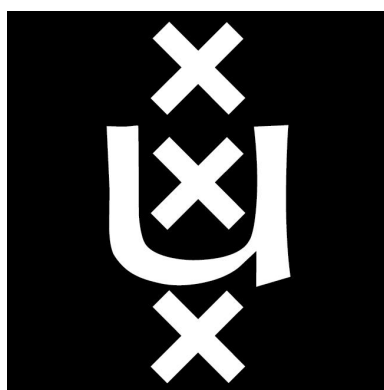


# Mathematical Masters Mini Manual 2017/18



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# About this document

## Goal

This document was written to assist UvA students in choosing courses within the two mathematical master programs and their tracks:

- *Mathematics*, consisting of four tracks:
  - Algebra and Geometry
  - Analysis and Dynamical Systems
  - Mathematical Physics
  - Stochastics
- *Stochastics and Financial Mathematics*

This manual contains information on the overall structure of the Master programs, and lists courses offered in 2017/18 per track, indicating both their level and relevance. Also, several “suggested lines” are given. These are clusters of related courses that offer the possibility of going in depth into several specializations.

We recommend that you discuss your programme with the coordinator of your master programme as early as possible.

## Other sources of information

Detailed course descriptions can be found in the online [UvA](#) and [VU](#) study guides, and on the [Mastermath](#) website. The blackboard page “[Mathematical Masters](#)” contains practical information regarding your programme, your Master Project, the PEP-form, the master room, etc. . .

## Non-standard programmes

If you want to follow a non-standard programme (e.g. a major/minor, a double master programme, or including courses not listed in the programme below), then in most cases you will need to have your proposed programme approved by the Examination Board. Contact the coordinator of your programme as soon as possible.

## Legal disclaimer

No rights can be derived from this document, the only legally binding source regarding your master degree is the *Teaching and Examination Regulations* (commonly known by their Dutch abbreviation OER). You can find this on the blackboard page “[Mathematical Masters](#)”.

For suggestions or corrections please contact Luuk Stehouwer ([luuk.stehouwer@gmail.com](mailto:luuk.stehouwer@gmail.com)) or Lenny Taelman ([l.d.j.taelman@uva.nl](mailto:l.d.j.taelman@uva.nl)).

# MSc Mathematics: track Algebra and Geometry

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## Program outline

- **6EC**: Master Seminar in Algebra and Geometry (year 1)
  - **36EC**: Master Project Mathematics (year 2)
  - **66EC**: Mathematics courses, consisting of
    - At least three courses out of:
      - \* Algebraic Geometry 1
      - \* Algebraic Methods in Combinatorics
      - \* Algebraic Topology
      - \* Lie Groups and Lie Algebras
      - \* Quivers
      - \* Riemann Surfaces
    - At least 2 advanced Algebra and Geometry courses
    - Remainder (about 30EC) mathematics courses (all tracks)
  - **12EC**: Free (must be master level; can be math, literature, ...)
- 

## Fall 2017

### Master Seminar

- Master Seminar in Algebra and Geometry (UvA)

### Suggested basic courses

- Algebraic Geometry 1 (Mastermath)
- Algebraic Number Theory (Mastermath)
- Algebraic Topology (Mastermath)
- Commutative Algebra (Mastermath)
- Cryptology (Mastermath)
- Differential Geometry (Mastermath)
- Quivers (UvA, not every year)

### Advanced Algebra and Geometry courses

- Advanced Algebraic Geometry: Algebraic Surfaces (Mastermath)
- Advanced Combinatorics (Mastermath)
- Advanced Hamiltonian Dynamics (Mastermath)
- Poisson Geometry (Mastermath, not every year)
- TFT and Moduli Spaces (UvA, not every year)

### Related courses

- Functional Analysis (Mastermath)

## Spring 2018

### Master Seminar

- [Master Seminar in Algebra and Geometry \(UvA\)](#)

### Suggested basic courses

- [Algebraic Methods in Combinatorics \(Mastermath\)](#)
- [Coding Theory \(Mastermath\)](#)
- [Elliptic Curves \(Mastermath\)](#)
- [Lie Groups and Lie Algebras \(Mastermath\)](#)
- [Modular Forms \(Mastermath\)](#)
- [Operator Algebras \(Mastermath\)](#)
- [Riemann Surfaces \(Mastermath\)](#)

