STUDY COMMITTEE FOR DATA SCIENCE
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1 Elective courses

The study in Data Science is a cooperation between department of mathematics, department of computer science department of economics and department of electro and computer technology. In these notes I collect courses that can be of interest as elective courses either on the third year of the bachelor study or on the master study.

Below is first a list of courses suitable as electives on the third year of study. Next follows a description of the master study followed by a list of elective courses suitable for the master study.

These notes will be updated each half year. Remember also to update your study contract when you sign up for courses.

2 Electives on third year of bachelor study

The following list states the most relevant courses, but you can also choose courses ouside this list.

Quick overview: Autumn		ECTS
Math/stat/ mathecon	Monte Carlo simulation	10
	Multivariate Statistical Analysis	10
	Graph Theory 1	10
Computer science	Software Engineering and Architecture	10
	Human-Computer Interaction	10
Economics	Investment and Finance (note: part of package)	10
	Business Economics	10
Electro and comtech	Signals and Systems	5
	Digital Signal Processing	5

Quick overview: Spring		ECTS
Math/stat/ mathecon	Mathematical Analysis 2	10
	Metaheuristics for Combinatorial Optimization	10
Computer science	Computability and Logic	10
	Programming Languages	10
Economics	Microeconomics I	10
Electro and comtech	Digital Signal Processing	5
	Digital Image Processing 1	5
	Discrete-time Signal Processing	5

3 Master degree

The master study is composed of 30 ECTS compulsory courses, a 30 ECTS specialization package, 30 ECTS elective courses and a 30 ECTS thesis. The student must choose one out of four specialization packages (it is allowed to start 10 ECTS of a specialization

package on the bachelor study). (As of now the specialization package *Signal Processing* is 25 ECTS, implying an extra 5 ECTS electives.)

3.1 Compolsory courses on the master study

- Advanced Statistical Learning (10 ECTS, autumn, startup autumn 2022) Linktoappearsoon
- Large Scale Optimization (10 ECTS, spring, startup spring 2023)
- Data Visualization (10 ECTS, autumn) https://kursuskatalog.au.dk/da/course/107652/Data-Visualization

3.2 Specialization packages on the master study

Quick overview		ECTS
Computational Statistics	Statistical Models	10
	Analysis of high dimensional data	10
	Reinforcement learning	10
Data-Intensive Systems	Advanced Data Management and Analysis	10
	Data Mining	10
	Computational Learning Theory	10
Finance and FinTech	Investment and Finance	10
	Financial intermediation and FinTech	10
	Quantitative Financial Economics	10
Signal Processing	Stochastic signal processing	5
	Computer Vision	10
	Advanced Signal Processing	10

4 Elective courses on the master study

Upon choosing a specialization package the courses on the thre remaining specialization packages can be chosen as elective courses. These courses are not repeated in the list below with other elective courses.

Quick overview: Autumn		ECTS
Math/stat/ mathecon	Applied Optimization: Location Planning (even numbered years)	10
	Multiple Criteria Optimization (odd numbered years)	10
	Theory of Measure and Integration	10
	Graph Theory 2 (even numbered years)	10
Computer science	Algorithms, Incentives, and Data	10
Economics	Time Series Econometrics	10
	Bayesian Data Analysis using R and STAN	10
	Microeconometrics	10
	Business Intelligence and Data Management	10
Electro and comtech	Applications of information theory from communication to learning	5
	Not started yet	

Quick overview: Spring		ECTS
Math/stat/ mathecon	Topological Data Analysis (odd numbered years)	10
Computer science	Cluster Analysis	10
	Randomized algorithms	10
Economics	Business Data Analysis	10
	Customer Analytics	10
Electro and comtech		

5 Electives on third year of bachelor study: details

In the list below *A* stands for *autumn* and *S* for spring. On clicking on the letter you are redirected to the list with a *quick overview*.

5.1 Mathematics/statistics/mathematical economics

A Monte Carlo simulation, 10 ECTS (kandidatkursus)
https://kursuskatalog.au.dk/en/course/107979/Monte-Carlo-Simulation
General introduction so solving a variety of problems via simulation.

