Statistics Master's Programme at Aarhus University: Elective Courses Spring 2026

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This document lists courses that you can take under the Master's degree programme in Statistics at Aarhus university. The degree programme is worth 120 ECTS, including a Master's thesis (30 ECTS) and elective courses (90 ECTS). According to the academic regulations, the programme must include at least 60 ECTS from the statistics and probability theory courses listed in Section 2; detailed rules can be found in the academic regulations that apply to your studies.

The Master's programme in Statistics builds upon our Bachelor's programme in Mathematics with specialization in Statistics. Section 3 lists the courses contained in this specialization. You can take some of these advanced undergraduate courses as part of your Master's study if your undergraduate programme did not include equivalent courses.

Your programme can also include optional courses in Mathematics, Computer Science or from other departments. A few examples are listed in Section 4. Another option is to spend up to 10 ECTS on a *Project in Statistics* or a *Vocational Training Project*, see Section 5.

Not all courses are offered every year. In Section 1, you find the plan for spring 2026 and a tentative forecast for the following two semesters (autumn 2026 and spring 2027).

Contents

1 Planned Course Offerings (Next Three Semesters)

The following list shows the plan for spring 2026. A "U" in square brackets indicates that the course is part of our advanced undergraduate programme, and "D" indicates that it is taught in Danish. Graduate courses are by default taught in English, and so are undergraduate courses marked by "[U]". ☞ A click on a course's title sends you to its entry in the commented list.

Even though the plans are finalized, the list is not legally binding; unforeseen circumstances can require that a course be cancelled or replaced.

Spring 2026	
Course	ECTS
Advanced Probability Theory [U, D]	10
An Introduction to Dirichlet Form Theory	5
Data Project	10
Introduction to Sampling	5
Random Networks	5
Risk	10
Spatial Point Processes	5
Statistical Inference for High Dimensional Data	10
Stochastic Processes	10
Stochastic Processes with Long-Range Dependence	5

The plans for the next two semesters are not finalized yet. It is still possible that some courses need to be cancelled, while interesting new courses may emerge :-). The course *Survival Analysis with SAS*, for example, is only taught in odd numbered years, while *Statistical Inference* is only taught in even numbered years. We will very likely be able to offer more courses in spring 2027. Despite a bit uncertainty, you can use the lists for your long term planning.

Autumn 2026, tentative plan	
Course	ECTS
Advanced Statistical Learning	10
Monte Carlo Simulation	10
Multivariate Statistical Analysis [U, D]	10
Reinforcement Learning	10
Statistical Inference	10
Statistical Models [U]	10
Stochastic Calculus	10
Spring 2027, tentative plan	
Course	ECTS
Advanced Probability Theory [U, D]	10
Data Project	10
Introduction to Stochastic Geometry	5
Risk	10
Statistical Inference for High Dimensional Data	10
Stochastic Processes	10
Topological Data Analysis	10

2 Elective Graduate Courses in Statistics and Probability Theory

This is a lightly commented list of recent courses for Statistics masters students, taught by faculty from the Department of Mathematics.

☞ A click on the course title sends you to the recent course description in the course catalogue, where you can find details about the course contents, academic prerequisites, the exam, and more.
If you are met by a blank page, the course is new and has no published entry in the course catalogue yet. (or a technical error has occurred)

Advanced Statistical Learning (10 ECTS, autumn, every year)

During this course you will analyze data, formulate statistical models, implement algorithms, and shine light into the black box of machine learning. The course covers selected topics in statistical learning, and describes in detail the mathematical and computational backgrounds for the models.

An Introduction to Dirichlet Form Theory (5 ECTS, spring 2026)

As a generalization of the classical Dirichlet integral associated with Brownian motion, the theory of Dirichlet forms offers a rigorous analytical framework to study certain classes of symmetric bilinear forms associated with Markov processes. In this introductory course, we will introduce the basic theory, some ”toy” examples, and a brief overview of recent development in this field.

Data Project (10 ECTS, spring, every year)

In this course, you will analyze data from one of the various research groups at Aarhus University, working in teams under the supervision of a group member. Past supervisors have come from bioinformatics, chemistry, particle therapy, nanoscience, and many other fields. Projects are introduced in the first week, followed by discussions on effective teamwork. In the past, students have often returned to their research groups for their bachelor or master thesis.