### Advanced Algebra and Geometry courses

- [Algebraic Geometry 2 \(Mastermath\)](#)
- [Algebraic Topology 2 \(Mastermath, not every year\)](#)
- [Quantum Groups and Integrable Systems \(UvA, not every year\)](#)
- [Topology in Physics \(Mastermath, not every year\)](#)

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## Suggested lines

### Algebraic Geometry

- Basic: [Algebraic Geometry 1, Commutative Algebra](#)
- Advanced: [Advanced Algebraic Geometry: Algebraic Surfaces, Algebraic Geometry 2](#)
- Related: [Algebraic Topology, Elliptic Curves, Riemann Surfaces](#)

### Differential Geometry

- Basic: [Differential Geometry, Lie Groups and Lie Algebras, Riemann Surfaces, Symplectic Geometry \(Fall 18/19\)](#)
- Advanced: [Poisson Geometry](#)
- Related: [Algebraic Topology](#)

### Number Theory

- Basic: [Algebraic Number Theory, Algorithmic Geometry of Numbers, Elliptic Curves, Modular Forms](#)
- Related: [Algebraic Geometry 1, Commutative Algebra](#)

### Discrete Mathematics

- Basic: [Advanced Linear Programming, Algebraic Methods in Combinatorics, Coding Theory](#)
- Advanced: [Advanced Combinatorics](#)
- Related: [Algebraic Topology, Commutative Algebra, Discrete Optimization, Probabilistic and Extremal Combinatorics, Quivers, Semidefinite Optimization](#)

## Research staff in Algebra and Geometry

### UvA

Raf Bocklandt, Miranda Cheng, Gerard van der Geer, Chris Lazda Arno Kret, Hans Maassen, Jan van Mill, Eric Opdam, Viresh Patel, Hessel Posthuma, Guus Regts, Nicolai Reshetikhin, Lex Schrijver, Sergey Shadrin, Mingmin Shen, Jasper Stokman, Lenny Taelman.

### VU

Sander Dahmen, Oliver Fabert, Rob de Jeu, Federica Pasquotto, Jan Sanders, Rob van der Vorst.

# MSc Mathematics: track Analysis and Dynamical Systems

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## Program outline

- **6EC**: Master Seminar in Analysis and Dynamical Systems (year 1)
  - **36EC**: Master Project Mathematics (year 2)
  - **66EC**: Mathematics courses, consisting of
    - At least 3 courses out of
      - \* Dynamical Systems
      - \* Functional Analysis
      - \* Finite Element Methods for Partial Differential Equations (Fall 18/19) (this course will be given in fall 2018)
      - \* Partial Differential Equations
    - At least 2 advanced Analysis and Dynamical Systems courses
    - Remainder (about 30EC): mathematical courses (all tracks)
  - **12EC**: Free (must be master level; can be math, literature, ...)
- 

## Fall 2017

### Master Seminar

- Master Seminar in Analysis and Dynamical Systems (UvA)

### Suggested basic courses

- Differential Geometry (Mastermath)
- Dynamical Systems (Mastermath)
- Functional Analysis (Mastermath)
- Mathematical Biology (Mastermath, not every year)
- Numerical Linear Algebra (Mastermath)
- Parallel Algorithms (Mastermath)
- Partial Differential Equations (Mastermath)

### Advanced Analysis and Dynamical Systems courses

- Advanced Hamiltonian Dynamics (Mastermath)
- Topics in Complex Analysis (UvA, not every year)
- Poisson Geometry (Mastermath, not every year)

### Related courses

- Measure Theoretic Probability (Mastermath)

## Spring 2018

### Master Seminar

- Master Seminar in Analysis and Dynamical Systems (VU)

### Suggested basic courses

- Continuum Mechanics (Mastermath)
- Introd. to Numerical Bifurcation Analysis of ODE's and Maps (Mastermath)
- Riemann Surfaces (Mastermath)
- Stochastic Differential Equations (Mastermath)

### Advanced Analysis and Dynamical Systems courses

- Nonlinear Waves (Mastermath)
- Inverse Problems in Imaging (Mastermath)

### Related courses

- Lie Groups and Lie Algebras (Mastermath)
- 

## Suggested lines

### Dynamical systems

- Basic: Dynamical Systems, Partial Differential Equations, Introd. to Numerical Bifurcation Analysis of ODE's and Maps
- Advanced: Advanced Hamiltonian Dynamics, Nonlinear Waves
- Related: Functional Analysis, Mathematical Biology

