AALBORG UNIVERSITET

# KANDIDATUDDANNELSEN I MATEMATIK-ØKONOMI, 2017

CAND.SCIENT.OECON.
AALBORG

MODULER SOM INDGÅR I STUDIEORDNINGEN

# INDHOLDSFORTEGNELSE

# ADVANCED TOPICS WITH APPLICATIONS

# 2019/2020

## PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge obtained by the modules on the 2nd semester.

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

- have expert understanding of relevant theories and methods within one of the main areas Financial Engineering or Operations Research
- knowledge of one or more applications of the theories within the scope of the first two semesters of the degree programme (for example, arbitrage theory and asset pricing, mean-variance analysis, martingale pricing, volatility analysis, quantitative risk management, operations management, project management, business intelligence , supply chain management, or data mining)

#### SKILLS

- must be able to identify, formulate and analyse a scientific problem independently, systematically and critically
- must be able to relate the problem to either the financial engineering subject area or the operations research subject area, including explaining the choices that have been made in connection to the delimitation of the problem
- must be able to independently make and justify the choice of theories and methods
- must be able to communicate research-based knowledge and discuss the professional and scientific problems with other people both within mathematics and economics

#### COMPETENCES

- must be able to control work and development situations which are complex, unpredictable and require new models within financial engineering or within operations research
- must be able to initiate and complete collaborations within financial engineering or operations research, and if relevant also other interdisciplinary collaborations, as well as assume professional responsibility
- must be able to independently assume responsibility for own professional development and specialisation

### TYPE OF INSTRUCTION

Project work.

### EXTENT AND EXPECTED WORKLOAD

This is a 20 ECTS project module and the work load is expected to be 600 hours for the student.

## EXAM

### EXAMS

| | |
|---|---|
| Name of exam | Videregående emner inden for matematik-økonomi med anvendelser (projekt) |
| Type of exam | Oral exam based on a project |
| ECTS | 20 |

| | |
|---|---|
| Assessment | 7-point grading scale |
| Type of grading | Internal examination |
| Criteria of assessment | The criteria of assessment are stated in the Examination Policies and Procedures |

## FACTS ABOUT THE MODULE

| | |
|---|---|
| Danish title | Videregående emner inden for matematik-økonomi med anvendelser |
| Module code | F-MOK-K3-1 |
| Module type | Project |
| Duration | 1 semester |
| Semester | Autumn |
| ECTS | 20 |
| Language of instruction | Danish and English |
| Empty-place Scheme | Yes |
| Location of the lecture | Campus Aalborg |
| Responsible for the module | J. Eduardo Vera-Valdés,<br>Peter Nielsen |

## ORGANISATION

| | |
|---|---|
| Study Board | Study Board of Mathematics, Physics and Nanotechnology |
| Department | Department of Mathematical Sciences |
| Faculty | Faculty of Engineering and Science |

# LONG MASTER'S THESIS. 60 ECTS

# 2019/2020

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

• have

o expert understanding within one or a few selected elements of a central mathematics-economics subject area based on high level research, or

o a broader insight into a central mathematical-economics subject area with respect to theories and methods and their interrelationships

• must be able to understand and on a scientific basis reflect upon the knowledge of the mathematical-economics subject area and be able to identify scientific problems

#### SKILLS

• must be able to identify, formulate and analyse a scientific problem independently, systematically and critically

• must be able to relate the problem to the mathematical-economics subject area, including explaining the choices that have been made in connection to the delimitation of the problem

• must be able to independently make and justify the choice of mathematical-economics theories and methods

• must be able to independently and critically evaluate the chosen theories and methods as well as the analyses, results and conclusions in the project, both during and at the end of the project period

• must be able to evaluate and choose between the scientific theories, methods, tools, and general skills within the mathematical-economics subject area

#### COMPETENCES

• must be able to control work and development situations which are complex, unpredictable and require new mathematical-economics models or methods for solution

• must be able to initiate and complete mathematically and economically oriented collaborations, and if relevant also other interdisciplinary collaborations, as well as assume professional responsibility

• must be able to independently assume responsibility for own professional development and specialisation

### TYPE OF INSTRUCTION

Project work.

### EXTENT AND EXPECTED WORKLOAD

This is a 60 ECTS project module and the work load is expected to be 1800 hours for the student.

# EXAM

## EXAMS

| | |
|---|---|
| Name of exam | Langt kandidatspeciale, 60 ECTS |
| Type of exam | Oral exam based on a project |
| ECTS | 60 |
| Permitted aids | All written and all electronic aids |
| Assessment | 7-point grading scale |
| Type of grading | External examination |
| Criteria of assessment | The criteria of assessment are stated in the Examination Policies and Procedures |

# FACTS ABOUT THE MODULE

| | |
|---|---|
| Danish title | Langt kandidatspeciale, 60 ECTS |
| Module code | F-MOK-K3-3 |
| Module type | Project |
| Duration | 2 semesters |
| Semester | Autumn |
| ECTS | 60 |
| Language of instruction | Danish |
| Location of the lecture | Campus Aalborg |
| Responsible for the module | Esben Høg |

# ORGANISATION

| | |
|---|---|
| Study Board | Study Board of Mathematics, Physics and Nanotechnology |
| Department | Department of Mathematical Sciences |
| Faculty | Faculty of Engineering and Science |

# MASTER'S THESIS, 30 ECTS

# 2019/2020

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Students who have completed the module meet the following criteria concerning at least one central area within mathematics-economics:

### LEARNING OBJECTIVES

#### KNOWLEDGE

• have

o expert understanding within one or a few selected elements of a central mathematics-economics subject area based on high level research, or

o a broader insight into a central mathematical-economics subject area with respect to theories and methods and their interrelationships

• must be able to understand and on a scientific basis reflect upon the knowledge of the mathematical-economics subject area and be able to identify scientific problems

#### SKILLS

• must be able to identify, formulate and analyse a scientific problem independently, systematically and critically

• must be able to relate the problem to the mathematical-economics subject area, including explaining the choices that have been made in connection to the delimitation of the problem

• must be able to independently make and justify the choice of mathematical-economics theories and methods

• must be able to independently and critically evaluate the chosen theories and methods as well as the analyses, results and conclusions in the project, both during and at the end of the project period

• must be able to evaluate and choose between the scientific theories, methods, tools, and general skills within the mathematical-economics subject area

#### COMPETENCES

• must be able to control work and development situations which are complex, unpredictable and require new mathematical-economics models or methods for solution

• must be able to initiate and complete mathematically and economically oriented collaborations, and if relevant also other interdisciplinary collaborations, as well as assume professional responsibility

• must be able to independently assume responsibility for own professional development and specialisation

### TYPE OF INSTRUCTION

Projeck work.

