectures, 28 h of exercises

Target group:

Mathematics, applied mathematics and statistics majors. Other students with a sufficient mathematical background.

Prerequisites and co-requisites:

Calculus in one and several dimensions, linear algebra I and II. Probability theory I. Probability theory II or Random variables and distributions.

Recommended or required reading:

Lecture notes.
Optional reading:
R. O. Duda, P. E. Hart, and D. G. Stork. Pattern Classification. Wiley-Interscience, second edition, 2000.
S. Theodoridis and K. Koutroumbas. Pattern Recognition. Academic Press, 1999.
A. Webb. Statistical Pattern Recognition. Arnold, 1999 (Second edition: John Wiley & Sons Ltd, 2002).

Assessment methods and criteria:

Final exam. In the first exam following the course the student gets credit for the (possible) homework problems he/she has solved during the course.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Lasse Holmström

Working life cooperation:

No

Other information:

No

801643S: Topology, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Mahmoud Filali
Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Language of instruction:

English (also Finnish)

Timing:

3.-5. year of studies. Timing varies.

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

56h lectures, 28h exercises

Target group:

Major students

Prerequisites and co-requisites:

Compulsory basic and intermediate studies in mathematics, 800329A Topologia I

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Mid-term exams or final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Mahmoud Filai

802651S: Abstract Measure Theory, 5 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Ville Suomala
Opintokohteen kielet: Finnish

ECTS Credits:

5 cr

Language of instruction:

Finnish

Timing:

Spring

Learning outcomes:

After completing the course, the students know the basics of abstract measure and integration theory and are able to apply the main theorems in concrete situations.

Contents:

Basic concepts of measure theory: outer measure, sigma-algebra, measure, measurability, Lebesgue measure, integral, product measure.
Basic theorems: Convergence theorems, Fubini's theorem.

Mode of delivery:

Lectures, Exercises.

Prerequisites and co-requisites:

Basic knowledge of analysis in Euclidean spaces, set theory and topology. The course 800322A.

Recommended or required reading:

Bruckner, Bruckner, Thomson: Real Analysis; Cohn: Measure Theory; Purmonen: Mitta- ja integraaliteoria; ...

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Ville Suomala

802650S: Fractal Geometry, 10 op

Voimassaolo: 01.01.2010 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Esa Järvenpää
Opintokohteen kielet: Finnish

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

802660S: Operator theory and integral equations, 10 op

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Valeriy Serov
Opintokohteen kielet: English

ECTS Credits:

10 cr

Language of instruction:

English

Timing:

The course is held in the whole autumn semester 2014/2015, during periods I and II. It is recommended to complete the course at the end of autumn semester.

Learning outcomes:

Upon completion the student should be able to:

- Operate with self-adjoint operators in the Hilbert spaces.
- Operate with compact operators in the Hilbert spaces.
- Operator with one-dimensional integral equations of the first and second order.

Contents:

1. Inner product spaces and Hilbert spaces.
2. Symmetric operators in the Hilbert space. J. von Neumann's theorems about symmetric operators. Basic criterion of self-adjointness.
3. Orthogonal projection operators. J. von Neumann's spectral theorem.
4. Spectrum of self-adjoint operator.
5. Riesz theory of compact operators.
6. Quadratic forms. Friedrichs extension of symmetric operators.

7. Elliptic differential operators in bounded domains.
8. Spectral function of self - adjoint operators. Green's function.
9. Integral operators with weak singularities. Integral equations of the first and second kind.
10. Volterra integral equations.
11. Singular integral equations.
12. Nyström's method for equation of second kind.
13. The Galerkin method for integral equations.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 56 h / Group work 24 h / Self-study 24 h. The exercises are completed as group work. (N.B. This must show all the course hours, which means that total 104 hours = 10 ECTS credits).

Target group:

Major students in mathematics, physics and engineering.

Prerequisites and co-requisites:

The required (or recommended) prerequisite is the completion of the following courses prior to enrolling for the course: Linear Algebra, Ordinary differential equations (I), Complex analysis (I), Analysis (I) and (II).

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

They following books are recommended (the course based on these books):
1) R. Kress, Linear integral equations, Springer-Verlag New York, 1999.
2) F. Riesz and B. Sz-Nagy, Functional analysis, Ungar, 1978.
3) A.N. Kolmogorov and S.V. Fomin, Elements of the theory of functions and functional analysis, DaverPublications, 1999.

Assessment methods and criteria:

The assessment criteria are based on the learning outcomes of the course. The final exam is required only.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Professor, Valery Serov
vserov@cc.oulu.fi

802664S: Differential geometry, 10 op

Voimassaolo: 01.06.2014 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

ECTS Credits:

10 cr

Language of instruction:

English (if foreign participants)

Timing:

Master's or PhD-studies

Learning outcomes:

The knowledge of basic concepts and results in differential geometry.

Contents:

Differentiable manifold, tangent space, derivative.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

56 h lectures, 28 h exercises.

Target group:

Mathematics and other interested students

Prerequisites and co-requisites:

Analysis of several variables

Grading:

1 - 5, fail

Person responsible:

Esa Järvenpää

H326603: Statistics optional advanced studies, 0 - 120 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Advanced Studies
Laji: Study module
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Electives

805609S: Statistical methods in epidemiology, 9 op

Opiskelumuoto: Advanced Studies
Laji: Course
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

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

805646S: Analysis of longitudial data, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
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:

5/6 cr

Language of instruction:

Finnish

Timing:

Every secon year.

Learning outcomes:

After finishing the course a student can apply pooled ordinary least squares, generalized least squares, random effects methods, and fixed effects methods.

Contents:

1. Introduction: data types, omitted variables.
2. Mathematical tools: conditional expectation, basic asymptotic theory.
3. Basics of ordinary least squares.
4. Estimating systems of equations by ordinary least squares and by generalized least squares, panel data and seemingly unrelated regression as examples, simultaneous exogeneity and strict exogeneity, consistency and asymptotic normality, homoskedasticity and heteroskedasticity.
5. Pooled ordinary least squares for panel data, aggregated time effect, dummy variables, testing serial correlation and heteroskedasticity.
6. Unobserved effects model: random effects and fixed effects.
7. Random effects methods: random effects structure of the covariance matrix.
8. Fixed effects methods: fixed effects transformation, the use of dummy variables, first differencing transformation.
9. Comparison of estimators.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are voluntary
exercises. There are 14 times 2 hour lectures and 7 times 2 hour exercises.

Target group:

Students of economics and mathematical sciences.

Prerequisites and co-requisites:

Basic Mathematics for Economics 1 and 2, Basic
Methods in Statistics 1, Introduction to Econometrics.

Recommended or required reading:

J. M. Wooldridge: Econometric Analysis of Cross Section and Panel Data (The MIT Press).

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

The course is organized every two years.
The home page of the course is http://cc.oulu.fi/~jklemela/panel/

805679S: Time series analysis, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

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:

5 cr

Language of instruction:

Finnish

Learning outcomes:

After finishing the course, a student can apply linear, nonlinear and nonparametric modeling of time series. A student learns how to choose between alternative time series models and can apply statistical software to fit time series models.

Contents:

1. The course covers basic concepts of time series analysis: stationarity, autocorrelation, spectral distribution and periodogram.
2. Linear time series analysis includes explanation, prediction, parameter estimation and model diagnostics in ARMA models.
3. Nonlinear time series analysis includes threshold models and heteroskedastic time series models (ARCH and GARCH).
4. Furthermore, nonlinear nonparametric smoothing is covered (time space smoothing and state space smoothing) and nonparametric estimation of spectral densities. Nonparametric function estimation includes kernel estimation, local polynomial regression and additive modeling.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are voluntary exercises.
There are 14 times 2 hour lectures and 7 times 2 hour exercises.

Target group:

Students of mathematical sciences, econometrics and finance students.

Prerequisites and co-requisites:

Basic probability theory.

Recommended optional programme components:

-

Recommended or required reading:

Fan, J. ja Yao, Q. (2005). Nonlinear Time Series, Springer.

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

Home page of the course is http://cc.oulu.fi/~jklemela/timeseries/
Recommended reading:
P. J. Brockwell and R. A. Davis: Time Series: Theory and Methods, Springer, 1991.
H. Lutkepohl: Introduction to Multiple Time Series Analysis, Springer.
J. Hamilton: Time Series, Princeton University Press The MIT Press, 1994.

805683S: The Statistical Foundation of Econometrics, 5 - 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

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 Foundation of Econometrics 5.0 op

ECTS Credits:

5/6 cr

Language of instruction:

Finnish

Timing:

Every second year.

Learning outcomes:

The course familiarizes students with applications of statistical models when inferences are made on economic phenomena. The principles of statistical inference on economic phenomena are the same as those of general
statistical inference but there are some special issues that make the inference different in economics than in other application areas of statistics. After finishing the course, a student can apply linear regression and a student is able to apply the method of instrumental variables. A student can diagnose the validity of the assumptions of the linear regression models and tune his inferences accordingly.