### Numerical Analysis

- Basic: Finite Element Methods for Partial Differential Equations (Fall 18/19), Numerical Linear Algebra, Numerical Methods for Time Dependent PDEs (Fall 18/19), Partial Differential Equations
  - Advanced: Inverse Problems in Imaging
  - Related: Applied Finite Elements, Functional Analysis, Parallel Algorithms
- 

## Research staff in Analysis and Dynamical Systems

### UvA

Jan Brandts, Daan Crommelin, Ale Jan Homburg, Han Peters, Rob Stevenson, Chris Stolk, Jan Wiegerinck.

### VU

Jan Bouwe van den Berg, Frank Bruggeman, Oliver Fabert, Ale Jan Homburg, Joost Hulshof, Rien Kaashoek, Federica Pasquotto, Bob Planqué, André Ran, Bob Rink, Jan Sanders, Rob van der Vorst.

# MSc Mathematics: track Mathematical Physics

**Note:** this is the programme for the new *track*, for students that start in 2017. Students that enrolled in the *MSc Mathematical Physics* before 2017 follow the programme at the end of this document.

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## Programme outline

- **6EC:** Master Seminar in Algebra and Geometry (year 1)
  - **36EC:** Master Project Mathematics (year 2)
  - **54EC:** Mathematics courses, consisting of
    - At least three courses out of:
      - \* Algebraic Geometry 1
      - \* Algebraic Topology
      - \* Differential Geometry
      - \* Lie Groups and Lie Algebras
      - \* Riemann Surfaces
    - At least two advanced Mathematical Physics courses.
    - Remainder (about 15EC) mathematics courses (all tracks)
  - **12EC:** At least two physics courses out of
    - Quantum Field Theory
    - Statistical Physics and Condensed Matter Theory I
    - String Theory
  - **12EC:** Free (must be master level; can be math, literature, ...)
- 

## Fall 2017

### Master Seminar

- Master Seminar in Algebra and Geometry (UvA)

### Suggested Basic courses

- Algebraic Geometry 1 (Mastermath)
- Algebraic Topology (Mastermath)
- Differential Geometry (Mastermath)
- Functional Analysis (Mastermath)
- Quivers (UvA, not every year)

### Advanced Mathematical Physics courses

- Poisson Geometry (Mastermath, not every year)
- TFT and Moduli Spaces (UvA, not every year)



## Spring 2018

### Master Seminar

- [Master Seminar in Algebra and Geometry \(UvA\)](#)

### Suggested Basic courses

- [Lie Groups and Lie Algebras \(Mastermath\)](#)
- [Operator Algebras \(Mastermath\)](#)
- [Riemann Surfaces \(Mastermath\)](#)

### Advanced Mathematical Physics courses

- [Foundations of General Relativity \(Mastermath\)](#)
- [Quantum Groups and Integrable Systems \(UvA, not every year\)](#)
- [Topology in Physics \(Mastermath, not every year\)](#)

### Related courses

- [Algebraic Geometry 2 \(Mastermath\)](#)
  - [Algebraic Topology 2 \(Mastermath, not every year\)](#)
- 

## Research staff in Mathematical Physics

### UvA

[Raf Bocklandt](#), [Miranda Cheng](#), [Gerard Helminck](#), [Hans Maassen](#), [Eric Opdam](#), [Hessel Posthuma](#), [Nicolai Reshetikhin](#), [Sergey Shadrin](#), [Jasper Stokman](#).

### VU

[Oliver Fabert](#), [Vincent Knibbeler](#), [Federica Pasquotto](#), [Jan Sanders](#), [Rob van der Vorst](#).

# MSc Mathematics: track Stochastics

**Note:** Because of significant overlap in content, students cannot take both the courses [Stochastic Integration \(UvA\)](#) and [Stochastic Differential Equations \(Mastermath\)](#).