A Multivariate Statistical Analysis, 10 ECTS
https://kursuskatalog.au.dk/en/course/108258/Multivariate-Statistical-Analysis
Extends the statistical tool box from the course Mathematical Statistics to the multidimensional case. (Prerequisites are fulfilled through the course Introdution to mathematics and optimization, Numerical linear algebra and Causal Inference)

A Graph Theory 1, 10 ECTS, (odd numbered years, kandidatkursus)
https://kursuskatalog.au.dk/en/course/108000/Graph-Theory-1
Graph theory is a mathematical subject of importance to many computer science and mathematical economics problems. (Prerequisites are fulfilled through the course Introdution to mathematics and optimization)

S Mathematical Analysis 2, 10 ECTS
https://kursuskatalog.au.dk/en/course/111785/Mathematical-Analysis-2
A follow up course on your basic knowledge in matematics. (Prerequisites are fulfilled through the course Introdution to mathematics and optimization, Numerical linear algebra)

S Metaheuristics for Combinatorial Optimization, 10 ECTS, (even numbered years, kandidatkursus)
https://kursuskatalog.au.dk/en/course/111616/Metaheuristics-for-Combinatorial-
In this course you learn how to solve decision problems with a finite number of useful solutions. (Prerequisites are fulfilled through the course Introdution to mathematics and optimization

5.2 Computer science

A Software Engineering and Architecture, 10 ECTS
https://kursuskatalog.au.dk/en/course/107637/Software-Engineering-and-Architec
Theories, methods and techniques in modern software construction. (Prerequisites are fulfilled through the course Introduction to programming with scientific applications)

A Human-Computer Interaction, 10 ECTS
https://kursuskatalog.au.dk/en/course/107641/Human-Computer-Interaction
Gain knowledge in and learn methods for analyzing and designing user interfaces. (Prerequisites are fulfilled through the course Introduction to programming with scientific applications)

S Computability and Logic, 10 ECTS
https://kursuskatalog.au.dk/en/course/111404/Computability-and-Logic
Basic subjects in computability and Logic. (Prerequisites are fulfilled through the course Introduction to programming with scientific applications and the course Algorithms and data structures)

S Programming Languages, 10 ECTS
https://kursuskatalog.au.dk/en/course/111642/Programming-Languages
Learn the basic principles in programming languages. (Prerequisites are fulfilled through the course Introduction to programming with scientific applications)

5.3 Economics

A Investment and Finance, 10 ECTS
https://kursuskatalog.au.dk/en/course/108056/Investment-and-Finance
Obtain a profound understanding of and insight into basic investment and financial theory. This course is part of a specialization package, but can be taken as an elective in your bachelor program in case you do not plan for the package. (Prerequisites are fulfilled through the course Introdution to mathematics and optimization, Numerical linear algebra and Causal Inference)

A Business Economics, 10 ECTS
https://kursuskatalog.au.dk/en/course/109115/Business-Economics
(This course is maybe not offered any more)

S Microeconomics I, 10 ECTS
https://kursuskatalog.au.dk/en/course/111333/Microeconomics-I
Learn about aspects of economic theory. (Prerequisites are fulfilled through the course Introdution to mathematics and optimization, Numerical linear algebra and Causal Inference)

If you want a background course for the specialization package *FinTech* you can either choose Microeconomics I (giving a background on basic economical theories) in the spring or Business Economics (giving a background on accounting in firms) in the autumn.

5.4 Electro and computer technology

A Signals and Systems, 5 ECTS
https://kursuskatalog.au.dk/en/course/108537/Signals-and-Systems
Learn how to describe a signal in mathematical terms and how to perform mathematical operatins on signals.

A+S Digital Signal Processing, 5 ECTS
https://kursuskatalog.au.dk/en/course/111559/SW3DSB-01-Digital-Signal-Processi
Learn how to analyze a digital signal og to extract useful information.

S Digital Image Processing 1, 5 ECTS
https://kursuskatalog.au.dk/en/course/112117/ETDIP1-01-Digital-Image-Processin
Learn the basic techniques in the analysis of digital images. (This course requires knowledge correpsonding to for example *Signals and systems* or *Digital Signal Processing* (which can be taken alongside))

S Discrete-time Signal Processing (5 ECTS, bachelor 4.semester, forår, Elektroteknologi)
https://kursuskatalog.au.dk/en/course/112129/Discrete-time-Signal-Processing
This is a more extensive course on discrete time signals and has as a prerequisite the course *Signals and systems*.

In order to choose the specialization package *Signal Processing* on your master study you need background material as in the course *Discrete-time signal processing* (which by itself requires knowledge from the course *Signals and systems*) or as in the course *Digital Signal Processing*, and background material as in the course *Digital Image Processing 1*.

