

# Applied Mathematics major 2018-2020

**Professor in charge:** Nuutti Hyvönen

**Other professors:** Chris Brzuska, Antti Hannukainen, Camilla Hollanti, Pauliina Ilmonen, Kaie Kubjas, Lasse Leskelä, Rolf Stenberg

**Extent:** 55–65 ECTS (long major) or 40–45 ECTS (compact major)

**Abbreviation:** AM

**Code:** SCI3053

## Objectives

The major in Applied Mathematics is designed for students interested in mathematical sciences and their application to other disciplines. It is based on a solid mathematical core that gives the student a broad set of skills for working on diverse mathematical problems. The major also includes an elective part that provides flexibility to orientate toward a master's thesis project in a chosen application area. A high proportion of students majoring in applied mathematics will continue their studies to a doctoral degree.

The importance of mathematical techniques is increasing in science and engineering as new fields employing sophisticated mathematical models are constantly emerging. The driving forces for such development are the ever-increasing computational resources, which should be used wisely and to their full power. This requires the education of mathematicians who are able to interact and collaborate with experts in application areas. The major in Applied Mathematics responds to this need.

## Content and structure

The major in Applied Mathematics can be taken either as a long major (55–65 ECTS) or a compact major (40–45 ECTS). The student's personal academic advisor provides assistance in planning the curriculum details.

### Mandatory studies (15 ECTS)

CODE	NAME	CREDITS	PERIOD	YEAR
<a href="#">MS-E1651</a>	Numerical matrix computations	5	II	1
<a href="#">MS-E2112</a>	Multivariate statistical analysis	5	III–IV	1
<a href="#">MS-E2122</a>	Nonlinear optimization	5	I–II	1

### Core studies (25–45 ECTS)

Select 25–45 credits for a long major or 25–30 credits for a compact major. In both cases, select at least one course from each of the three categories below.

#### Computational mathematics

CODE	NAME	CREDITS	PERIOD	YEAR
<a href="#">MS-E1142</a>	Computational algebraic geometry	5	I (every other year)	1 or 2
<a href="#">MS-E1461</a>	Hilbert spaces	5	I	1 or 2
<a href="#">MS-E1652</a>	Computational methods for differential equations	5	I	1 or 2
<a href="#">MS-E1653</a>	Finite element method	5	III–IV	1 or 2
<a href="#">MS-E1654</a>	Computational inverse problems	5	IV	1 or 2

#### Optimization

CODE	NAME	CREDITS	PERIOD	YEAR
<a href="#">MS-E2121</a>	Linear optimization	5	I–II	1 or 2

MS-E2123	Integer optimization	5	III–IV (every other year)	1 or 2
MS-E2134	Decision making and problem solving	5	III–IV	1 or 2

## Statistics and probability

CODE	NAME	CREDITS	PERIOD	YEAR
MS-E1600	Probability theory	5	III	1 or 2
MS-E1602	Large random systems	5	IV (every other year)	1 or 2
MS-E1603	Random graphs and network statistics	5	I	1 or 2
CS-E5710	Bayesian data analysis	5	I–II	1 or 2

Students taking a long major select in addition sufficiently many courses in mathematics or other mathematical sciences to obtain a total of 55–65 credits. Courses not in the below list of recommended courses may also be included with the consent of the professor in charge.

## Recommended courses

CODE	NAME	CREDITS	PERIOD	YEAR
MS-E1050	Graph theory	5	I (2018-2019) II (2019-2020)	1 or 2
MS-E1110	Number theory	5	II (2018-2019) I (2019-2020)	1 or 2
MS-E1111	Galois theory	5	IV (every other year)	1 or 2
MS-E1687	Advanced topics in cryptography	5	III–IV	1 or 2
MS-E1742	Computational mechanics 1	5	I	1 or 2
MS-E1743	Computational mechanics 2	5	II	1 or 2
CS-E3190	Principles of algorithmic techniques	5	I–II	1 or 2
CS-E3210	Machine learning: Basic principles	5	I–II	1 or 2
CS-E4500	Advanced course in algorithms	5	III–IV	1 or 2
CS-E4510	Distributed algorithms	5	I–II	1 or 2
CS-E4320	Cryptography and data security	5	I–II	1 or 2
CS-E4530	Computational complexity theory	5	III–IV	1 or 2
CS-E4555	Combinatorics	5	III–IV	1 or 2
CS-E4580	Programming parallel computers	5	V	1 or 2
CS-E5740	Complex networks	5	I–II	1 or 2
CS-E5745	Mathematical methods for network science	5	III (every other year)	1 or 2
PHYS-E0412	Computational physics	5	III–V	1 or 2
PHYS-E0419	Dynamics of particles, fluids and solids	5	I–II	1 or 2