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## Program outline

- **6EC:** [Master Seminar in Stochastics](#) (year 1)
  - **36EC:** [Master Project Mathematics](#) (year 2)
  - **66EC:** Mathematics courses, consisting of
    - Compulsory courses:
      - \* [Asymptotic Statistics](#) (Mastermath)
      - \* [Measure Theoretic Probability](#) (Mastermath)
      - \* [Stochastic Processes](#) (Mastermath)
    - At least 2 advanced Stochastics courses
    - Remainder (about 30EC): mathematics courses (all tracks)
  - **12EC:** Free (must be master courses; can be math, literature, ...)
- 

## Fall 2017

### Master Seminar

- [Master Seminar in Stochastics](#) (UvA)

### Suggested basic courses

- [Applied Stochastic Modelling](#) (VU)
- [Asymptotic Statistics](#) (Mastermath)
- [Forensic Probability and Statistics](#) (Mastermath)
- [Machine Learning Theory](#) (Mastermath)
- [Measure Theoretic Probability](#) (Mastermath)
- [Probabilistic and Extremal Combinatorics](#) (Mastermath)
- [Simulation Methods in Statistics](#) (UvA)
- [Statistical Models](#) (VU)
- [Stochastic Optimization](#) (VU)
- [Stochastic Simulation](#) (UvA)

### Advanced Stochastics courses

- [Discrete Choice Analysis: Theory and Applications](#) (Mastermath, not every year)
- [Interest Rate Models](#) (UvA)
- [Portfolio Theory](#) (UvA)

### Related courses

- [Dynamical Systems](#) (Mastermath)
- [Functional Analysis](#) (Mastermath)

- [Partial Differential Equations \(Mastermath\)](#)
- 

## Spring 2018

### Master Seminar

- [Master Seminar in Stochastics \(VU\)](#)

### Suggested basic courses

- [Queueing Theory \(Mastermath\)](#)
- [Applied Statistics \(Mastermath\)](#)
- [Stochastic Integration \(UvA\)](#)
- [Stochastic Processes \(Mastermath\)](#)
- [Time Series \(Mastermath\)](#)

### Advanced Stochastics courses

- [Percolation: from Introduction to Frontiers of Current Research \(Mastermath, not every year\)](#)
- [Queues & Levy Fluctuation Theory \(UvA\)](#)
- [Statistics for High-dimensional Data \(VU\)](#)
- [Statistical Theory for High- and Infinite-Dimensional Models \(Mastermath\)](#)

### Related courses

- [Optimization of Business Processes \(VU\)](#)
- 

## Suggested lines

### Probability

- Basic: [Applied Stochastic Modelling](#), [Measure Theoretic Probability](#), [Stochastic Integration](#), [Stochastic Simulation](#)
- Advanced: [Percolation: from Introduction to Frontiers of Current Research](#), [Queues & Levy Fluctuation Theory](#)
- Related: [Functional Analysis](#), [Dynamics of Networks](#), [Partial Differential Equations](#), [Time Series](#)

### Statistics

- Basic: [Applied Stochastic Modelling](#), [Asymptotic Statistics](#), [Measure Theoretic Probability](#), [Time Series](#), [Statistical Models](#), [Simulation Methods in Statistics](#), [Applied Statistics](#)
- Advanced: [Statistics for Networks \(18/19\)](#), [Statistical Theory for High- and Infinite-Dimensional Models](#)
- Related: [Forensic Probability and Statistics](#), [Functional Analysis](#), [Machine Learning Theory](#)

## Applied Stochastics & Operations Research

- Basic: [Advanced Linear Programming](#), [Continuous Optimization](#), [Heuristic Methods in Operations Research](#), [Scheduling](#), [Stochastic Optimization](#)
- Related: [Discrete Optimization](#), [Forensic Probability and Statistics](#), [Machine Learning Theory](#), [Queueing Theory](#), [Stochastic Simulation](#)

## Discrete Mathematics

**Note:** For more algebraic courses in discrete mathematics, also consider the suggested line of discrete mathematics in the track Algebra & Geometry.

- Basic: [Discrete Optimization](#), [Dynamics of Networks](#), [Probabilistic and Extremal Combinatorics](#), [Scheduling](#), [Semidefinite Optimization](#)
- Related: [Advanced Linear Programming](#), [Computational Complexity](#), [Stochastic Optimization](#)

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## Research staff in Stochastics

### UvA

[Arnoud den Boer](#), [Sonja Cox](#), [Daan Crommelin](#), [Jan-Pieter Dorsman](#), [Bert van Es](#), [Asma Khedher](#), [Chris Klaassen](#), [Bas Kleijn](#), [Michel Mandjes](#), [Sindo Núñez Queija](#), [Marjan Sjerps](#), [Peter Spreij](#), [Erik Winands](#), [Harry van Zanten](#).