Contents:

1. Introduction: causal relationships and ceteris paribus analysis, data structures, stochastic explanatory variables.
2. Matrix algebra and the least squares estimator.
3. Conditional expectation.
4. Basic asymptotic theory: the weak law of large numbers, the central limit theorem, consistency and asymptotic normality of estimators.
5. The single-equation linear model: endogeneity and exogeneity, consistency and asymptotic normality of the ordinary least squares estimator, homoskedasticity and heteroskedasticity, identifiability of parameters, t-test, Wald's test, F-test, Lagrange multiplier test, omitted variables problem, proxy variables solution to the omitted variables problem, measurement errors.
6. Instrumental variables: two-stage least squares estimator, consistency and asymptotic normality, asymptotic efficiency, indicator variables solution.
7. Newey-West estimator of covariance matrix, generalized method of moments and instrumental variables,
testing for endogeneity (Hausman test), testing for heteroskedasticity (Breusch-Pagan test, White's test), testing for autocorrelation (Durbin-Watson test, Box-Pierce test).

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are partly compulsory exercises.
There are 14 times 2 hour lectures and 7 times 2 hour exercises.

Target group:

Students of economics and mathematical sciences.

Prerequisites and co-requisites:

Basic Mathematics for Economics 1 and 2, Basic methods in statistics 1, Introduction to Econometrics.

Recommended or required reading:

J. M. Wooldridge: Econometric Analysis of Cross Section and Panel Data (The MIT Press)

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5

Person responsible:

Jussi Klemelä.

Other information:

The course is organized every two years. The course was organized at spring 2014.
The home page of the course is http://cc.oulu.fi/~jklemela/econometrics/
Recommended literature: William H. Greene: Econometric Analysis (Prentice Hall).

805681S: Generalized Linear Models, 9 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

805699S: Statistical methods in epidemiology, 8 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

806618S: Computationally intensive statistical methods, 9 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

806621S: Spatial Data Analysis, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

806628S: Statistical Finance, 5 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Jussi Klemelä

Opintokohteen kielet: Finnish

ECTS Credits:

5 cr

Language of instruction:

Finnish

Timing:

Every second year.

Learning outcomes:

On a successful completion of this course, the student is familiar with the basic concepts of derivative pricing and knows how to calculate the Black-Scholes price of a stock option. In addition, after completion of the course, the student knows how to calculate a Markowotz portfolio, how to evaluate the return and the risk of a portfolio, and knows how to calculate performance measures for a portfolio.

Contents:

1. Introduction: The main asset classes and derivative types.
2. The main concepts needed to price futures and options, arbitrage pricing and pricing with statistical arbitrage, the arbitrage free price of futures, the put-call-parity.
3. Pricing of options in the single period and multiperiod binary model, Black-Scholes pricing, and pricing in incomplete models.
4. The basic methods for choosing and evaluating a portfolio, Markowitz theory for the portfolio choice, maximization of the expected utility, and the maximization of the conditional expected utility.

Mode of delivery:

Face-to-face teachin

Learning activities and teaching methods:

Besides lectures, there are voluntary exercises.
There are 14 times 2 hour lectures and 7 times 2 hour exercises.

Target group:

Students of mathematical sciences, students of finance and economics.

Prerequisites and co-requisites:

Basic knowledge of statistics and probability.

Recommended optional programme components:

The course is suitable together with the course "Market Risk Analysis".

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Examination

Grading:

1 - 5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

The home page of the course is http://cc.oulu.fi/~jklemela/stafin/
The course is lectured every second year.
Additional literature:
Franke, J., Härdle, W., and Hafner, C. M. (2004).
Statistics of Financial Markets, Springer.

Bouchaud, J.-P. and Potters, M. (2003).
Theory of Financial Risk and Derivative Pricing,
Cambridge University Press.
Ruppert, D. (2004). Statistics and Finance, Springer.

806629S: Introduction to Sampling Methods, 4 op

Voimassaolo: 01.01.2010 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Läärä Esa
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

806630S: Market Risk Analysis, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Jussi Klemelä
Opintokohteen kielet: Finnish
Leikkaavuudet:

806330A Analysis of Market Risk 5.0 op

ECTS Credits:

5 cr

Language of instruction:

Finnish

Timing:

Every second year.

Learning outcomes:

The student knows how to estimate the unconditional value-at-risk using empirical quantiles, parametric modeling, semiparametric modeling, and extreme value theory. The student knows also how to estimate the conditional value-at-risk using GARCH models. Student knows how to apply statistical software to make the calculations.

Contents:

The course is an introduction to the quantitative risk management of a portfolio of stocks. The course introduces various risk measures, extreme value theory, and modeling of financial time series. The course covers:
1. Conditional and unconditional loss distribution,
2. Value-at-Risk and other risk measures,
3. standard methods of estimating Value-at-Risk: multivariate normal modeling, historical simulation /empirical quantiles, and the Monte Carlo method,
4. Modeling of distributions: multivariate distributions, normal mixture distributions, spherical and elliptical distributions, and dimension reduction,
5. Modeling of financial time series: ARMA models, GARCH models, and volatility models,
6. Copulas and measures of dependence,
7. Extreme value theory: block maxima and threshold exceedance methods.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are voluntary exercises.
There are 14 times 2 hour lectures and 7 times 2 hour exercises

Target group:

Students of mathematical sciences, students of finance and economics.

Prerequisites and co-requisites:

Basic knowledge of statistics.

Recommended optional programme components:

The course is suitable together with the course "Statistical Finance".

Recommended or required reading:

McNeil, A. J., Frey, R., and Embrechts, P. (2005).Quantitative Risk Management: Concepts, Techniques and Tools,Princeton Series in Finance, 608 pp.

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

The home page of the course is http://cc.oulu.fi/~jklemela/marketrisk/
The course is lectured every second year.

805651S: Stochastic processes, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

806622S: Probability, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

805611S: Mathematical statistics II, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
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

ECTS Credits:

10 cr

Language of instruction:

Finnish

Timing:

Every second year.

Learning outcomes:

On a successful completion of this course, the student can derive asymptotic distributions of estimators and test statistics in regular parametric models and can derive confidence intervals and p-values ot statistical tests based on these asymptotic distributions.

Contents:

The course covers statistical inference in finite dimensional parametric models:
1. asymptotic theory (convergence of random variables, weak law of large numbers and the central limit theorem),
2. likelihood inference (consistency and asymptotic normality, exponential families),
3. least squares method and the method of moments (consistency and asymptotic normality),
4. test theory (testing based on likelihood function and testing in linear models).
Furthermore, the course covers efficiency in parametric and nonparametric models, resampling, nonparametric function estimation, and adaptive estimation.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are voluntary exercises.
There are 28 times 2 hour lectures and 14 times 2 hour exercises.

Target group:

Master's students of statistics, students of mathematical sciences.

Prerequisites and co-requisites:

Statistical Inference I

Recommended optional programme components:

-

Recommended or required reading:

Davison, A. C. (2003).
Statistical Models, Cambridge Series in Statistical and Probabilistic Mathematics.

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

The home page of the course is http://cc.oulu.fi/~jklemela/stainf/
The course is organized every two year.
Additional literature:
Lehmann, E. ja Casella, G. Theory of Point Estimation.

805611S: Mathematical statistics II, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

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

ECTS Credits:
10 cr
Language of instruction:
Finnish
Timing:
Every second year.
Learning outcomes:
On a successful completion of this course, the student can derive asymptotic distributions of estimators and test statistics in regular parametric models and can derive confidence intervals and p-values ot statistical tests based on these asymptotic distributions.
Contents:
The course covers statistical inference in finite dimensional parametric models:
1. asymptotic theory (convergence of random variables, weak law of large numbers and the central limit theorem),
2. likelihood inference (consistency and asymptotic normality, exponential families),
3. least squares method and the method of moments (consistency and asymptotic normality),
4. test theory (testing based on likelihood function and testing in linear models).
Furthermore, the course covers efficiency in parametric and nonparametric models, resampling, nonparametric function estimation, and adaptive estimation.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Besides lectures, there are voluntary exercises.
There are 28 times 2 hour lectures and 14 times 2 hour exercises.
Target group:
Master's students of statistics, students of mathematical sciences.
Prerequisites and co-requisites:
Statistical Inference I
Recommended optional programme components:
-
Recommended or required reading:
Davison, A. C. (2003).
Statistical Models, Cambridge Series in Statistical and Probabilistic Mathematics.
Assessment methods and criteria:
Examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1 - 5
Person responsible:
Jussi Klemelä
Working life cooperation:
-
Other information:
The home page of the course is http://cc.oulu.fi/~jklemela/stainf/
The course is organized every two year.
Additional literature:
Lehmann, E. ja Casella, G. Theory of Point Estimation.

805644S: Maturity test, 0 op

Opiskelumuoto: Advanced Studies

Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

806624S: Practical training/consulting, 5 - 7 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Jari Päkkilä
Opintokohteen kielet: Finnish
Voidaan suorittaa useasti: Kyllä

Assessment methods and criteria:
Read more about assessment criteria at the University of Oulu webpage.
Person responsible:
Jari Päkkilä

805620S: Pro Gradu seminar, 8 op

Voimassaolo: 01.09.2012 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Läärä Esa
Opintokohteen kielet: Finnish

ECTS Credits:
10 cr
Language of instruction:
Finnish
Timing:
4.-5. year of studies.
Learning outcomes:
After successful completion of the Pro gradu -seminar the student is able to conduct a small scale statistical investigation and report it both in written form and orally.