### EXTENT AND EXPECTED WORKLOAD

This is a 30 ECTS project module and the work load is expected to be 900 hours for the student.

# EXAM

## EXAMS

| | |
|---|---|
| Name of exam | Kandidatspeciale, 30 ECTS |
| Type of exam | Master's thesis/final project |
| ECTS | 30 |
| Permitted aids | All written and all electronic aids |
| Assessment | 7-point grading scale |
| Type of grading | External examination |
| Criteria of assessment | The criteria of assessment are stated in the Examination Policies and Procedures |

# FACTS ABOUT THE MODULE

| | |
|---|---|
| Danish title | Kandidatspeciale, 30 ECTS |
| Module code | F-MOK-K4-1 |
| Module type | Project |
| Duration | 1 semester |
| Semester | Spring |
| ECTS | 30 |
| Language of instruction | Danish |
| Location of the lecture | Campus Aalborg |
| Responsible for the module | Esben Høg |

# ORGANISATION

| | |
|---|---|
| Study Board | Study Board of Mathematics, Physics and Nanotechnology |
| Department | Department of Mathematical Sciences |
| Faculty | Faculty of Engineering and Science |

# EMPIRICAL FINANCIAL MODELLING AND APPLIED ECONOMETRICS

# 2019/2020

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

- have understanding of relevant theories and methods within one or more of these areas: option pricing and estimation of time-varying volatility models, zero coupon term structure models, dynamic term structure models, models for stock portfolios and intertemporal asset pricing models, event studies in corporate finance, or computational finance and Monte Carlo methods applied to pricing
- are able to understand and to reflect on these subject areas' issues on a scientific basis

#### SKILLS

- must be able to identify, formulate and analyse a scientific problem independently, systematically and critically
- must be able to relate the problem to financial econometrics or quantitative finance, including explanations of the choices that have been made
- must be able to independently perform and justify the choice of theories and methods
- must be able to communicate research-based knowledge and discuss the professional and scientific problems with other people both within mathematics and economics

#### COMPETENCES

- must be able to identify, formulate and analyse a scientific problem independently, systematically and critically
- must be able to relate the problem to financial econometrics or quantitative finance, including explanations of the choices that have been made
- must be able to independently perform and justify the choice of theories and methods
- must be able to communicate research-based knowledge and discuss the professional and scientific problems with other people both within mathematics and economics

### TYPE OF INSTRUCTION

Project work.

### EXTENT AND EXPECTED WORKLOAD

This is a 15 ECTS project module and the work load is expected to be 450 hours for the student.

## EXAM

### EXAMS

| | |
|---|---|
| Name of exam | Empirisk finansiering og anvendt økonometri |
| Type of exam | Oral exam based on a project |
| ECTS | 15 |
| Assessment | 7-point grading scale |
| Type of grading | Internal examination |

| | |
|---|---|
| Criteria of assessment | The criteria of assessment are stated in the Examination Policies and Procedures |

## FACTS ABOUT THE MODULE

| | |
|---|---|
| Danish title | Empirisk finansiering og anvendt økonometri |
| Module code | F-MOK-K1-1 |
| Module type | Project |
| Duration | 1 semester |
| Semester | Autumn |
| ECTS | 15 |
| Language of instruction | Danish and English |
| Empty-place Scheme | Yes |
| Location of the lecture | Campus Aalborg |
| Responsible for the module | Henning Bunzel,<br>Esben Høg |

## ORGANISATION

| | |
|---|---|
| Study Board | Study Board of Mathematics, Physics and Nanotechnology |
| Department | Department of Mathematical Sciences |
| Faculty | Faculty of Engineering and Science |

# OPERATIONS RESEARCH. PROJECT

# 2019/2020

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

- have gained in-depth knowledge of the development of quantitative operations management (OM) models on real life problems. The knowledge could be gained in a development project:
    - with one or more companies or public organisations
    - in a lab environment

#### SKILLS

- be able to develop, test and demonstrate the limitations of quantitative methods for Operations Management
- be able to compare and evaluate theoretical and experimental results
- be able to critically evaluate applied methods and their results

#### COMPETENCES

- possess the ability to identify opportunities for implementing quantitative methods from operations management
- be able to develop Operations Management techniques that can be implemented in an industrial, service or public organization
- be able to evaluate the impact of implementing the developed methods

### TYPE OF INSTRUCTION

Project work.

### EXTENT AND EXPECTED WORKLOAD

This is a 15 ECTS project module and the work load is expected to be 450 hours for the student.

## EXAM

### EXAMS

| | |
|---|---|
| Name of exam | Operationsanalyse. Projekt |
| Type of exam | Oral exam based on a project |
| ECTS | 15 |
| Assessment | 7-point grading scale |

| | |
|---|---|
| Type of grading | Internal examination |
| Criteria of assessment | The criteria of assessment are stated in the Examination Policies and Procedures |

## FACTS ABOUT THE MODULE

| | |
|---|---|
| Danish title | Operationsanalyse. Projekt |
| Module code | F-MOK-K1-2 |
| Module type | Project |
| Duration | 1 semester |
| Semester | Autumn |
| ECTS | 15 |
| Language of instruction | Danish |
| Empty-place Scheme | Yes |
| Location of the lecture | Campus Aalborg |
| Responsible for the module | Peter Nielsen |

## ORGANISATION

| | |
|---|---|
| Study Board | Study Board of Mathematics, Physics and Nanotechnology |
| Department | Department of Mathematical Sciences |
| Faculty | Faculty of Engineering and Science |

# FINANCIAL ECONOMETRICS AND QUANTITATIVE METHODS IN FINANCE

# 2019/2020

## PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge obtained by the modules Analysis 2 and Probability Theory from the BSc in Mathematics-Economics.