### VU

[René Bekker](#), [Eduard Belitser](#), [Rob van den Berg](#), [Sandjai Bhulai](#), [Federico Camia](#), [Elenna Dugundji](#), [Bram Gorissen](#), [Mathisca de Gunst](#), [Wouter Kager](#), [Ger Koole](#), [Ronald Meester](#), [Rob van der Mei](#), [Klaas Slooten](#), [Mark van de Wiel](#), [Wessel van Wieringen](#).

# MSc Stochastics and Financial Mathematics

**Note:** Because of significant overlap in content, students cannot take two of the three courses [Stochastic Integration](#) (UvA), [Stochastic Calculus](#) (UvA, MSc Econometrics) and [Stochastic Differential Equations](#) (Mastermath).

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## Program outline

- **6EC:** Master Seminar in Stochastics (year 1)
  - **36EC:** Master Project Stochastics and Financial Mathematics (year 2)
  - **66EC:** Mathematics and SFM courses, consisting of
    - [Measure Theoretic Probability](#) (Mastermath)
    - at least 2 courses out of
      - \* [Computational Finance](#) (UvA MSc Computational Science)
      - \* [Interest Rate Models](#) (UvA)
      - \* [Portfolio Theory](#) (UvA)
      - \* [Stochastic Processes for Finance](#) (VU)
    - at least 2 advanced SFM courses
  - **12EC:** Free (must be master courses; can be a designated SFM course, Math, literature, ...)
- 

## Fall 2017

### Master Seminar

- [Master Seminar in Stochastics](#) (UvA)

### Basic SFM courses

- [Applied Stochastic Modelling](#) (VU)
- [Asymptotic Statistics](#) (Mastermath)
- [Forensic Probability and Statistics](#) (Mastermath)
- [Functional Analysis](#) (Mastermath)
- [Machine Learning Theory](#) (Mastermath)
- [Measure Theoretic Probability](#) (Mastermath)
- [Partial Differential Equations](#) (Mastermath)
- [Simulation Methods in Statistics](#) (UvA)
- [Statistical Models](#) (VU)
- [Stochastic Optimization](#) (VU)
- [Stochastic Processes for Finance](#) (VU)
- [Stochastic Simulation](#) (UvA)

### Advanced SFM courses

- [Discrete Choice Analysis: Theory and Applications](#) (Mastermath, not every year)
- [Interest Rate Models](#) (UvA)

- [Portfolio Theory \(UvA\)](#)
- 

## Spring 2018

### Master Seminar

- [Master Seminar in Stochastics \(VU\)](#)

### Basic SFM courses

- [Computational Finance \(UvA, MSc Computational Science\)](#)
- [Optimization of Business Processes \(VU\)](#)
- [Percolation: from Introduction to Frontiers of Current Research \(Mastermath, not every year\)](#)
- [Queueing Theory \(Mastermath\)](#)
- [Applied Statistics \(Mastermath\)](#)
- [Stochastic Integration \(UvA\)](#)
- [Time Series \(Mastermath\)](#)

### Advanced SFM courses

- [Queues & Levy Fluctuation Theory \(UvA\)](#)
  - [Statistical Theory for High- and Infinite-Dimensional Models \(Mastermath\)](#)
  - [Statistics for High-dimensional Data \(VU\)](#)
- 

## Research staff in SFM

### UvA

[Arnoud den Boer](#), [Sonja Cox](#), [Jan-Pieter Dorsman](#), [Bert van Es](#), [Asma Khedher](#), [Chris Klaassen](#), [Bas Kleijn](#), [Michel Mandjes](#), [Sindo Núñez Queija](#), [Marjan Sjerps](#), [Peter Spreij](#), [Robin de Vilder](#), [Erik Winands](#), [Harry van Zanten](#).

### VU

[René Bekker](#), [Eduard Belitser](#), [Rob van den Berg](#), [Sandjai Bhulai](#), [Federico Camia](#), [Elenna Dugundji](#), [Bram Gorissen](#), [Mathisca de Gunst](#), [Wouter Kager](#), [Ger Koole](#), [Ronald Meester](#), [Rob van der Mei](#).