Contents:
Under supervision of the leader of the seminar each student conducts a small-scale statistical investigation on a given empirical topic and material, makes a writtenh report from it and presents it orally in seminar sessions. The written report is the M.Sc. thesis, when statistics is the major subject of the student.
Mode of delivery:
Face-to-face teaching, seminars
Learning activities and teaching methods:
Seminars and meetings in two years
Target group:
Major students in statistics
Prerequisites and co-requisites:
Compulsory basic and intermediate studies in statistics
Recommended optional programme components:
-
Recommended or required reading:
-
Assessment methods and criteria:
Participation into seminar sessions, seminar presentation and written paper.
Read more about assessment criteria at the University of Oulu webpage.

Grading:
Fail/Pass
Person responsible:
Esa Läärä
Working life cooperation:
-

805642S: Pro gradu thesis, 30 op

Opiskelumuoto: Advanced Studies
Laji: Diploma thesis
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Assessment methods and criteria:
Read more about assessment criteria at the University of Oulu webpage.

806631S: Random variables and distributions, 10 op

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Läärä Esa
Opintokohteen kielet: Finnish
Leikkaavuudet:

805628S	Probability Distributions	5.0 op

Ei opintojaksokuvauksia.

H325003: Mathematics, optional advanced studies, 0 - 120 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Advanced Studies
Laji: Study module
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Electives

802653S: Lebesgue Measure and Integration Theory, 5 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Mikael Lindström
Opintokohteen kielet: Finnish

Assessment methods and criteria:
Read more about assessment criteria at the University of Oulu webpage.

801698S: Cryptography, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

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

Language of instruction:

Finnish/English

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-Srassen.

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

802655S: Continued Fractions, 5 op

Voimassaolo: 01.01.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Language of instruction:

FI/EN

Recommended or required reading:

G.H. Hardy & E.M. Wright: An Introduction to the Theory of Numbers.
Kenneth H. Rosen: Elementary number theory and its applications.
Lisa Lorentzen and Haakon Waadeland: Continued Fractions with Applications (1992).
Oskar Perron: Die Lehre von den Kettenbruchen (1913).

Course material: http://cc.oulu.fi/~tma/OPETUS.html

802644S: Introduction to Functional Analysis, 10 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Mahmoud Filali

Opintokohteen kielet: Finnish

Learning outcomes:

If we think of functional analysis as infinite dimensional linear algebra, then the course offers the tools and the ways to handle this infinite dimension. After completing the course successfully, the student will be able to follow almost any material on functional analysis.

Contents:

After recalling some basic definitions on linear algebra and giving the basic definitions concerning normed spaces, we present the uniform boundedness principle and the open mapping theorem. In this first part of the course, the relative compactness of the unit ball in a normed space is studied under the norm topology. Hahn-Banach Theorem is presented in its various forms: algebraic, analytic and geometric, and followed by Krein-Milman Theorem. We end up with the weak topology on normed spaces and the weak* topology on Banach duals. The relative compactness of the unit ball is studied with respect to these two topologies.

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Mahmoud Filali

802636S: Information Theory, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

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

Language of instruction:

Finnish.

Timing:

Spring semester, 3rd and 4th periods.

Learning outcomes:

Upon completing the course the student will
- be familiar with the central concepts and results of information theory
- be able to solve mathematical problems that arise in information theory
- be able to derive the central results of information theory

Contents:

The course introduces Claude Shannons' mathematical theory of communication, its basic concepts and results. The questions discussed include quantification of the amount of information of an information source, compression of information, coding, communication of coded information through a communication channel and decoding of received messages.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

56 h of lectures, 28 h of exercises.

Target group:

Mathematics, applied mathematics and statistics majors. Other students with a sufficient mathematical background.

Prerequisites and co-requisites:

Calculus in one and several dimensions, linear algebra I and II. Probability theory I. Probability theory II or Random variables and distributions.

Recommended or required reading:

Lecture notes written by the instructor.

Assessment methods and criteria:

Final exam. In the first exam following the course the student gets credit for the homework problems he /she has solved during the course.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Lasse Holmström

Working life cooperation:

-

Other information:

Level: advanced studies.

802635S: Introduction to partial differential equations, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
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 R^n and in bounded domains, potential theory, Green's function, Heat equation in R^n and in bounded domains, Wave equation in R^n and in bounded domans, d'Alembert formula for any dimensions, Fourier method.

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Valeriy Serov

802652S: Hilbert Spaces, 5 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

800624S Analysis III 10.0 op

ECTS Credits:

5 ECTS credits

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

800651S: Functional analysis, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Language of instruction:

Finnish (English if neede)

Timing:

4-5 year of studies. Timig varies.

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.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

56h lectures, 24h exercises

Target group:

Major students

Prerequisites and co-requisites:

Compulsory basic and intermediate studies.

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes
E. Kreyszig: Introductory Functional Analysis with Applications, Wiley Classics Library, 1989
K. Astala, P. Piiroinen, H.-O. Tylli, Funktionaalianalyysin peruskurssi, Helsingin yliopisto, luentomoniste 2008.

Assessment methods and criteria:

Final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Mikael Lindström

Working life cooperation:

-

802629S: Function estimation, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Lasse Holmström
Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Language of instruction:

Finnish

Timing:

Spring semester, 3rd and 4th periods

Learning outcomes:

Upon completing the course the student will be able to
- characterise the basic features non-parametric function estimation methods
- apply such estimation methods to practical problems
- derive some of the basic results of non-parametric function estimation for kernel estimators

Contents:

The course focuses on the theory and practice of non-parametric function estimation with a special emphasis on kernel methods. The particular functions considered are a probability density function and a regression function.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

42 h of lectures, 28 h of exercises

Target group:

Mathematics, applied mathematics and statistics majors. Other students with a sufficient mathematical background.

Prerequisites and co-requisites:

Calculus in one and several dimensions. Probability theory I. Probability theory II or Random variables and distributions.

Recommended optional programme components:

No

Recommended or required reading:

Lecture notes written by the instructor.

Assessment methods and criteria:

Final exam. In the first exam following the course the student gets credit for the homework problems he /she has solved during the course. This is agreed in the beginning of the course.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Lasse Holmström

Working life cooperation:

No

Other information:

No

800674S: Fourier transform and distributions, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Valeriy Serov
Opintokohteen oppimateriaali:
Stein, Elias M.; Shakarchi R., , 2003
Taylor, Michael E., , 1996
Grafakos Loukas, , 2004
Stakgold, Ivar , , 1998
Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Language of instruction:

English

Timing:

4.-5. year of studies. Timing varies.

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.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

56h lectures, 28h exercises

Target group:

Major students

Prerequisites and co-requisites:

Euclidiean topology, Series and integrals, Multidimensional analysis, Complex analysis I and II, and Linear algebra I and II.

Recommended optional programme components:

-

Recommended or required reading:

Luentomoniste
E.M. Stein & R. Shakarchi: Fourier Analysis (an Introduction), Princeton University Press, 2003;
L. Grafakos: Classical and Modern Fourier Analysis, Pearson Education, 2004;
I. Stakgold: Green's Functions and Boundary Value Problems, 2nd edition, Wiley, 1998;
M. Taylor: Partial Differential Equations (Basic Theory), Springer, 1996.

Assessment methods and criteria:

Final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Valeriy Serov

Working life cooperation:

-

802647S: Fourier series and the discrete Fourier transform, 10 op

Voimassaolo: 01.01.2010 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Valeriy Serov
Opintokohteen kielet: English

Ei opintojaksokuvauksia.

802656S: Algebraic numbers, 5 op

Voimassaolo: 01.01.2012 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Language of instruction:

FI/EN

Learning outcomes:

As usual in my mathematical studies I shall be ableto solve problems arising from the subject andto 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:

First we revise some basics of rings and fieldswhich are needed to proceed ahead field extensions. In particular, divisibility in an integral domain is carefully studied yielding to applications in the theory of polynomial algebra and algebraic integers.
The theory of algebraic numbers is strongly based on polynomial algebra, where the properties of zeros and divisibility of polynomials are considered.
The definition of an algebraic number will be generalized to the algebraic elements of field extensions going forward to algebraic fields.Considered as most important algebraic fields we get number fields which are finitely generated subfields of the field A of all complex algebraic numbers. In particular, we study quadratic number fields.

Further, we shall consider the divisibility and factorization of algebraic integers with some applications to Diophantine equations.

Prerequisites and co-requisites:

Algebra I and II, Linear algebra I and II, Basics in Number Theory (Number theory I)

Recommended or required reading:

I.N. Stewart and D.O. Tall: Algebraic number theory.
Daniel Marcus: Number fields.
J.B. Fraleigh: Abstract algebra.
Michael Artin: Algebra.

Course material: http://cc.oulu.fi/~tma/OPETUS.html

802637S: Advanced Problem Solving, 2 - 6 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Peter Hästö
Opintokohteen kielet: English

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

802645S: Number Theory A, 5 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Tapani Matala-aho
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

802646S: Number Theory B, 5 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Tapani Matala-aho
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

802631S: Modern real analysis, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Learning outcomes:

On successful completion of this course, the student will be able to
- derive and prove basic results of modern real analysis.
- apply the results and methods of modern real analysis in different topics of mathematics, like in the theory of partial differential equations.

Contents:

The course presents Lebesgue spaces (Hölder's and Minkowski's inequalities, completeness, dual spaces), the Vitali covering theorem, the Hardy-Littlewood maximal function, approximation with smooth functions using convolution, Lebesgue's density theorem, Sobolev's inequalities.