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

- understanding of the most common applied quantitative and empirical methods in econometrics, including in particular financial econometrics
- knowledge about option pricing and estimation of time-varying volatility models
- know about zero coupon term structure models
- know about dynamic term structure models
- know about models for stock portfolios and intertemporal asset pricing models
- know about event studies in corporate finance
- know about computational finance and Monte Carlo methods applied, e.g., to the pricing of exotic options

#### SKILLS

- are able to argue for the importance of econometric/statistical methods in the analysis of a given financial problem
- are able to build econometric models and judge their applicability

#### COMPETENCES

- are able to demonstrate understanding of the theory of the econometric models and know how to reason within the models
- are able to communicate the results of an econometric analysis to non-specialists in the financial sector
- are able to analyse financial data using the available software

### EXTENT AND EXPECTED WORKLOAD

This is a 5 ECTS course module and the work load is expected to be 150 hours for the student.

## EXAM

### EXAMS

| | |
|---|---|
| Name of exam | Økonometri og kvantitative metoder inden for finansiering |
| Type of exam | Written or oral exam |
| ECTS | 5 |
| Assessment | 7-point grading scale |
| Type of grading | Internal examination |
| Criteria of assessment | The criteria of assessment are stated in the Examination Policies and Procedures |

## FACTS ABOUT THE MODULE

| | |
|---|---|
| Danish title | Økonometri og kvantitative metoder inden for finansiering |
| Module code | F-MOK-K1-4 |
| Module type | Course |
| Duration | 1 semester |
| Semester | Autumn |
| ECTS | 5 |
| Language of instruction | Danish and English |
| Empty-place Scheme | Yes |
| Location of the lecture | Campus Aalborg |
| Responsible for the module | Esben Høg |

## ORGANISATION

| | |
|---|---|
| Study Board | Study Board of Mathematics, Physics and Nanotechnology |
| Department | Department of Mathematical Sciences |
| Faculty | Faculty of Engineering and Science |

# MÅLTEORI OG STOKASTISKE PROCESSER

# 2019/2020

## FORUDSÆTNINGER/ANBEFALEDE FORUDSÆTNINGER FOR AT DELTAGE I MODULET

The module builds on knowledge obtained by the modules Linear Algebra with Applications, Analysis 1, Analysis 2, and Probability Theory from the BSc in Mathematics-Economics.

## MODULETS INDHOLD, FORLØB OG PÆDAGOGIK

### LÆRINGSMÅL

#### VIDEN

- know selected topics concerning general measure theory with special focus on probability theoretical. Topics as existence and uniqueness of measures, Lebesgue-integration, Expectation and condition expectation, Radon-Nikodyms theorem, and information expressed through sigma-algebras
- know about stochastic processes in discrete and continuous time
- know about Wiener processes
- know about Martingales
- know about stochastic integrals, Ito's formula and Girsanovs theorem

#### FÆRDIGHEDER

- are able to calculate fundamental characteristics for stochastic processes.
- are able to conduct a change of measure for a martingale

#### KOMPETENCER

- are able to formulate mathematical results in a correct manner by means of measure-theoretical and probabilistic argumentation.
- are able to apply and mediate basic mathematics and theory related to stochastic processes.
- able to gain additional knowledge regarding probability theoretical subjects related to stochastic processes and their application in Finance

### UNDERVISNINGSFORM

As described in the introduction to Chapter 3.

### OMFANG OG FORVENTET ARBEJDSINDSATS

Kursusmodulets omfang er 5 ECTS svarende til 150 timers studieindsats.

## EKSAMEN

### PRØVER

| | |
|---|---|
| Prøvens navn | Measure Theory and Stochastic Processes |
| Prøveform | Skriftlig eller mundtlig |
| ECTS | 5 |
| Bedømmelsesform | Bestået/ikke bestået |

| | |
|---|---|
| Censur | Intern prøve |
| Vurderingskriterier | Vurderingskriterierne er angivet i Universitetets eksamensordning |

## FAKTA OM MODULET

| | |
|---|---|
| Engelsk titel | Measure Theory and Stochastic Processes |
| Modulkode | F-MOK-K1-3 |
| Modultype | Kursus |
| Varighed | 1 semester |
| Semester | Efterår |
| ECTS | 5 |
| Undervisningssprog | Dansk og engelsk |
| Undervisningssted | Campus Aalborg |
| Modulansvarlig | Bjarne Højgaard |

## ORGANISATION

| | |
|---|---|
| Studienævn | Studienævn for Matematik, Fysik og Nanoteknologi |
| Institut | Institut for Matematiske Fag |
| Fakultet | Det Ingeniør- og Naturvidenskabelige Fakultet |

# NUMERICAL ANALYSIS

# 2019/2020

## PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge obtained by the modules Linear Algebra with Applications, Analysis 1, and Probability Theory from the BSc in Mathematics or similar.

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

- have knowledge of floating point arithmetic, including the international standards for floating point arithmetic
- have knowledge of error analysis and stability of numerical algorithms
- have knowledge of polynomial interpolation and its application to the derivation of numerical algorithms
- have knowledge of basic results in approximation theory
- have knowledge of methods for finding zeroes of functions
- have knowledge of numerical linear algebra, in particular algorithms adapted to large sparse systems of linear equations
- have knowledge of methods for numerical differentiation, including spectral methods
- have knowledge of methods for numerical integration, including Gaussian quadrature
- have knowledge of numerical solution methods for ordinary differential equations, including spectral methods
- have knowledge of some probabilistic methods in numerical analysis, including Monte-Carlo methods

#### SKILLS

- can implement basic numerical algorithms in different computer architectures
- can choose appropriate numerical methods to solve a given class of problems

#### COMPETENCES

- can evaluate the appropriateness of a given numerical method for solving a class of problems
- are aware of the limitations of numerical methods to solve a class of problems

### EXTENT AND EXPECTED WORKLOAD

This is a 5 ECTS project module and the work load is expected to be 150 hours for the student.