# MSc Mathematical Physics (Old Style)

**Note:** this is the programme for students that enrolled *before* 2017. New students follow the track Mathematical Physics within the MSc Mathematics.

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## Programme outline

- **6EC:** Master Seminar in Algebra and Geometry (year 1)
  - **48EC:** Master Project in Mathematical Physics (year 2)
  - **36EC:** Compulsory mathematics courses:
    - Algebraic Topology
    - Differential Geometry
    - Lie Groups and Lie Algebras
    - Quantum Groups and Integrable Systems
    - TFT and Moduli Spaces
  - **12EC:** At least 2 physics courses out of
    - Quantum Field Theory
    - Statistical Physics and Condensed Matter Theory I
    - String Theory
  - **18EC:** Mathematics or physics courses from the next section
- 

## Fall 2017

### Master Seminar

- Master Seminar in Algebra and Geometry (UvA)

### Suggested Basic courses

- Algebraic Geometry 1 (Mastermath)
- Algebraic Topology (Mastermath)
- Differential Geometry (Mastermath)
- Functional Analysis (Mastermath)
- Quantum Field Theory extension (UvA)
- Quivers (UvA, not every year)
- Statistical Physics and Condensed Matter Theory I (UvA)
- Statistical Physics and Condensed Matter Theory extension (UvA)

### Advanced courses

- Poisson Geometry (Mastermath, not every year)
- TFT and Moduli Spaces (UvA, not every year)

## Spring 2018

### Master Seminar

- [Master Seminar in Algebra and Geometry \(UvA\)](#)

### Suggested Basic courses

- [General Relativity \(UvA\)](#)
- [Lie Groups and Lie Algebras \(Mastermath\)](#)
- [Operator Algebras \(Mastermath\)](#)
- [Riemann Surfaces \(Mastermath\)](#)
- [Statistical Physics and Condensed Matter Theory II \(UvA\)](#)
- [String Theory \(UvA\)](#)
- [String Theory extension \(UvA\)](#)

### Advanced courses

- [Foundations of General Relativity \(Mastermath\)](#)
- [Quantum Groups and Integrable Systems \(UvA, not every year\)](#)
- [Topology in Physics \(Mastermath, not every year\)](#)

### Related courses

- [Algebraic Geometry 2 \(Mastermath\)](#)
- [Algebraic Topology 2 \(Mastermath, not every year\)](#)

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## Research staff in Mathematical Physics

### UvA

[Raf Bocklandt](#), [Guido Carlet](#), [Miranda Cheng](#), [Gerard Helminck](#), [Hans Maassen](#), [Eric Opdam](#), [Hessel Posthuma](#), [Nicolai Reshetikhin](#), [Sergey Shadrin](#), [Jasper Stokman](#).

### VU

[Oliver Fabert](#), [Vincent Knibbeler](#), [Federica Pasquotto](#), [Jan Sanders](#), [Rob van der Vorst](#).



## Other Courses

Not all courses offered in the Mathematical Masters fall explicitly under a specific track. Below are listed additional mathematics courses that students can follow and are not listed as a basic or advanced course under a specific track. Students are also encouraged to approach professors for the option of a [Reading Course Mathematics](#) in a suggested advanced topic.

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### Fall 2017

- [Complexity Theory](#) (Mastermath)
  - [Continuous Optimization](#) (Mastermath)
  - [Discrete Optimization](#) (Mastermath)
  - [Heuristic Methods in Operations Research](#) (Mastermath)
  - [Reading Course Mathematics](#) (UvA)
  - [Set Theory](#) (Mastermath)
  - [Systems and Control](#) (Mastermath)
- 

### Spring 2018

- [Applied Finite Elements](#) (Mastermath)
- [Advanced Linear Programming](#) (Mastermath)
- [Algorithms Beyond the Worst Case](#) (Mastermath)
- [Category Theory and Topos Theory](#) (Mastermath)
- [Coding and Cryptography](#) (VU)
- [Computational Complexity](#) (UvA)
- [Descriptive Set Theory](#) (Mastermath)
- [History and Philosophy of Mathematics](#) (UvA)
- [Dynamics of Networks](#) (Mastermath)
- [Quantum Computing](#) (Mastermath)
- [Reading Course Mathematics](#) (UvA)
- [Scheduling](#) (Mastermath)
- [Selected Areas in Cryptology](#) (Mastermath)
- [Semidefinite Optimization](#) (Mastermath)