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

800688S: Theory of Optimization, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

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

Language of instruction:

Finnish

Timing:

Autumn.

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.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 56 h / Group work 24 h.

Target group:

All

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Luenberger D.G.: introduction to Linear and Nonlinear Programming, Peressini A.L., Sullivan F.E. and Uhl, J.J.Jr.: The Mathematics of Nonlinear Pro-gramming, Lecture Notes.

Assessment methods and criteria:

During the course, there are two intermediate exams.
Final exam ater the course.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Erkki Laitinen

Working life cooperation:

-

800660S: Group Theory, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Niemenmaa Markku
Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Language of instruction:

Finnish

Timing:

4-5 year of studies. Timing varies.

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 56 h, exercises 28 h.

Target group:

Major students

Prerequisites and co-requisites:

802355A Number theory and groups
802355A Rings, Fields and polynomials
800343A Permutations, fields and Galois' theory

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Mid-term exam or final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Markku Niemenmaa

Working life cooperation:

-

802633S: Statistical Pattern Recognition, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
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

Language of instruction:

Finnish

Timing:

Spring semester, 3rd and 4th periods.

Learning outcomes:

Upon completing the course the student will
-be familiar with the most common classifiers used in pattern recognition
-be able to apply pattern recognition methods to practical problems
-be able derive some of the basic mathematical results of pattern recognition theory

Contents:

The course focuses on the theory and practice of pattern recognition with emphasis on classifiers and feature extraction

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

42 h of lectures, 28 h of exercises

Target group:

Mathematics, applied mathematics and statistics majors. Other students with a sufficient mathematical background.

Prerequisites and co-requisites:

Calculus in one and several dimensions, linear algebra I and II. Probability theory I. Probability theory II or Random variables and distributions.

Recommended or required reading:

Lecture notes.
Optional reading:
R. O. Duda, P. E. Hart, and D. G. Stork. Pattern Classification. Wiley-Interscience, second edition, 2000.
S. Theodoridis and K. Koutroumbas. Pattern Recognition. Academic Press, 1999.
A. Webb. Statistical Pattern Recognition. Arnold, 1999 (Second edition: John Wiley & Sons Ltd, 2002).

Assessment methods and criteria:

Final exam. In the first exam following the course the student gets credit for the (possible) homework problems he/she has solved during the course.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Lasse Holmström

Working life cooperation:

No

Other information:

No

801643S: Topology, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Mahmoud Filali
Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Language of instruction:

English (also Finnish)

Timing:

3.-5. year of studies. Timing varies.

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

56h lectures, 28h exercises

Target group:

Major students

Prerequisites and co-requisites:

Compulsory basic and intermediate studies in mathematics, 800329A Topologia I

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Mid-term exams or final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Mahmoud Filai

802651S: Abstract Measure Theory, 5 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Ville Suomala
Opintokohteen kielet: Finnish

ECTS Credits:

5 cr

Language of instruction:

Finnish

Timing:

Spring

Learning outcomes:

After completing the course, the students know the basics of abstract measure and integration theory and are able to apply the main theorems in concrete situations.

Contents:

Basic concepts of measure theory: outer measure, sigma-algebra, measure, measurability, Lebesgue measure, integral, product measure.
Basic theorems: Convergence theorems, Fubini's theorem.

Mode of delivery:

Lectures, Exercises.

Prerequisites and co-requisites:

Basic knowledge of analysis in Euclidean spaces, set theory and topology. The course 800322A.

Recommended or required reading:

Bruckner, Bruckner, Thomson: Real Analysis; Cohn: Measure Theory; Purmonen: Mitta- ja integraaliteoria; ...

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Ville Suomala

802650S: Fractal Geometry, 10 op

Voimassaolo: 01.01.2010 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Esa Järvenpää
Opintokohteen kielet: Finnish

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

802660S: Operator theory and integral equations, 10 op

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail

Opettajat: Valeriy Serov

Opintokohteen kielet: English

ECTS Credits:

10 cr

Language of instruction:

English

Timing:

The course is held in the whole autumn semester 2014/2015, during periods I and II. It is recommended to complete the course at the end of autumn semester.

Learning outcomes:

Upon completion the student should be able to:

- Operate with self-adjoint operators in the Hilbert spaces.
- Operate with compact operators in the Hilbert spaces.
- Operator with one-dimensional integral equations of the first and second order.

Contents:

1. Inner product spaces and Hilbert spaces.
2. Symmetric operators in the Hilbert space. J. von Neumann's theorems about symmetric operators. Basic criterion of self-adjointness.
3. Orthogonal projection operators. J. von Neumann's spectral theorem.
4. Spectrum of self-adjoint operator.
5. Riesz theory of compact operators.
6. Quadratic forms. Friedrichs extension of symmetric operators.
7. Elliptic differential operators in bounded domains.
8. Spectral function of self - adjoint operators. Green's function.
9. Integral operators with weak singularities. Integral equations of the first and second kind.
10. Volterra integral equations.
11. Singular integral equations.
12. Nyström's method for equation of second kind.
13. The Galerkin method for integral equations.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 56 h / Group work 24 h / Self-study 24 h. The exercises are completed as group work. (N.B. This must show all the course hours, which means that total 104 hours = 10 ECTS credits).

Target group:

Major students in mathematics, physics and engineering.

Prerequisites and co-requisites:

The required (or recommended) prerequisite is the completion of the following courses prior to enrolling for the course: Linear Algebra, Ordinary differential equations (I), Complex analysis (I), Analysis (I) and (II).

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

They following books are recommended (the course based on these books):
1) R. Kress, Linear integral equations, Springer-Verlag New York, 1999.
2) F. Riesz and B. Sz-Nagy, Functional analysis, Ungar, 1978.
3) A.N. Kolmogorov and S.V. Fomin, Elements of the theory of functions and functional analysis, DaverPublications, 1999.

Assessment methods and criteria:

The assessment criteria are based on the learning outcomes of the course. The final exam is required only.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Professor, Valery Serov
vserov@cc.oulu.fi

802664S: Differential geometry, 10 op

Voimassaolo: 01.06.2014 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

ECTS Credits:

10 cr

Language of instruction:

English (if foreign participants)

Timing:

Master's or PhD-studies

Learning outcomes:

The knowledge of basic concepts and results in differential geometry.

Contents:

Differentiable manifold, tangent space, derivative.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

56 h lectures, 28 h exercises.

Target group:

Mathematics and other interested students

Prerequisites and co-requisites:

Analysis of several variables

Grading:

1 - 5, fail

Person responsible:

Esa Järvenpää

H326603: Statistics optional advanced studies, 0 - 120 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Advanced Studies
Laji: Study module
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Electives

805609S: Statistical methods in epidemiology, 9 op

Opiskelumuoto: Advanced Studies

Laji: Course

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

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

805646S: Analysis of longitudial data, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

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:

5/6 cr

Language of instruction:

Finnish

Timing:

Every secon year.

Learning outcomes:

After finishing the course a student can apply pooled ordinary least squares, generalized least squares, random effects methods, and fixed effects methods.

Contents:

1. Introduction: data types, omitted variables.
2. Mathematical tools: conditional expectation, basic asymptotic theory.
3. Basics of ordinary least squares.
4. Estimating systems of equations by ordinary least squares and by generalized least squares, panel data and seemingly unrelated regression as examples, simultaneous exogeneity and strict exogeneity, consistency and asymptotic normality, homoskedasticity and heteroskedasticity.
5. Pooled ordinary least squares for panel data, aggregated time effect, dummy variables, testing serial correlation and heteroskedasticity.
6. Unobserved effects model: random effects and fixed effects.
7. Random effects methods: random effects structure of the covariance matrix.
8. Fixed effects methods: fixed effects transformation, the use of dummy variables, first differencing transformation.
9. Comparison of estimators.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are voluntary
exercises. There are 14 times 2 hour lectures and 7 times 2 hour exercises.

Target group:

Students of economics and mathematical sciences.

Prerequisites and co-requisites:

Basic Mathematics for Economics 1 and 2, Basic
Methods in Statistics 1, Introduction to Econometrics.

Recommended or required reading:

J. M. Wooldridge: Econometric Analysis of Cross Section and Panel Data (The MIT Press).

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

The course is organized every two years.
The home page of the course is http://cc.oulu.fi/~jklemela/panel/

805679S: Time series analysis, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
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:

5 cr

Language of instruction:

Finnish

Learning outcomes:

After finishing the course, a student can apply linear, nonlinear and nonparametric modeling of time series. A student learns how to choose between alternative time series models and can apply statistical software to fit time series models.

Contents:

1. The course covers basic concepts of time series analysis: stationarity, autocorrelation, spectral distribution and periodogram.
2. Linear time series analysis includes explanation, prediction, parameter estimation and model diagnostics in ARMA models.
3. Nonlinear time series analysis includes threshold models and heteroskedastic time series models (ARCH and GARCH).
4. Furthermore, nonlinear nonparametric smoothing is covered (time space smoothing and state space smoothing) and nonparametric estimation of spectral densities. Nonparametric function estimation includes kernel estimation, local polynomial regression and additive modeling.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are voluntary exercises.
There are 14 times 2 hour lectures and 7 times 2 hour exercises.