## EXAM

### EXAMS

| | |
|---|---|
| Name of exam | Numerical Analysis |
| Type of exam | Oral exam<br>In order to participate in the exam, students must have actively participated in course progress by way of one or several independent oral and/or written contributions. |
| ECTS | 5 |
| Assessment | Passed/Not Passed |
| Type of grading | Internal examination |

| | |
|---|---|
| Criteria of assessment | The criteria of assessment are stated in the Examination Policies and Procedures |

## FACTS ABOUT THE MODULE

| | |
|---|---|
| Danish title | Numerisk analyse |
| Module code | F-MAT-K1-2 |
| Module type | Course |
| Duration | 1 semester |
| Semester | Autumn |
| ECTS | 5 |
| Language of instruction | Danish and English |
| Empty-place Scheme | Yes |
| Location of the lecture | Campus Aalborg |
| Responsible for the module | Henrik Garde,<br>Arne Jensen |

## ORGANISATION

| | |
|---|---|
| Study Board | Study Board of Mathematics, Physics and Nanotechnology |
| Department | Department of Mathematical Sciences |
| Faculty | Faculty of Engineering and Science |

# TOPICS IN OPERATIONS RESEARCH

# 2019/2020

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

• manufacturing planning and control including inventory management and material requirements planning
• optimization of discrete problems

• heuristics and meta-heuristics

• relational databases and their usage

#### SKILLS

• formulate discrete optimization problems
• chose the appropriate solution strategy to a number of discrete optimization problems

• perform basic database operations

#### COMPETENCES

• understand the principles of inventory management
• understand differences in solutions strategies

• apply heuristics and meta-heuristic methods to solve complex problems

• understand relational data structures

• understand the limitations, advantages and disadvantages of relational data structures

### TYPE OF INSTRUCTION

As described in §17.

### EXTENT AND EXPECTED WORKLOAD

This is a 5 ECTS course module and the work load is expected to be 150 hours for the student.

## EXAM

### EXAMS

| | |
|---|---|
| Name of exam | Topics in Operations Research |
| Type of exam | Written or oral exam |
| ECTS | 5 |

| | |
|---|---|
| Assessment | 7-point grading scale |
| Type of grading | Internal examination |
| Criteria of assessment | The criteria of assessment are stated in the Examination Policies and Procedures |

## FACTS ABOUT THE MODULE

| | |
|---|---|
| Danish title | Emner i operationsanalyse |
| Module code | F-MOK-K1-5 |
| Module type | Course |
| Duration | 1 semester |
| Semester | Autumn |
| ECTS | 5 |
| Language of instruction | Danish and English |
| Empty-place Scheme | Yes |
| Location of the lecture | Campus Aalborg |
| Responsible for the module | Esben Høg |

## ORGANISATION

| | |
|---|---|
| Study Board | Study Board of Mathematics, Physics and Nanotechnology |
| Department | Department of Mathematical Sciences |
| Faculty | Faculty of Engineering and Science |

# ADVANCED OPERATIONS MANAGEMENT

# 2019/2020

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

- Have gained both theoretical and practical knowledge about stochastic simulation and its utilisation in improvement of planning and control systems in companies and supply chains
- Have gained knowledge of a number of numerical and mathematical methods and models for designing and improving planning and control concepts in companies and supply chains
- Have gained knowledge and understanding about numerical analysis of demand patterns
- Have gained knowledge about advanced order management systems
- Have gained knowledge about stochastic discrete event simulation and simulation tools
- Have gained knowledge to identify key performance indicators relevant to evaluate stochastic simulation models.

#### SKILLS

- Be able to analyse and develop order management systems for both industrial and service companies
- Be able to conduct a numerical analysis of a company's and supply chain's performance. This involves both choice and utilisation of statistical analysis methods on selected elements of companies and supply chains
- Show understanding the utilisation of probabilistic models in connection with design and usage of planning and control systems. This includes knowledge and insight into the opportunities and limitations of probabilistic models
- Be able to utilise stochastic discrete event simulation to assess opportunities and limitations of a production system and be able to utilise simulation as a tool for analysis and synthesis in their project work
- Be able to be model and simulate a specific company's production system and evaluate the performance of this system
- Be able to design and redesign planning and control systems in production and service management companies and supply chains adapted to a company's or supply chain's specific situation.

#### COMPETENCES

- Be able to combine a number of mathematical tools in an appropriate manner to conduct an analysis of the as-is situation of a company or supply chain.

### TYPE OF INSTRUCTION

The course consists of a number of lectures as well as the student's independent learning effort. The form and extent of the course is determined and described in connection with planning the semester. The lesson plans, literature etc. are created in connection with this. The course is conducted as a combination of single-disciplinary, problem-oriented and cross-disciplinary fields of study, and it is structured from a work and evaluation form which combines skills and reflection:

- Lectures
- Class work
- Project work
- Workshops
- Exercises (alone and in groups)
- Teacher feedback
- Reflection on content
- Portfolio work.

### EXTENT AND EXPECTED WORKLOAD

Since it is a 5 ECTS course module the expected workload is 150 hours for the student.

# EXAM

## EXAMS

| | |
|---|---|
| Name of exam | Advanced Operations Management |
| Type of exam | Written or oral exam |
| ECTS | 5 |
| Assessment | 7-point grading scale |
| Type of grading | Internal examination |
| Criteria of assessment | The criteria of assessment are stated in the Examination Policies and Procedures |

# FACTS ABOUT THE MODULE

| | |
|---|---|
| Danish title | Advanced Operations Management |
| Module code | M-OSM-K1-2 |
| Module type | Course |
| Duration | 1 semester |
| Semester | Autumn |
| ECTS | 5 |
| Language of instruction | English |
| Empty-place Scheme | Yes |
| Location of the lecture | Campus Aalborg |
| Responsible for the module | Kjeld Nielsen |

# ORGANISATION

| | |
|---|---|
| Study Board | Study Board of Production |
| Department | Department of Materials and Production |
| Faculty | Faculty of Engineering and Science |

# FLEXIBLE MANUFACTURING

# 2019/2020

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

- Have gained knowledge about mass customization systems in an operations management context
- Have gained knowledge about assessment of mass customization performance
- Have gained knowledge about product architecture, manufacturing architecture and their relations to mass customization
- Have gained knowledge about flexible manufacturing systems, reconfigurable manufacturing systems, changeable manufacturing systems, automated manufacturing systems and the differences between these.
- Have gained knowledge of planning methods designed specifically for flexible manufacturing systems.

#### SKILLS

- Be able to analyze a product family in terms of variety and product architecture
- Be able to evaluate different IT solutions supporting mass customization, including product configurators and perform basic modelling
- Be able to analyze a range of manufacturing tasks and evaluate different types of manufacturing systems to determine the appropriate level of flexibility vs. automation
- Be able to model flexible manufacturing  problems

#### COMPETENCES

- Have the competence to evaluate a company’s product portfolio in terms of volume, variety and manufacturing tasks and identify solutions for IT system support and manufacturing system design.