Introduction to Sampling (5 ECTS, spring, even numbered years)

The course gives an introduction to sampling from finite populations. This is for instance used for opinion polls or other surveys. A number of variance reducing methods will be discussed, like stratification, systematic sampling and sampling proportional to size, all very important in practical applications.

Introduction to Stochastic Geometry (5 ECTS, spring, odd numbered years)

Stochastic geometry is a branch of probability theory which deals with set-valued random elements. For instance, the outcome of a stochastic experiment can be a point cloud, a random compact set or an affine plane in n-dimensional space. The theory allows to assess geometric characteristics such as volume and surface area of random sets and has thus various applications in biology, geology and materials science.

Lévy Processes (10 ECTS, spring, odd numbered years)

Lévy processes form a fundamental class of stochastic processes with stationary, independent increments, generalizing both Brownian motion and Poisson processes to include jumps of varying intensity and frequency. These processes are indispensable for modeling systems with sudden, discontinuous changes, such as financial asset prices, insurance claims, or particle collisions. In the course we will develop the basic theory of such processes.

Monte Carlo Simulation (10 ECTS, autumn, every year)

The first-year probability and statistics lectures explain how to do calculations with very simple distributions. However, in modern applications in data science and finance, we deal with enormously complicated settings, where such simple calculations are no longer possible. This course presents the most fundamental tools from Monte Carlo simulations, which are designed to harness the power of modern-day computing facilities for the analysis of complex models.

Random Networks (5 ECTS, spring 2026)

How do social networks, the internet, or biological systems stay connected as they grow? This course introduces the mathematics behind such complex systems using random graph models. We study fundamental examples (Erdős–Rényi, configuration, preferential attachment), explore local convergence to understand stable small-scale patterns in huge networks, and analyze phase transitions and connectivity thresholds. The course is theory-oriented with rigorous proofs, but always linked to real-world network phenomena.

Reinforcement Learning (10 ECTS, autumn, every year)

In Reinforcement Learning you want to navigate through a set of states, each emitting a random reward, so as to maximize expected future cumulated reward. The main characteristic of reinforcement learning is that you can interact with the environment so as to explore the reward distributions, and based on this choose a strategy closer to the optimal strategy.

Risk (10 ECTS, spring, every year)

The course "Risk" explores the mathematical description, quantification, and comparison of financial risks using applied probability. Topics include distributional orderings, point processes, large

deviations, and extreme value theory. Rather than specializing, students build a rich probabilistic toolkit. While understanding mathematical tools, we come across many surprising results, including the quirky behavior of heavy-tailed variables and the waiting-time paradox. By the end, you will have a true "Swiss army knife" of probability techniques at your disposal.

Spatial Point Processes (5 ECTS, spring, even numbered years)

Spatial point processes are stochastic models for spatial point patterns, like positions of neurons in the brain or cell phone antennas in urban space. They also serve as basis for more complex Stochastic Geometry models. The course combines theoretical foundations of spatial point processes with practical analysis and simulations using the R package `spatstat`.

Statistical Inference (10 ECTS, autumn, even numbered years)

Statistical inference is the process of drawing conclusions about parameters based on sample data. This course provides a rigorous introduction to the subject, grounded in measure theory and advanced probability. Key topics include point estimation, confidence intervals, hypothesis testing, asymptotic theory, and the distinction between causality and association. The practical relevance of the theoretical tools is emphasized throughout.

Statistical Inference for High Dimensional Data (10 ECTS, spring, every year)

High-dimensional statistics focuses on models with many parameters. The main challenge, known as *curse of dimensionality*, is that data points become sparse and hard to analyze as dimensions increase. This makes traditional tools unreliable. A key concept is enhancing classical estimators with extra terms to use data more efficiently.

Stochastic Calculus (10 ECTS, autumn, every year)

Stochastic Calculus is a branch of mathematics that extends classical calculus to stochastic processes, particularly those related to Brownian motion It provides the theoretical foundation for modeling systems influenced by uncertainty and is essential in fields like quantitative finance, physics, and engineering. The course will be a thorough introduction to the theory.

Stochastic Processes (10 ECTS, spring, every year)

This course is intended for students with a solid background in measure-theoretic probability. It covers fundamental stochastic processes in both discrete and continuous time, with emphasis on their mathematical foundations. Rigorous proofs are therefore central to the course, along with the development of practical skills in working with probabilistic models.

Stochastic Processes with Long-Range Dependence (5 ECTS, spring 2026)

Long-range dependence is empirically observed in many stochastic systems such as financial time series, climate data and network traffic. This course gives an introduction to the theory of long-range dependence. On top of this, we will also apply the theory on concrete data sets.