6 Specialization packages on the master study: details

1. Computational Statistics

   A Statistical Models (10 ECTS, the name may change, startup autumn 2022)
   https://kursuskatalog.au.dk/en

S Analysis of high dimensional data (10 ECTS, start 2023)

A Reinforcement learning (10 ECTS, start efterår 2023)

2. Data-Intensive Systems

   A Advanced Data Management and Analysis (10 ECTS)
   https://kursuskatalog.au.dk/en/course/107659/Advanced-Data-Management-and-

   S Data Mining (10 ECTS)
   https://kursuskatalog.au.dk/en/course/111412/Data-Mining

   A Computational Learning Theory (10 ECTS)
   https://kursuskatalog.au.dk/en/course/108983/Computational-Learning-Theory

3. Finance and FinTech

   A Investment and Finance (10 ECTS)
   https://kursuskatalog.au.dk/en/course/108056/Investment-and-Finance

   S Financial intermediation and FinTech (10 ECTS)
   https://kursuskatalog.au.dk/en/course/110064/Financial-Intermediation-and-
   (This course can only be taken on your master study.)

   A Quantitative Financial Economics (10 ECTS)
   https://kursuskatalog.au.dk/en/course/105775/3310-Quantitative-Financial-E

   The course *Investering og Finansiering* must be taken prior to *Financial intermediation and FinTech* and prior to or alongside *Quantitative Financial Economics*.

4. Signal Processing

   A Stochastic signal processing (10 ECTS)
   https://kursuskatalog.au.dk/en/course/109176/Stochastic-Signal-Processing

   S Computer Vision (10 ECTS)
   Udbydes først forår 2023.

   A Advanced Signal Processing (10ECTS)
   https://kursuskatalog.au.dk/en/course/111951/Advanced-Signal-Processing

   Before starting on this package one should have knowledge in stochastic signal analysis and signal processing corresponding to an introductory course on BSc level. It will be advantageous also to have basic knowledge in image processing, corresponding to a introductory course on BSc level.

7 Electives on the master study: details

7.1 Mathematics/statistics/mathematical economics

The list below does not include courses mentioned previously under electives on third year of bachelor study.

A Applied Optimization: Location Planning 10 ECTS (efterår, even numbered years)
https://kursuskatalog.au.dk/en/course/100503/Applied-Optimization-Location-Pla
(This course requires knowledge on *duality in linear optimization* that you gain for example through the compulsory master course *Large Scale Optimization*)

A Multiple Criteria Optimization, 10 ECTS (efterår, odd numbered years)
https://kursuskatalog.au.dk/en/course/108001/Multiple-Criteria-Optimization
(This course requires knowledge on *duality in linear optimization* that you gain for example through the compulsory master course *Large Scale Optimization*)

A Theory of Measure and Integration, 10 ECTS.
https://kursuskatalog.au.dk/en/course/108257/Theory-of-Measure-and-Integration
In order to follow this course you must have taken the course *Mathematical analysis 2*.

A Graph Theory 2, 10 ECTS (efterår, even numbered years)
https://kursuskatalog.au.dk/en/course/100497/Graph-Theory-2
(This course requires some knowledge from Graph theory 1 or, alternatively, that you study these subjects yourself at the start of the course)

S Topolgical Data Analysis, 10 ECTS, (spring, odd numbered years, startup 2023)

7.2 Computer science

A Algorithms, Incentives, and Data, 10 ECTS
https://kursuskatalog.au.dk/en/course/108981/Algorithms-Incentives-and-Data

S Cluster Analysis, 10ECTS
https://kursuskatalog.au.dk/en/course/108982/Cluster-Analysis

S Randomized algorithms, 10 ECTS
https://kursuskatalog.au.dk/en/course/111411/Randomized-algorithms

7.3 Economics

A Time Series Econometrics, 10 ECTS
https://kursuskatalog.au.dk/en/course/105942/4616-Time-Series-Econometrics
(This course can only be taken on your master study. Bygger ovenpå Kausal Inferens)

A Bayesian Data Analysis using R and STAN, 10 ECTS
https://kursuskatalog.au.dk/en/course/105983/Bayesian-Data-Analysis-using-R-an
(This course can only be taken on your master study.)

A Microeconometrics, 10 ECTS
https://kursuskatalog.au.dk/en/course/105941/4615-Microeconometrics
(This course can only be taken on your master study. Bygger ovenpå Kausal Inferens)

A Business Intelligence and Data Management, 10 ECTS
https://kursuskatalog.au.dk/en/course/105742/Business-Intelligence-and-Data-Ma
(This course can only be taken on your master study.)

S Business Data Analysis, 10 ECTS
https://kursuskatalog.au.dk/en/course/109997/4118-Business-Data-Analysis
(This course can only be taken on your master study. Bygger ovenpå Kausal Inferens)

S Customer Analytics, 10 ECTS
https://kursuskatalog.au.dk/en/course/109973/Customer-Analytics
(This course can only be taken on your master study.)

7.4 Electro and computer technology

A Applications of information theory from communication to learning, 5 ECTS
Kurset udbydes først efterår ?
Kurset forudsætter viden svarende til kurset *Diskret-tids signalbehandling*.