### TYPE OF INSTRUCTION

The course consists of a number of lectures as well as the student’s independent learning effort. The form and extent of the course is determined and described in connection with planning the semester. The lesson plans, literature etc. are created in connection with this. The course is conducted as a combination of single-disciplinary, problem-oriented and cross-disciplinary fields of study, and it is structured from a work and evaluation form which combines skills and reflection:

- Lectures
- Class work
- Project work
- Workshops
- Exercises (alone and in groups)
- Teacher feedback
- Reflection on content
- Portfolio work.

### EXTENT AND EXPECTED WORKLOAD

Since it is a 5 ECTS course module the expected workload is 150 hours for the student.

# EXAM

## EXAMS

| | |
|---|---|
| Name of exam | Flexible Manufacturing |
| Type of exam | Written or oral exam |
| ECTS | 5 |
| Assessment | 7-point grading scale |
| Type of grading | Internal examination |
| Criteria of assessment | The criteria of assessment are stated in the Examination Policies and Procedures |

# FACTS ABOUT THE MODULE

| | |
|---|---|
| Danish title | Fleksibel produktion |
| Module code | M-OSM-K1-3 |
| Module type | Course |
| Duration | 1 semester |
| Semester | Autumn |
| ECTS | 5 |
| Language of instruction | English |
| Empty-place Scheme | Yes |
| Location of the lecture | Campus Aalborg |
| Responsible for the module | Kjeld Nielsen |

# ORGANISATION

| | |
|---|---|
| Study Board | Study Board of Production |
| Department | Department of Materials and Production |
| Faculty | Faculty of Engineering and Science |

# IN-DEPTH STUDY OF FINANCIAL ENGINEERING

# 2019/2020

## PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge obtained by the modules on the 1st semester.

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

- have expert understanding of relevant theories and methods within quantitative finance and computational statistics or continuous time finance in general
- are able to understand and on a scientific basis reflect on these subject areas' scientific issues

#### SKILLS

- must be able to identify, formulate and analyse a scientific problem independently, systematically and critically
- must be able to relate the problem to a quantitative finance subject area, including explaining the choices that have been made in connection to the delimitation of the problem
- must be able to independently make and justify the choice of theories and methods
- must be able to communicate research-based knowledge and discuss the professional and scientific problems with other people both within mathematics and economics

#### COMPETENCES

- must be able to identify, formulate and analyse a scientific problem independently, systematically and critically
- must be able to relate the problem to a quantitative finance subject area, including explaining the choices that have been made in connection to the delimitation of the problem
- must be able to independently make and justify the choice of theories and methods
- must be able to communicate research-based knowledge and discuss the professional and scientific problems with other people both within mathematics and economics

### TYPE OF INSTRUCTION

Project work.

### EXTENT AND EXPECTED WORKLOAD

This is a 15 ECTS project module and the work load is expected to be 450 hours for the student.

## EXAM

### EXAMS

| | |
|---|---|
| Name of exam | Fordybelse inden for Financial Engineering |
| Type of exam | Oral exam based on a project |
| ECTS | 15 |
| Assessment | 7-point grading scale |

| | |
|---|---|
| Type of grading | External examination |
| Criteria of assessment | The criteria of assessment are stated in the Examination Policies and Procedures |

## FACTS ABOUT THE MODULE

| | |
|---|---|
| Danish title | Fordybelse inden for Financial Engineering |
| Module code | F-MOK-K2-1 |
| Module type | Project |
| Duration | 1 semester |
| Semester | Spring |
| ECTS | 15 |
| Language of instruction | Danish and English |
| Empty-place Scheme | Yes |
| Location of the lecture | Campus Aalborg |
| Responsible for the module | Esben Høg,<br>Peter Nielsen |

## ORGANISATION

| | |
|---|---|
| Study Board | Study Board of Mathematics, Physics and Nanotechnology |
| Department | Department of Mathematical Sciences |
| Faculty | Faculty of Engineering and Science |

# SUPPLY CHAIN OPERATIONS AND ANALYSIS

# 2019/2020

## PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge obtained by the modules on the 1st semester.

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

- have gained in-depth knowledge of supply chain operations and analyzing the behavior of supply chains.
- The knowledge could be gained in a development project:
  with one or more companies or public organisations

  or

  in a lab environment concerning supply chain software or techniques

#### SKILLS

- should be able to analyse and model the behaviour of supply chains using data mining,
- should be able to model a Business Intelligence setup,
- should be able to critically evaluate the applied methods and their results

#### COMPETENCES

- possess the ability to identify and implement monitoring and analysis with special focus on cross-company issues (e.g. one or more customers or suppliers)
- should be able to implement supply chain systems in an industrial, service or public organisation

### TYPE OF INSTRUCTION

Project work.

### EXTENT AND EXPECTED WORKLOAD

This is a 15 ECTS project module and the work load is expected to be 450 hours for the student.

## EXAM

### EXAMS

| | |
|---|---|
| Name of exam | Supply Chain Operations and Analysis |
| Type of exam | Oral exam based on a project |

| | |
|---|---|
| ECTS | 15 |
| Assessment | 7-point grading scale |
| Type of grading | External examination |
| Criteria of assessment | The criteria of assessment are stated in the Examination Policies and Procedures |

## FACTS ABOUT THE MODULE

| | |
|---|---|
| Danish title | Supply Chain Operations and Analysis |
| Module code | F-MOK-K2-2 |
| Module type | Project |
| Duration | 1 semester |
| Semester | Spring |
| ECTS | 15 |
| Language of instruction | Danish and English |
| Location of the lecture | Campus Aalborg |
| Responsible for the module | Esben Høg,<br>Peter Nielsen |

## ORGANISATION

| | |
|---|---|
| Study Board | Study Board of Mathematics, Physics and Nanotechnology |
| Department | Department of Mathematical Sciences |
| Faculty | Faculty of Engineering and Science |