Target group:

Students of mathematical sciences, econometrics and finance students.

Prerequisites and co-requisites:

Basic probability theory.

Recommended optional programme components:

-

Recommended or required reading:

Fan, J. ja Yao, Q. (2005). Nonlinear Time Series, Springer.

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

Home page of the course is http://cc.oulu.fi/~jklemela/timeseries/
Recommended reading:
P. J. Brockwell and R. A. Davis: Time Series: Theory and Methods, Springer, 1991.
H. Lutkepohl: Introduction to Multiple Time Series Analysis, Springer.
J. Hamilton: Time Series, Princeton University Press The MIT Press, 1994.

805683S: The Statistical Foundation of Econometrics, 5 - 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

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 Foundation of Econometrics	5.0 op

ECTS Credits:

5/6 cr

Language of instruction:

Finnish

Timing:

Every second year.

Learning outcomes:

The course familiarizes students with applications of statistical models when inferences are made on economic phenomena. The principles of statistical inference on economic phenomena are the same as those of general
statistical inference but there are some special issues that make the inference different in economics than

in other application areas of statistics. After finishing the course, a student can apply linear regression and a student is able to apply the method of instrumental variables. A student can diagnose the validity of the assumptions of the linear regression models and tune his inferences accordingly.

Contents:

1. Introduction: causal relationships and ceteris paribus analysis, data structures, stochastic explanatory variables.
2. Matrix algebra and the least squares estimator.
3. Conditional expectation.
4. Basic asymptotic theory: the weak law of large numbers, the central limit theorem, consistency and asymptotic normality of estimators.
5. The single-equation linear model: endogeneity and exogeneity, consistency and asymptotic normality of the ordinary least squares estimator, homoskedasticity and heteroskedasticity, identifiability of parameters, t-test, Wald's test, F-test, Lagrange multiplier test, omitted variables problem, proxy variables solution to the omitted variables problem, measurement errors.
6. Instrumental variables: two-stage least squares estimator, consistency and asymptotic normality, asymptotic efficiency, indicator variables solution.
7. Newey-West estimator of covariance matrix, generalized method of moments and instrumental variables,
testing for endogeneity (Hausman test), testing for heteroskedasticity (Breusch-Pagan test, White's test), testing for autocorrelation (Durbin-Watson test, Box-Pierce test).

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are partly compulsory exercises.
There are 14 times 2 hour lectures and 7 times 2 hour exercises.

Target group:

Students of economics and mathematical sciences.

Prerequisites and co-requisites:

Basic Mathematics for Economics 1 and 2, Basic methods in statistics 1, Introduction to Econometrics.

Recommended or required reading:

J. M. Wooldridge: Econometric Analysis of Cross Section and Panel Data (The MIT Press)

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5

Person responsible:

Jussi Klemelä.

Other information:

The course is organized every two years. The course was organized at spring 2014.
The home page of the course is http://cc.oulu.fi/~jklemela/econometrics/
Recommended literature: William H. Greene: Econometric Analysis (Prentice Hall).

805681S: Generalized Linear Models, 9 op

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

805699S: Statistical methods in epidemiology, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

806618S: Computationally intensive statistical methods, 9 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

806621S: Spatial Data Analysis, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

806628S: Statistical Finance, 5 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Jussi Klemelä
Opintokohteen kielet: Finnish

ECTS Credits:

5 cr

Language of instruction:

Finnish

Timing:

Every second year.

Learning outcomes:

On a successful completion of this course, the student is familiar with the basic concepts of derivative pricing and knows how to calculate the Black-Scholes price of a stock option. In addition, after completion of the course, the student knows how to calculate a Markowotz portfolio, how to evaluate the return and the risk of a portfolio, and knows how to calculate performance measures for a portfolio.

Contents:

1. Introduction: The main asset classes and derivative types.
2. The main concepts needed to price futures and options, arbitrage pricing and pricing with statistical arbitrage, the arbitrage free price of futures, the put-call-parity.
3. Pricing of options in the single period and multiperiod binary model, Black-Scholes pricing, and pricing in incomplete models.
4. The basic methods for choosing and evaluating a portfolio, Markowitz theory for the portfolio choice, maximization of the expected utility, and the maximization of the conditional expected utility.

Mode of delivery:

Face-to-face teachin

Learning activities and teaching methods:

Besides lectures, there are voluntary exercises.
There are 14 times 2 hour lectures and 7 times 2 hour exercises.

Target group:

Students of mathematical sciences, students of finance and economics.

Prerequisites and co-requisites:

Basic knowledge of statistics and probability.

Recommended optional programme components:

The course is suitable together with the course "Market Risk Analysis".

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Examination

Grading:

1 - 5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

The home page of the course is http://cc.oulu.fi/~jklemela/stafin/
The course is lectured every second year.
Additional literature:
Franke, J., Härdle, W., and Hafner, C. M. (2004).
Statistics of Financial Markets, Springer.
Bouchaud, J.-P. and Potters, M. (2003).
Theory of Financial Risk and Derivative Pricing,
Cambridge University Press.
Ruppert, D. (2004). Statistics and Finance, Springer.

806629S: Introduction to Sampling Methods, 4 op

Voimassaolo: 01.01.2010 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Läärä Esa
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

806630S: Market Risk Analysis, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Jussi Klemelä
Opintokohteen kielet: Finnish
Leikkaavuudet:

806330A	Analysis of Market Risk	5.0 op

ECTS Credits:

5 cr

Language of instruction:

Finnish

Timing:

Every second year.

Learning outcomes:

The student knows how to estimate the unconditional value-at-risk using empirical quantiles, parametric modeling, semiparametric modeling, and extreme value theory. The student knows also how to estimate the conditional value-at-risk using GARCH models. Student knows how to apply statistical software to make the calculations.

Contents:

The course is an introduction to the quantitative risk management of a portfolio of stocks. The course introduces various risk measures, extreme value theory, and modeling of financial time series. The course covers:
1. Conditional and unconditional loss distribution,
2. Value-at-Risk and other risk measures,
3. standard methods of estimating Value-at-Risk: multivariate normal modeling, historical simulation /empirical quantiles, and the Monte Carlo method,
4. Modeling of distributions: multivariate distributions, normal mixture distributions, spherical and elliptical distributions, and dimension reduction,
5. Modeling of financial time series: ARMA models, GARCH models, and volatility models,
6. Copulas and measures of dependence,
7. Extreme value theory: block maxima and threshold exceedance methods.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are voluntary exercises.
There are 14 times 2 hour lectures and 7 times 2 hour exercises

Target group:

Students of mathematical sciences, students of finance and economics.

Prerequisites and co-requisites:

Basic knowledge of statistics.

Recommended optional programme components:

The course is suitable together with the course "Statistical Finance".

Recommended or required reading:

McNeil, A. J., Frey, R., and Embrechts, P. (2005).Quantitative Risk Management: Concepts, Techniques and Tools,Princeton Series in Finance, 608 pp.

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

The home page of the course is http://cc.oulu.fi/~jklemela/marketrisk/
The course is lectured every second year.

805651S: Stochastic processes, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

806622S: Probability, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

805611S: Mathematical statistics II, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
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

ECTS Credits:

10 cr

Language of instruction:

Finnish

Timing:

Every second year.

Learning outcomes:

On a successful completion of this course, the student can derive asymptotic distributions of estimators and test statistics in regular parametric models and can derive confidence intervals and p-values ot statistical tests based on these asymptotic distributions.

Contents:

The course covers statistical inference in finite dimensional parametric models:
1. asymptotic theory (convergence of random variables, weak law of large numbers and the central limit theorem),
2. likelihood inference (consistency and asymptotic normality, exponential families),
3. least squares method and the method of moments (consistency and asymptotic normality),
4. test theory (testing based on likelihood function and testing in linear models).
Furthermore, the course covers efficiency in parametric and nonparametric models, resampling, nonparametric function estimation, and adaptive estimation.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are voluntary exercises.
There are 28 times 2 hour lectures and 14 times 2 hour exercises.

Target group:

Master's students of statistics, students of mathematical sciences.

Prerequisites and co-requisites:

Statistical Inference I

Recommended optional programme components:

-

Recommended or required reading:

Davison, A. C. (2003).
Statistical Models, Cambridge Series in Statistical and Probabilistic Mathematics.

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

The home page of the course is http://cc.oulu.fi/~jklemela/stainf/
The course is organized every two year.
Additional literature:
Lehmann, E. ja Casella, G. Theory of Point Estimation.

800698S: Pro gradu thesis, 30 op

Opiskelumuoto: Advanced Studies

Laji: Diploma thesis

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
30 cr
Language of instruction:
Finnish (also English)
Learning outcomes:
After writing the Master's degree, student has written an analytical and logical study of a problem or theory in a field of mathematics, applied mathematics or statistics. Completing the thesis succesfully, student is able to write scientific articles and texts in mathematics.
Contents:
The scope of the Master's thesis is 20 cr for Teacher students and 30 cr in other disciplines. In Master's thesis, the student engages in researching a specific mathematical area or problem in the field of mathematics, appliead mathematics or statistics.
Mode of delivery:
Thesis
Learning activities and teaching methods:
Own work, meetings with the supervisor
Target group:
Major students
Prerequisites and co-requisites:
Bachelor's degree (or equivalent), 20-50 cr advanced studies
Recommended optional programme components:
-
Recommended or required reading:
-
Assessment methods and criteria:
Thesis
Read more about assessment criteria at the University of Oulu webpage.