Survival Analysis with SAS (10 ECTS, autumn, odd numbered years)

Survival analysis is a statistical framework for studying the time until an event of interest—such as death, system failure, or disease recurrence—occurs. It is widely used in fields such as medicine, engineering, public health, and the social sciences. A key challenge in this area is the presence of incomplete data, as some events are not observed within the study period (censoring).

This course provides students with hands-on experience in analyzing real-world survival data and applying key methods. It also highlights the role of advanced probability theory in survival analysis, particularly in asymptotic analysis and counting process formulations, supporting more flexible and robust modeling.

Time Series Analysis (10 ECTS, autumn 2025)

Time series data arises in many statistical applications, including finance, environmental science, and economics, where understanding how systems evolve is key to making informed decisions. This course introduces the fundamental principles of time series analysis, focusing on the dynamic relationships within dependent data.

Topological Data Analysis (10 ECTS, spring, odd numbered years)

When analyzing moderately sized data sets, traditional methods often attempt to describe their structure through elementary time- or distance-based correlations. However, for many complex data sets such simple approaches are no longer sufficient and it is important to understand the topological shape of the data. This course presents an introduction topological data analysis, which provides powerful tools to discover hidden structures at multiple scales.

3 Advanced Undergraduate Courses

The following courses are compulsory courses from our Bachelor's programme in Mathematics with specialization in Statistics. They are offered every year. You can take these courses if your undergraduate programme did not cover theses topics.

For students who started their Bachelor studies before autumn 2024, the course "Stochastic Processes" was a compulsory part of the specialization. It is now listed under Graduate Courses.

Advanced Probability Theory (10 ECTS, spring, every year)

This course gives a thorough introduction to a number of fundamental topics in probability theory that are of crucial significance for the modern theory of probability. The course thus provides the

necessary background for advanced courses in e.g. stochastic modelling, mathematical finance and theoretical statistics.

Multivariate Statistical Analysis (10 ECTS, autumn, every year)

This course extends univariate results from introductory courses like "Introduction to Probability & Statistics" and "Mathematical Statistics" to the multivariate case. It is largely proof-based, and many results from the introductory courses are given formal proofs. While applications in R are included, the focus is more on theory than on applications.

Statistical Models (10 ECTS, autumn, every year)

Various aspects of parametric statistical modelling and inference are addressed in this course: In the first part, you will explore the basic ideas of likelihood theory and be introduced to generalized linear models and their theoretical background, exponential dispersion families. The second part is an introduction to Bayesian statistics, covering both theory and applications in R.

4 Optional Courses

Up to 30 ECTS may be chosen from other degree programmes, for example Mathematics, Mathematics-Economics, Data Science, Computer Science, or Science Studies.

To get inspiration from the course catalogue, consider the ☞ **list of electives for Statistics**. Other courses are possible, too. Courses should substantially differ from your undergraduate programme. Remember that your choice has to be approved by the head of degree programme.

Possible courses from the department of Mathematics include for example:

- **Advanced Analysis**, 10 ECTS, Spring
- **Differential Equations** [U], 5 ECTS, Spring
- **Fourier Analysis** [U], 5 ECTS, Autumn
- **Graph Theory 1**, 10 ECTS, Autumn
- **Theory of Measure and Integration** [U], 10 ECTS, Autumn

Examples for courses from other departments are

- **Causal Inference** [U], 10 ECTS, Autumn
- **Databases** [U], 10 ECTS, Spring
- **Data Visualization**, 10 ECTS, Autumn
- **Statistical Learning and Machine Learning** [U], 10 ECTS, Autumn

Again, [U] means undergraduate course.

There may occur overlap between the schedule of lectures or labs of these courses and the statistics courses.

5 Project Work

You may replace course work of up to 10 ECTS by working on a project, either on an academic topic or an industry project.

- **Project Work in Statistics** (5 or 10 ECTS) is independent study under supervision. It allows you to dive deep into a topic that is not offered as regular course. To do that, you need to find an appropriate faculty member who would act as your project supervisor. Read more about that in the course description.
- **Vocational Training Project** (10 ECTS) is a project in collaboration with industry. We do not organize vocational training projects to choose from. However, if you find a company that has an interesting problem, and offers you supervision, you are welcome to suggest the project to the head of programme, and they will help you find an academic co-supervisor. Unfortunately, it is not allowed to be employed by the company while doing the project.