# QUANTITATIVE FINANCE AND COMPUTATIONAL STATISTICS

# 2019/2020

## MODULETS INDHOLD, FORLØB OG PÆDAGOGIK

### LÆRINGSMÅL

#### VIDEN

- know about quantitative software development with a focus on computational finance
- know about core models & products: stochastic volatility models, vanilla & exotic derivatives
- know about numerical treatment of stochastic differential equations (SDEs) and partial differential equations (PDEs)
- know about Monte Carlo foundations and applications
- know about Fourier transform pricing
- calibration (applied numerical optimization, market data)

#### FÆRDIGHEDER

- are able to analyse a given model and apply it on market data
- are able to develop quantitative software in line with the existing practices in the financial industry
- are able to perform all stages of the verification and validation (V&V) process in quantitative software development – assessing the results obtained from a financial model

#### KOMPETENCER

- are able to independently develop, analyse, and apply quantitative finance models relevant to a financial problem at hand
- are able to communicate the results of applying the models appropriate to a given financial problem to non-specialists in the financial industry
- discuss relative strengths and weaknesses of numerical methods (SDEs, PDEs, Fourier Transform) in relation to financial products (derivatives) and tasks (pricing, hedging, calibration)

### UNDERVISNINGSFORM

Forelæsninger med tilhørende opgaveregning.

### OMFANG OG FORVENTET ARBEJDSINDSATS

Kursusmodulets omfang er 5 ECTS svarende til 150 timers studieindsats.

## EKSAMEN

### PRØVER

| | |
|---|---|
| Prøvens navn | Quantitative Finance and Computational Statistics |
| Prøveform | Skriftlig eller mundtlig<br>Individual oral or written exam, or individual ongoing during the course. In order to participate in the course evaluation, students must have actively participated in course progress by way of one or several independent oral and/or written contributions. |
| ECTS | 5 |

| | |
|---|---|
| Bedømmelsesform | Bestået/ikke bestået |
| Censur | Intern prøve |
| Vurderingskriterier | Vurderingskriterierne er angivet i Universitetets eksamensordning |

## FAKTA OM MODULET

| | |
|---|---|
| Engelsk titel | Quantitative Finance and Computational Statistics |
| Modulkode | F-MOK-K2-3 |
| Modultype | Kursus |
| Varighed | 1 semester |
| Semester | Forår |
| ECTS | 5 |
| Undervisningssprog | Dansk og engelsk |
| Tomplads | Ja |
| Undervisningssted | Campus Aalborg |
| Modulansvarlig | Maria Simonsen |

## ORGANISATION

| | |
|---|---|
| Studienævn | Studienævn for Matematik, Fysik og Nanoteknologi |
| Institut | Institut for Matematiske Fag |
| Fakultet | Det Ingeniør- og Naturvidenskabelige Fakultet |

# CONTINUOUS TIME FINANCE

# 2019/2020

## PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge obtained by the modules on the 1st semester and in particular Measure Theory and Stochastic Processes.

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

- know about the Black-Scholes model
- know about risk-neutral pricing
- know about the martingale representation theorem and the martingale approach to arbitrage theory
- know about the market price of risk
- know about options, exotic options, and American derivatives
- know about hedging
- know about standard models of the term structure of interest rates

#### SKILLS

- are able to work in-depth in other financial theory topics, e.g., credit risk models or advanced option theory
- are able to construct a relevant continuous time financial model based on a concrete problem.
- are able to analyse the models through martingales and arbitrage theory
- are able to judge the validity of results obtained

#### COMPETENCES

- are able to communicate results of analysis of continuous time financial models to non-specialists in the financial world
- are able to develop the ability to individually develop own continuous time models suited for a given financial problem

### EXTENT AND EXPECTED WORKLOAD

Kursusmodulets omfang er 5 ECTS svarende til 150 timers studieindsats.

## EXAM

### EXAMS

| | |
|---|---|
| Name of exam | Kontinuert-tids finansiering |
| Type of exam | Written or oral exam |
| ECTS | 5 |
| Assessment | Passed/Not Passed |
| Type of grading | Internal examination |
| Criteria of assessment | The criteria of assessment are stated in the Examination Policies and Procedures |

## FACTS ABOUT THE MODULE

| | |
|---|---|
| Danish title | Kontinuert-tids finansiering |
| Module code | F-MOK-K2-4 |
| Module type | Course |
| Duration | 1 semester |
| Semester | Spring |
| ECTS | 5 |
| Language of instruction | Danish and English |
| Empty-place Scheme | Yes |
| Location of the lecture | Campus Aalborg |
| Responsible for the module | Bent Jesper Christensen |

## ORGANISATION

| | |
|---|---|
| Study Board | Study Board of Mathematics, Physics and Nanotechnology |
| Department | Department of Mathematical Sciences |
| Faculty | Faculty of Engineering and Science |

# DATA MINING

# 2019/2020

## FORUDSÆTNINGER/ANBEFALEDE FORUDSÆTNINGER FOR AT DELTAGE I MODULET

Modulet bygger på viden opnået i modulet Statistisk inferens for lineære modeller.

## MODULETS INDHOLD, FORLØB OG PÆDAGOGIK

### LÆRINGSMÅL

#### VIDEN

- har opnået en forståelse af computerintensive teknikker til at validere modeller (kryds-validering og bootstrap) samt kunne redegøre for varians-bias problematikken
- har kendskab til forskellige metoder til at visualisere høj-dimensionale data
- har forståelse for forskellen mellem klassifikation og regression, samt kende til metoder til at udføre klassifikation vha. klassifikationstræer, prototype metoder samt Bayes classifiers
- kan redegøre for supervised og unsupervised metoder inden for statistical learning
- kan redegøre for analysen af transaktionsdata vha. associationsregler
- kan udføre link mining for netværksdata fx. internetsider
- har viden om metoder til at udføre hierarkisk og partitionel klyngeanalyse
- har viden om model averaging og bagging samt boosting

#### FÆRDIGHEDER

- er i stand til at identificere og anvende en relevant data mining algoritme i en specifik kontekst
- kan identificere og diskutere svagheder/styrker ved forskellige data mining algoritmer i relation til en specifik analyse opgave
- kan fortolke og kommunikere resultaterne af en given data mining analyse til ikke-specialister

#### KOMPETENCER

- har evnen til at kunne overskue potentialer og begrænsninger af forskellige data mining software pakker
- har forståelsen til kvalificeret at vælge og anvende et specifikt stykke software som imødekommer brugerkrav

### OMFANG OG FORVENTET ARBEJDSINDSATS

Kursusmodulets omfang er 5 ECTS svarende til 150 timers studieindsats.