Grading:
1-5
Person responsible:
Professors and other teaching personnel
Working life cooperation:
-

H325003: Mathematics, optional advanced studies, 0 - 120 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Advanced Studies
Laji: Study module
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Electives

802653S: Lebesgue Measure and Integration Theory, 5 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Mikael Lindström
Opintokohteen kielet: Finnish

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

801698S: Cryptography, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
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

Language of instruction:

Finnish/English

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-Srassen.

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

802655S: Continued Fractions, 5 op

Voimassaolo: 01.01.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Language of instruction:

FI/EN

Recommended or required reading:

G.H. Hardy & E.M. Wright: An Introduction to the Theory of Numbers.
Kenneth H. Rosen: Elementary number theory and its applications.
Lisa Lorentzen and Haakon Waadeland: Continued Fractions with Applications (1992).
Oskar Perron: Die Lehre von den Kettenbruchen (1913).

Course material: http://cc.oulu.fi/~tma/OPETUS.html

802644S: Introduction to Functional Analysis, 10 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Mahmoud Filali

Opintokohteen kielet: Finnish

Learning outcomes:

If we think of functional analysis as infinite dimensional linear algebra, then the course offers the tools and the ways to handle this infinite dimension. After completing the course successfully, the student will be able to follow almost any material on functional analysis.

Contents:

After recalling some basic definitions on linear algebra and giving the basic definitions concerning normed spaces, we present the uniform boundedness principle and the open mapping theorem. In this first part of the course, the relative compactness of the unit ball in a normed space is studied under the norm topology. Hahn-Banach Theorem is presented in its various forms: algebraic, analytic and geometric, and followed by Krein-Milman Theorem. We end up with the weak topology on normed spaces and the weak* topology on Banach duals. The relative compactness of the unit ball is studied with respect to these two topologies.

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Mahmoud Filali

802636S: Information Theory, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

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

Language of instruction:

Finnish.

Timing:

Spring semester, 3rd and 4th periods.

Learning outcomes:

Upon completing the course the student will
- be familiar with the central concepts and results of information theory
- be able to solve mathematical problems that arise in information theory
- be able to derive the central results of information theory

Contents:

The course introduces Claude Shannons' mathematical theory of communication, its basic concepts and results. The questions discussed include quantification of the amount of information of an information source, compression of information, coding, communication of coded information through a communication channel and decoding of received messages.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

56 h of lectures, 28 h of exercises.

Target group:

Mathematics, applied mathematics and statistics majors. Other students with a sufficient mathematical background.

Prerequisites and co-requisites:

Calculus in one and several dimensions, linear algebra I and II. Probability theory I. Probability theory II or Random variables and distributions.

Recommended or required reading:

Lecture notes written by the instructor.

Assessment methods and criteria:

Final exam. In the first exam following the course the student gets credit for the homework problems he /she has solved during the course.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Lasse Holmström

Working life cooperation:

-

Other information:

Level: advanced studies.

802635S: Introduction to partial differential equations, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

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 R^n and in bounded domains, potential theory, Green's function, Heat equation in R^n and in bounded domains, Wave equation in R^n and in bounded domans, d'Alembert formula for any dimensions, Fourier method.

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Valeriy Serov

802652S: Hilbert Spaces, 5 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

800624S	Analysis III	10.0 op

ECTS Credits:

5 ECTS credits

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

800651S: Functional analysis, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Language of instruction:

Finnish (English if neede)

Timing:

4-5 year of studies. Timig varies.

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.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

56h lectures, 24h exercises

Target group:

Major students

Prerequisites and co-requisites:

Compulsory basic and intermediate studies.

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes
E. Kreyszig: Introductory Functional Analysis with Applications, Wiley Classics Library, 1989
K. Astala, P. Piiroinen, H.-O. Tylli, Funktionaalianalyysin peruskurssi, Helsingin yliopisto, luentomoniste 2008.

Assessment methods and criteria:

Final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Mikael Lindström

Working life cooperation:

-

802629S: Function estimation, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Lasse Holmström
Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Language of instruction:

Finnish

Timing:

Spring semester, 3rd and 4th periods

Learning outcomes:

Upon completing the course the student will be able to
- characterise the basic features non-parametric function estimation methods
- apply such estimation methods to practical problems
- derive some of the basic results of non-parametric function estimation for kernel estimators

Contents:

The course focuses on the theory and practice of non-parametric function estimation with a special emphasis on kernel methods. The particular functions considered are a probability density function and a regression function.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

42 h of lectures, 28 h of exercises

Target group:

Mathematics, applied mathematics and statistics majors. Other students with a sufficient mathematical background.

Prerequisites and co-requisites:

Calculus in one and several dimensions. Probability theory I. Probability theory II or Random variables and distributions.

Recommended optional programme components:

No

Recommended or required reading:

Lecture notes written by the instructor.

Assessment methods and criteria:

Final exam. In the first exam following the course the student gets credit for the homework problems he /she has solved during the course. This is agreed in the beginning of the course.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Lasse Holmström

Working life cooperation:

No

Other information:

No

800674S: Fourier transform and distributions, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Valeriy Serov

Opintokohteen oppimateriaali:

Stein, Elias M.; Shakarchi R., , 2003
Taylor, Michael E., , 1996
Grafakos Loukas, , 2004
Stakgold, Ivar , , 1998

Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Language of instruction:

English

Timing:

4.-5. year of studies. Timing varies.

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.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

56h lectures, 28h exercises

Target group:

Major students

Prerequisites and co-requisites:

Euclidiean topology, Series and integrals, Multidimensional analysis, Complex analysis I and II, and Linear algebra I and II.

Recommended optional programme components:

-

Recommended or required reading:

Luentomoniste
E.M. Stein & R. Shakarchi: Fourier Analysis (an Introduction), Princeton University Press, 2003;
L. Grafakos: Classical and Modern Fourier Analysis, Pearson Education, 2004;
I. Stakgold: Green's Functions and Boundary Value Problems, 2nd edition, Wiley, 1998;
M. Taylor: Partial Differential Equations (Basic Theory), Springer, 1996.

Assessment methods and criteria:

Final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Valeriy Serov

Working life cooperation:

-

802647S: Fourier series and the discrete Fourier transform, 10 op

Voimassaolo: 01.01.2010 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Valeriy Serov

Opintokohteen kielet: English

Ei opintojaksokuvauksia.

802656S: Algebraic numbers, 5 op

Voimassaolo: 01.01.2012 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Language of instruction:

FI/EN

Learning outcomes:

As usual in my mathematical studies I shall be ableto solve problems arising from the subject andto 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:

First we revise some basics of rings and fieldswhich are needed to proceed ahead field extensions. In particular, divisibility in an integral domain is carefully studied yielding to applications in the theory of polynomial algebra and algebraic integers.
The theory of algebraic numbers is strongly based on polynomial algebra, where the properties of zeros and divisibility of polynomials are considered.
The definition of an algebraic number will be generalized to the algebraic elements of field extensions going forward to algebraic fields.Considered as most important algebraic fields we get number fields which are finitely generated subfields of the field A of all complex algebraic numbers. In particular, we study quadratic number fields.
Further, we shall consider the divisibility and factorization of algebraic integers with some applications to Diophantine equations.

Prerequisites and co-requisites:

Algebra I and II, Linear algebra I and II, Basics in Number Theory (Number theory I)

Recommended or required reading:

I.N. Stewart and D.O. Tall: Algebraic number theory.
Daniel Marcus: Number fields.
J.B. Fraleigh: Abstract algebra.
Michael Artin: Algebra.

Course material: http://cc.oulu.fi/~tma/OPETUS.html

802637S: Advanced Problem Solving, 2 - 6 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Peter Hästö
Opintokohteen kielet: English

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

802645S: Number Theory A, 5 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Tapani Matala-aho
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

802646S: Number Theory B, 5 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Tapani Matala-aho
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

802631S: Modern real analysis, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Learning outcomes:

On successful completion of this course, the student will be able to
- derive and prove basic results of modern real analysis.
- apply the results and methods of modern real analysis in different topics of mathematics, like in the theory of partial differential equations.

Contents:

The course presents Lebesgue spaces (Hölder's and Minkowski's inequalities, completeness, dual spaces), the Vitali covering theorem, the Hardy-Littlewood maximal function, approximation with smooth functions using convolution, Lebesgue's density theorem, Sobolev's inequalities.

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

800688S: Theory of Optimization, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
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

Language of instruction:

Finnish

Timing:

Autumn.

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.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 56 h / Group work 24 h.

Target group:

All

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Luenberger D.G.: introduction to Linear and Nonlinear Programming, Peressini A.L., Sullivan F.E. and Uhl, J.J.Jr.: The Mathematics of Nonlinear Pro-gramming, Lecture Notes.

Assessment methods and criteria:

During the course, there are two intermediate exams.
Final exam ater the course.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Erkki Laitinen

Working life cooperation:

-

800660S: Group Theory, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Niemenmaa Markku
Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Language of instruction:

Finnish

Timing:

4-5 year of studies. Timing varies.

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 56 h, exercises 28 h.