## EKSAMEN

### PRØVER

| | |
|---|---|
| Prøvens navn | Data Mining |
| Prøveform | Skriftlig eller mundtlig |
| ECTS | 5 |
| Bedømmelsesform | Bestået/ikke bestået |
| Censur | Intern prøve |
| Vurderingskriterier | Vurderingskriterierne er angivet i Universitetets eksamensordning |

## FAKTA OM MODULET

| | |
|---|---|
| Engelsk titel | Data Mining |
| Modulkode | F-MOK-K2-5 |
| Modultype | Kursus |
| Varighed | 1 semester |
| Semester | Forår |
| ECTS | 5 |
| Undervisningssprog | Dansk og engelsk |
| Tomplads | Ja |
| Undervisningssted | Campus Aalborg |
| Modulansvarlig | J. Eduardo Vera-Valdés |

## ORGANISATION

| | |
|---|---|
| Studienævn | Studienævn for Matematik, Fysik og Nanoteknologi |
| Institut | Institut for Matematiske Fag |
| Fakultet | Det Ingeniør- og Naturvidenskabelige Fakultet |

# MANUFACTURING AND SUPPLY CHAIN SYSTEMS

# 2019/2020

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

- Have gained knowledge of the structure and functionality of manufacturing and supply chain systems such as Enterprise Resource Planning, Advanced Planning & Scheduling, Vendor Managed Inventory, Optimisation Suites and Shop Floor Planning & Control
- Have gained knowledge of planning technologies and configuration of manufacturing and supply chain systems
- Have gained knowledge of how to share information and coordinate decisions in a supply chain

#### SKILLS

- Be able to work with differentiated manufacturing and supply chain control
- Be able to work with manufacturing and supply chain control principles
- Be able to work with information sharing levels

#### COMPETENCES

- Be able to select and design differentiated manufacturing and supply chain control principles
- Be able to develop planning and control solutions

### TYPE OF INSTRUCTION

The course consists of a number of lectures as well as the student's independent learning effort. The form and extent of the course is determined and described in connection with planning the semester. The lesson plans, literature etc. are created in connection with this. The course is conducted as a combination of single-disciplinary, problem-oriented and cross-disciplinary fields of study, and it is structured from a work and evaluation form which combines skills and reflection:

- Lectures
- Class work
- Project work
- Workshops
- Exercises (alone and in groups)
- Teacher feedback
- Reflection on content
- Portfolio work.

### EXTENT AND EXPECTED WORKLOAD

Since it is a 5 ECTS course module the expected workload is 150 hours for the student.

## EXAM

### EXAMS

| | |
|---|---|
| Name of exam | Manufacturing and Supply Chain Systems |
| Type of exam | Written or oral exam |
| ECTS | 5 |

| | |
|---|---|
| Assessment | 7-point grading scale |
| Type of grading | Internal examination |
| Criteria of assessment | The criteria of assessment are stated in the Examination Policies and Procedures |

## FACTS ABOUT THE MODULE

| | |
|---|---|
| Danish title | Fremstillings- og forsyningskædesystemer |
| Module code | M-OSM-K2-2 |
| Module type | Course |
| Duration | 1 semester |
| Semester | Spring |
| ECTS | 5 |
| Language of instruction | English |
| Empty-place Scheme | Yes |
| Location of the lecture | Campus Aalborg |
| Responsible for the module | Thomas Ditlev Brunø |

## ORGANISATION

| | |
|---|---|
| Study Board | Study Board of Production |
| Department | Department of Materials and Production |
| Faculty | Faculty of Engineering and Science |

# BUSINESS INTELLIGENCE AND ANALYTICS

# 2019/2020

## PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

This module is based on knowledge gained on the 1st Semester of the Operations and Innovation Management specialisation or the Operations and Supply Management specialisation.

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

- Account for Business Intelligence (BI) concepts, theories and methods including:
  - Creation of knowledge from either people/employees/"experts" or from analysing existing data
  - Knowledge representation
  - Traditional BI handling systems such as expert systems, knowledge base systems, decision support systems and executive information systems.

#### SKILLS

- Make decisions about the optimal use of the BI concepts, theories, methods and selected systems for identification of needs, development of alternative solutions, evaluation selection and implementation
- Use BI in disciplines such as enterprise engineering/modelling, business analytics, data mining, etc.

#### COMPETENCES

- Apply knowledge and skills in relation to business intelligence development projects and thereby apply the knowledge handling activities: knowledge acquisition, knowledge verification, knowledge representation and knowledge engineering.

### TYPE OF INSTRUCTION

The teaching is organized in accordance with the general form of teaching. Please see the programme cirruculum §17.

### EXTENT AND EXPECTED WORKLOAD

Since it is a 5 ECTS course module the expected workload is 150 hours for the student.

## EXAM

### EXAMS

| | |
|---|---|
| Name of exam | Business Intelligence and Analytics |
| Type of exam | Written or oral exam |
| ECTS | 5 |
| Assessment | 7-point grading scale |
| Type of grading | Internal examination |
| Criteria of assessment | The criteria of assessment are stated in the Examination Policies and Procedures |

## FACTS ABOUT THE MODULE

| | |
|---|---|
| Danish title | Business Intelligence og analytiske metoder |
| Module code | M-OIM-K2-3 |
| Module type | Course |
| Duration | 1 semester |
| Semester | Spring |
| ECTS | 5 |
| Language of instruction | English |
| Empty-place Scheme | Yes |
| Location of the lecture | Campus Aalborg |
| Responsible for the module | Kim Nørgaard Jensen |

## ORGANISATION

| | |
|---|---|
| Study Board | Study Board of Production |
| Department | Department of Materials and Production |
| Faculty | Faculty of Engineering and Science |

# TOPICS IN STATISTICAL SCIENCES I

# 2019/2020

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

- dynamical linear models, including the Kalman filter
- population methods, specifically evolutionary computing and genetic algorithms
- meta analysis
- robust statistical methods including non-parametric models
- factor analysis
- graphical models, including hierarchical models

#### SKILLS

- can apply the relevant methodologies to one or more datasets by using appropriate software implementations, and interpret the output and modify the model parameters accordingly
- are able to state the underlying assumptions and argue about limitations and extendibility of the methodology in one or more specific settings
- can assess goodness-of-fit for the models where appropriate

#### COMPETENCES

- can acquire supplementary knowledge about the relevant methodologies
- can combine appropriate topics from the course to analyse a specific dataset.
- can in writing describe the methodologies, results and outcome from an analysis of a specific dataset

### TYPE OF INSTRUCTION

Lectures with exercises.

### EXTENT AND EXPECTED WORKLOAD

This is a 5 ECTS course module and the work load is expected to be 150 hours for the student.

## EXAM

### EXAMS

| | |
|---|---|
| Name of exam | Emner inden for statistisk videnskab I |
| Type of exam | Written or oral exam |
| ECTS | 5 |
| Assessment | 7-point grading scale |
| Type of grading | Internal examination |
| Criteria of assessment | The criteria of assessment are stated in the Examination Policies and Procedures |

## FACTS ABOUT THE MODULE

| | |
|---|---|
| Danish title | Emner inden for statistisk videnskab I |
| Module code | F-MAT-K1-5 |
| Module type | Course |
| Duration | 1 semester |
| Semester | Autumn |
| ECTS | 5 |
| Language of instruction | Danish and English |
| Empty-place Scheme | Yes |
| Location of the lecture | Campus Aalborg |
| Responsible for the module | Torben Tvedebrink,<br>Søren Højsgaard |

## ORGANISATION

| | |
|---|---|
| Study Board | Study Board of Mathematics, Physics and Nanotechnology |
| Department | Department of Mathematical Sciences |
| Faculty | Faculty of Engineering and Science |

# TOPICS IN STATISTICAL SCIENCE II

# 2019/2020

## PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge obtained by the module Topics in Statistical Science I.

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

The students completing the module will have gained knowledge about a number of topics from the statistical sciences at an advanced level. The list may include, but is not limited to, the following topics:

### LEARNING OBJECTIVES

#### KNOWLEDGE

- state space models and hidden Markov models
- expectation-maximisation (EM) algorithm and missing data
- multivariate Gaussian distribution (and related distributions, e.g. Hotelling's $T^2$ and Wishart distributions)
- INLA
- generalised estimating equations
- bootstrap, cross-validation and other resampling techniques

#### SKILLS

- can apply the relevant methodologies to one or more datasets by using appropriate software implementations, and interpret the output and modify the model parameters accordingly
- are able state the underlying assumptions and argue about limitations and extendibility of the methodology in one or more specific settings
- can assess goodness-of-fit for the models where appropriate

#### COMPETENCES

- can acquire supplementary knowledge about the relevant methodologies
- can combine appropriate topics from the course to analyse a specific dataset
- can in writing describe the methodologies, results and outcome from an analysis of a specific dataset

### EXTENT AND EXPECTED WORKLOAD

This is a 5 ECTS course module and the work load is expected to be 150 hours for the student.

## EXAM

### EXAMS

| | |
|---|---|
| Name of exam | Emner inden for statistisk videnskab II |
| Type of exam | Written or oral exam |
| ECTS | 5 |
| Assessment | 7-point grading scale |
| Type of grading | Internal examination |

| | |
|---|---|
| Criteria of assessment | The criteria of assessment are stated in the Examination Policies and Procedures |

## FACTS ABOUT THE MODULE

| | |
|---|---|
| Danish title | Emner inden for statistisk videnskab II |
| Module code | F-MAT-K1-6 |
| Module type | Course |
| Duration | 1 semester |
| Semester | Autumn |
| ECTS | 5 |
| Language of instruction | Danish and English |
| Empty-place Scheme | Yes |
| Location of the lecture | Campus Aalborg |
| Responsible for the module | Torben Tvedebrink,<br>Søren Højsgaard |

## ORGANISATION

| | |
|---|---|
| Study Board | Study Board of Mathematics, Physics and Nanotechnology |
| Department | Department of Mathematical Sciences |
| Faculty | Faculty of Engineering and Science |

# STATISTICS FOR DURATION DATA

# 2019/2020

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

- understand the special features of duration data (e.g. censoring, non-normality)
- derive the likelihood function for right-censored data
- know basic characterisations of duration data distributions such as the survival and hazard function
- be able to derive basic non-parametric estimates such as the Kaplan-Meier and Nelson-Aalen estimates
- know parametric models for duration data
- understand the assumptions underlying the Cox partial likelihood
- derive the Cox partial likelihood
- know methods of model assessment for parametric models and the Cox proportional hazards

#### SKILLS

- be able to identify relevant type of censoring for a specific set of duration data
- be able to estimate and interpret survival functions or cumulative hazard functions for a specific set of duration data
- be able to fit duration data using parametric or semi-parametric regression models
- be able to assess the validity of a model for a specific set of duration data

#### COMPETENCES

- be able to identify an appropriate duration data methodology for investigating a specified hypothesis of interest
- be able to interpret and critically assess results of the analysis carried out using the chosen methodology
- be able to convey the results of the analysis to a non-statistician

### TYPE OF INSTRUCTION

Lectures with exercises.

### EXTENT AND EXPECTED WORKLOAD

This is a 5 ECTS course module and the work load is expected to be 150 hours for the student.

## EXAM

### EXAMS

| | |
|---|---|
| Name of exam | Varighedsanalyse/Statistics for Duration Data |
| Type of exam | Active participation/continuous evaluation |
| ECTS | 5 |
| Assessment | Passed/Not Passed |
| Type of grading | Internal examination |
| Criteria of assessment | The criteria of assessment are stated in the Examination Policies and Procedures |

## FACTS ABOUT THE MODULE

| | |
|---|---|
| Danish title | Varighedsanalyse |
| Module code | F-MAT-K1-4 |
| Module type | Course |
| Duration | 1 semester |
| Semester | Autumn |
| ECTS | 5 |
| Language of instruction | Danish and English |
| Empty-place Scheme | Yes |
| Location of the lecture | Campus Aalborg |
| Responsible for the module | Rasmus Waagepetersen |

## ORGANISATION

| | |
|---|---|
| Study Board | Study Board of Mathematics, Physics and Nanotechnology |
| Department | Department of Mathematical Sciences |
| Faculty | Faculty of Engineering and Science |