Target group:

Major students

Prerequisites and co-requisites:

802355A Number theory and groups
802355A Rings, Fields and polynomials
800343A Permutations, fields and Galois' theory

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Mid-term exam or final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Markku Niemenmaa

Working life cooperation:

-

802633S: Statistical Pattern Recognition, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
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

Language of instruction:

Finnish

Timing:

Spring semester, 3rd and 4th periods.

Learning outcomes:

Upon completing the course the student will
-be familiar with the most common classifiers used in pattern recognition
-be able to apply pattern recognition methods to practical problems
-be able derive some of the basic mathematical results of pattern recognition theory

Contents:

The course focuses on the theory and practice of pattern recognition with emphasis on classifiers and feature extraction

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

42 h of lectures, 28 h of exercises

Target group:

Mathematics, applied mathematics and statistics majors. Other students with a sufficient mathematical background.

Prerequisites and co-requisites:

Calculus in one and several dimensions, linear algebra I and II. Probability theory I. Probability theory II or Random variables and distributions.

Recommended or required reading:

Lecture notes.
Optional reading:
R. O. Duda, P. E. Hart, and D. G. Stork. Pattern Classification. Wiley-Interscience, second edition, 2000.
S. Theodoridis and K. Koutroumbas. Pattern Recognition. Academic Press, 1999.
A. Webb. Statistical Pattern Recognition. Arnold, 1999 (Second edition: John Wiley & Sons Ltd, 2002).

Assessment methods and criteria:

Final exam. In the first exam following the course the student gets credit for the (possible) homework problems he/she has solved during the course.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Lasse Holmström

Working life cooperation:

No

Other information:

No

801643S: Topology, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Mahmoud Filali
Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Language of instruction:

English (also Finnish)

Timing:

3.-5. year of studies. Timing varies.

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

56h lectures, 28h exercises

Target group:

Major students

Prerequisites and co-requisites:

Compulsory basic and intermediate studies in mathematics, 800329A Topologia I

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Mid-term exams or final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Mahmoud Filai

802651S: Abstract Measure Theory, 5 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Ville Suomala
Opintokohteen kielet: Finnish

ECTS Credits:

5 cr

Language of instruction:

Finnish

Timing:

Spring

Learning outcomes:

After completing the course, the students know the basics of abstract measure and integration theory and are able to apply the main theorems in concrete situations.

Contents:

Basic concepts of measure theory: outer measure, sigma-algebra, measure, measurability, Lebesgue measure, integral, product measure.
Basic theorems: Convergence theorems, Fubini's theorem.

Mode of delivery:

Lectures, Exercises.

Prerequisites and co-requisites:

Basic knowledge of analysis in Euclidean spaces, set theory and topology. The course 800322A.

Recommended or required reading:

Bruckner, Bruckner, Thomson: Real Analysis; Cohn: Measure Theory; Purmonen: Mitta- ja integraaliteoria; ...

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Ville Suomala

802650S: Fractal Geometry, 10 op

Voimassaolo: 01.01.2010 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Esa Järvenpää
Opintokohteen kielet: Finnish

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

802660S: Operator theory and integral equations, 10 op

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Valeriy Serov
Opintokohteen kielet: English

ECTS Credits:

10 cr

Language of instruction:

English

Timing:

The course is held in the whole autumn semester 2014/2015, during periods I and II. It is recommended to complete the course at the end of autumn semester.

Learning outcomes:

Upon completion the student should be able to:

- Operate with self-adjoint operators in the Hilbert spaces.
- Operate with compact operators in the Hilbert spaces.
- Operator with one-dimensional integral equations of the first and second order.

Contents:

1. Inner product spaces and Hilbert spaces.
2. Symmetric operators in the Hilbert space. J. von Neumann's theorems about symmetric operators. Basic criterion of self-adjointness.
3. Orthogonal projection operators. J. von Neumann's spectral theorem.
4. Spectrum of self-adjoint operator.
5. Riesz theory of compact operators.
6. Quadratic forms. Friedrichs extension of symmetric operators.

7. Elliptic differential operators in bounded domains.
8. Spectral function of self - adjoint operators. Green's function.
9. Integral operators with weak singularities. Integral equations of the first and second kind.
10. Volterra integral equations.
11. Singular integral equations.
12. Nyström's method for equation of second kind.
13. The Galerkin method for integral equations.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 56 h / Group work 24 h / Self-study 24 h. The exercises are completed as group work. (N.B. This must show all the course hours, which means that total 104 hours = 10 ECTS credits).

Target group:

Major students in mathematics, physics and engineering.

Prerequisites and co-requisites:

The required (or recommended) prerequisite is the completion of the following courses prior to enrolling for the course: Linear Algebra, Ordinary differential equations (I), Complex analysis (I), Analysis (I) and (II).

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

They following books are recommended (the course based on these books):
1) R. Kress, Linear integral equations, Springer-Verlag New York, 1999.
2) F. Riesz and B. Sz-Nagy, Functional analysis, Ungar, 1978.
3) A.N. Kolmogorov and S.V. Fomin, Elements of the theory of functions and functional analysis, DaverPublications, 1999.

Assessment methods and criteria:

The assessment criteria are based on the learning outcomes of the course. The final exam is required only.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Professor, Valery Serov
vserov@cc.oulu.fi

802664S: Differential geometry, 10 op

Voimassaolo: 01.06.2014 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

ECTS Credits:

10 cr

Language of instruction:

English (if foreign participants)

Timing:

Master's or PhD-studies

Learning outcomes:

The knowledge of basic concepts and results in differential geometry.

Contents:

Differentiable manifold, tangent space, derivative.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

56 h lectures, 28 h exercises.

Target group:

Mathematics and other interested students

Prerequisites and co-requisites:

Analysis of several variables

Grading:

1 - 5, fail

Person responsible:

Esa Järvenpää

H326603: Statistics optional advanced studies, 0 - 120 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Advanced Studies
Laji: Study module
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Electives

805609S: Statistical methods in epidemiology, 9 op

Opiskelumuoto: Advanced Studies
Laji: Course
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

Assessment methods and criteria:

Read more about assessment criteria at the University of Oulu webpage.

805646S: Analysis of longitudial data, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
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:

5/6 cr

Language of instruction:

Finnish

Timing:

Every secon year.

Learning outcomes:

After finishing the course a student can apply pooled ordinary least squares, generalized least squares, random effects methods, and fixed effects methods.

Contents:

1. Introduction: data types, omitted variables.
2. Mathematical tools: conditional expectation, basic asymptotic theory.
3. Basics of ordinary least squares.
4. Estimating systems of equations by ordinary least squares and by generalized least squares, panel data and seemingly unrelated regression as examples, simultaneous exogeneity and strict exogeneity, consistency and asymptotic normality, homoskedasticity and heteroskedasticity.
5. Pooled ordinary least squares for panel data, aggregated time effect, dummy variables, testing serial correlation and heteroskedasticity.
6. Unobserved effects model: random effects and fixed effects.
7. Random effects methods: random effects structure of the covariance matrix.
8. Fixed effects methods: fixed effects transformation, the use of dummy variables, first differencing transformation.
9. Comparison of estimators.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are voluntary
exercises. There are 14 times 2 hour lectures and 7 times 2 hour exercises.

Target group:

Students of economics and mathematical sciences.

Prerequisites and co-requisites:

Basic Mathematics for Economics 1 and 2, Basic
Methods in Statistics 1, Introduction to Econometrics.

Recommended or required reading:

J. M. Wooldridge: Econometric Analysis of Cross Section and Panel Data (The MIT Press).

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

The course is organized every two years.
The home page of the course is http://cc.oulu.fi/~jklemela/panel/

805679S: Time series analysis, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

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:

5 cr

Language of instruction:

Finnish

Learning outcomes:

After finishing the course, a student can apply linear, nonlinear and nonparametric modeling of time series. A student learns how to choose between alternative time series models and can apply statistical software to fit time series models.

Contents:

1. The course covers basic concepts of time series analysis: stationarity, autocorrelation, spectral distribution and periodogram.
2. Linear time series analysis includes explanation, prediction, parameter estimation and model diagnostics in ARMA models.
3. Nonlinear time series analysis includes threshold models and heteroskedastic time series models (ARCH and GARCH).
4. Furthermore, nonlinear nonparametric smoothing is covered (time space smoothing and state space smoothing) and nonparametric estimation of spectral densities. Nonparametric function estimation includes kernel estimation, local polynomial regression and additive modeling.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are voluntary exercises.
There are 14 times 2 hour lectures and 7 times 2 hour exercises.

Target group:

Students of mathematical sciences, econometrics and finance students.

Prerequisites and co-requisites:

Basic probability theory.

Recommended optional programme components:

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Recommended or required reading:

Fan, J. ja Yao, Q. (2005). Nonlinear Time Series, Springer.

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

Home page of the course is http://cc.oulu.fi/~jklemela/timeseries/
Recommended reading:
P. J. Brockwell and R. A. Davis: Time Series: Theory and Methods, Springer, 1991.
H. Lutkepohl: Introduction to Multiple Time Series Analysis, Springer.
J. Hamilton: Time Series, Princeton University Press The MIT Press, 1994.

805683S: The Statistical Foundation of Econometrics, 5 - 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

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 Foundation of Econometrics 5.0 op

ECTS Credits:

5/6 cr

Language of instruction:

Finnish

Timing:

Every second year.

Learning outcomes:

The course familiarizes students with applications of statistical models when inferences are made on economic phenomena. The principles of statistical inference on economic phenomena are the same as those of general
statistical inference but there are some special issues that make the inference different in economics than in other application areas of statistics. After finishing the course, a student can apply linear regression and a student is able to apply the method of instrumental variables. A student can diagnose the validity of the assumptions of the linear regression models and tune his inferences accordingly.

Contents:

1. Introduction: causal relationships and ceteris paribus analysis, data structures, stochastic explanatory variables.
2. Matrix algebra and the least squares estimator.
3. Conditional expectation.
4. Basic asymptotic theory: the weak law of large numbers, the central limit theorem, consistency and asymptotic normality of estimators.
5. The single-equation linear model: endogeneity and exogeneity, consistency and asymptotic normality of the ordinary least squares estimator, homoskedasticity and heteroskedasticity, identifiability of parameters, t-test, Wald's test, F-test, Lagrange multiplier test, omitted variables problem, proxy variables solution to the omitted variables problem, measurement errors.
6. Instrumental variables: two-stage least squares estimator, consistency and asymptotic normality, asymptotic efficiency, indicator variables solution.
7. Newey-West estimator of covariance matrix, generalized method of moments and instrumental variables,
testing for endogeneity (Hausman test), testing for heteroskedasticity (Breusch-Pagan test, White's test), testing for autocorrelation (Durbin-Watson test, Box-Pierce test).

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are partly compulsory exercises.
There are 14 times 2 hour lectures and 7 times 2 hour exercises.

Target group:

Students of economics and mathematical sciences.

Prerequisites and co-requisites:

Basic Mathematics for Economics 1 and 2, Basic methods in statistics 1, Introduction to Econometrics.

Recommended or required reading:

J. M. Wooldridge: Econometric Analysis of Cross Section and Panel Data (The MIT Press)

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5

Person responsible:

Jussi Klemelä.

Other information:

The course is organized every two years. The course was organized at spring 2014.
The home page of the course is http://cc.oulu.fi/~jklemela/econometrics/
Recommended literature: William H. Greene: Econometric Analysis (Prentice Hall).

805681S: Generalized Linear Models, 9 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

805699S: Statistical methods in epidemiology, 8 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

806618S: Computationally intensive statistical methods, 9 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

806621S: Spatial Data Analysis, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

806628S: Statistical Finance, 5 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Jussi Klemelä

Opintokohteen kielet: Finnish

ECTS Credits:

5 cr

Language of instruction:

Finnish

Timing:

Every second year.

Learning outcomes:

On a successful completion of this course, the student is familiar with the basic concepts of derivative pricing and knows how to calculate the Black-Scholes price of a stock option. In addition, after completion of the course, the student knows how to calculate a Markowotz portfolio, how to evaluate the return and the risk of a portfolio, and knows how to calculate performance measures for a portfolio.

Contents:

1. Introduction: The main asset classes and derivative types.
2. The main concepts needed to price futures and options, arbitrage pricing and pricing with statistical arbitrage, the arbitrage free price of futures, the put-call-parity.
3. Pricing of options in the single period and multiperiod binary model, Black-Scholes pricing, and pricing in incomplete models.
4. The basic methods for choosing and evaluating a portfolio, Markowitz theory for the portfolio choice, maximization of the expected utility, and the maximization of the conditional expected utility.

Mode of delivery:

Face-to-face teachin

Learning activities and teaching methods:

Besides lectures, there are voluntary exercises.
There are 14 times 2 hour lectures and 7 times 2 hour exercises.

Target group:

Students of mathematical sciences, students of finance and economics.

Prerequisites and co-requisites:

Basic knowledge of statistics and probability.

Recommended optional programme components:

The course is suitable together with the course "Market Risk Analysis".

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Examination

Grading:

1 - 5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

The home page of the course is http://cc.oulu.fi/~jklemela/stafin/
The course is lectured every second year.
Additional literature:
Franke, J., Härdle, W., and Hafner, C. M. (2004).
Statistics of Financial Markets, Springer.

Bouchaud, J.-P. and Potters, M. (2003).
Theory of Financial Risk and Derivative Pricing,
Cambridge University Press.
Ruppert, D. (2004). Statistics and Finance, Springer.

806629S: Introduction to Sampling Methods, 4 op

Voimassaolo: 01.01.2010 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Läärä Esa
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

806630S: Market Risk Analysis, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Jussi Klemelä
Opintokohteen kielet: Finnish
Leikkaavuudet:

806330A Analysis of Market Risk 5.0 op

ECTS Credits:

5 cr

Language of instruction:

Finnish

Timing:

Every second year.

Learning outcomes:

The student knows how to estimate the unconditional value-at-risk using empirical quantiles, parametric modeling, semiparametric modeling, and extreme value theory. The student knows also how to estimate the conditional value-at-risk using GARCH models. Student knows how to apply statistical software to make the calculations.

Contents:

The course is an introduction to the quantitative risk management of a portfolio of stocks. The course introduces various risk measures, extreme value theory, and modeling of financial time series. The course covers:
1. Conditional and unconditional loss distribution,
2. Value-at-Risk and other risk measures,
3. standard methods of estimating Value-at-Risk: multivariate normal modeling, historical simulation /empirical quantiles, and the Monte Carlo method,
4. Modeling of distributions: multivariate distributions, normal mixture distributions, spherical and elliptical distributions, and dimension reduction,
5. Modeling of financial time series: ARMA models, GARCH models, and volatility models,
6. Copulas and measures of dependence,
7. Extreme value theory: block maxima and threshold exceedance methods.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are voluntary exercises.
There are 14 times 2 hour lectures and 7 times 2 hour exercises

Target group:

Students of mathematical sciences, students of finance and economics.

Prerequisites and co-requisites:

Basic knowledge of statistics.

Recommended optional programme components:

The course is suitable together with the course "Statistical Finance".

Recommended or required reading:

McNeil, A. J., Frey, R., and Embrechts, P. (2005).Quantitative Risk Management: Concepts, Techniques and Tools,Princeton Series in Finance, 608 pp.

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

The home page of the course is http://cc.oulu.fi/~jklemela/marketrisk/
The course is lectured every second year.

805651S: Stochastic processes, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

806622S: Probability, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

805611S: Mathematical statistics II, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
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

ECTS Credits:

10 cr

Language of instruction:

Finnish

Timing:

Every second year.

Learning outcomes:

On a successful completion of this course, the student can derive asymptotic distributions of estimators and test statistics in regular parametric models and can derive confidence intervals and p-values ot statistical tests based on these asymptotic distributions.

Contents:

The course covers statistical inference in finite dimensional parametric models:
1. asymptotic theory (convergence of random variables, weak law of large numbers and the central limit theorem),
2. likelihood inference (consistency and asymptotic normality, exponential families),
3. least squares method and the method of moments (consistency and asymptotic normality),
4. test theory (testing based on likelihood function and testing in linear models).
Furthermore, the course covers efficiency in parametric and nonparametric models, resampling, nonparametric function estimation, and adaptive estimation.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Besides lectures, there are voluntary exercises.
There are 28 times 2 hour lectures and 14 times 2 hour exercises.

Target group:

Master's students of statistics, students of mathematical sciences.

Prerequisites and co-requisites:

Statistical Inference I

Recommended optional programme components:

-

Recommended or required reading:

Davison, A. C. (2003).
Statistical Models, Cambridge Series in Statistical and Probabilistic Mathematics.

Assessment methods and criteria:

Examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5

Person responsible:

Jussi Klemelä

Working life cooperation:

-

Other information:

The home page of the course is http://cc.oulu.fi/~jklemela/stainf/
The course is organized every two year.
Additional literature:
Lehmann, E. ja Casella, G. Theory of Point Estimation.

Tutkintorakenteisiin kuulumattomien opintokokonaisuuksien ja -jaksojen kuvaukset

806623S: An introduction to stochastic modelling, 8 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Läärä Esa
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

806627S: Linear mixed models in the analysis of panel data, 6 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

802356A: Metric Topology, 5 op

Voimassaolo: 01.01.2012 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Esa Järvenpää
Opintokohteen kielet: Finnish
Leikkaavuudet:

802358A	Metric Spaces	5.0 op
802352A	Euclidean Topology	4.0 op

ECTS Credits:
5 cr
Language of instruction:
Finnish
Timing:
1. year, 3. period
Learning outcomes:
After the course student is able to
- define elementary topological concepts (open and closed sets, accumulation point, etc)
- handle sequences of real numbers
- proof fundamental theorems related to continuous functions

Contents:
The courses goal is to expand students knowledge and understanding of continuous functions. Course considers basic topology of n-dimensional Euclidean space. Important concepts are, for instance, open and closed sets, compactness and completeness.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
32h lectures, 18h exercises
Target group:

Major students (who are aiming to Master's degree in mathematics (research oriented line))
Prerequisites and co-requisites:
802154P Elementary functions
802155P Limit and continuity
802156P Derivative

Assessment methods and criteria:
Final exam
Grading:
1-5
Person responsible:
Esa Järvenpää

806625S: Multivariate analysis, 6 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

806617S: Nonparametric and robust methods, 8 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

806604S: Principles of bayesian inference, 10 op

Voimassaolo: - 01.09.2012
Opiskelumuoto: Advanced Studies
Laji: Course
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.

806603S: Robust methods, 6 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.