UNIVERSITY OF AMSTERDAM

Mathematics
Stochastics & Financial Mathematics

UvA Faculty of Science

Why a Mathematics master at UvA?

Deepening your knowledge in Mathematics, gearing towards

Mathematical research

and/or

Mathematics in relation to Physics, Education, Finance, Econometrics, Data Science….

Two year master programmes (120 EC)

- Mathematics: research master, possible with minor or major.
- Stochastics and Financial Mathematics (SFM).

Double master programmes

- Double Master Mathematics & Theoretical Physics **(180EC).**
- Double Master Mathematics & Econometrics **(150EC).**
- Double Master SFM & Econometrics **(150EC).**

Master mathematics (regular variant)

Four specialisation directions:

- Algebra & Geometry
- Mathematical Physics
- Analysis & Dynamical Systems
- Stochastics

National component: mastermath.
Local components: master seminar, local courses, master project.

Structure of the master Mathematics

- 6 EC: **Master Seminar** (whole first year)
- 66 EC: **Mathematics courses**
  - ~ 36 EC within your specialisation
  - at least 2 advanced courses
  - ~ 30 EC free within Mathematics
- 12 EC: **Free programme**
- 36 EC: **Master Project**

Master SFM (regular variant)

Focus on mathematical aspects in Finance, Decision and Data Science.

Research-oriented as well as geared to applications in business (finance, data analysis, consultancy).

National component: mastermath.
Local components: master seminar, local courses, master project.

Structure of the master SFM

- 3 EC: **Master Seminar** (one semester)
- 69 EC: **courses**
  - Measure Theoretic Probability
  - 2 out of 4 financial mathematics courses, or
  - 2 out of 4 data analytics courses
  - ~ 30 EC free within stochastics, mathematical data analytics. At least two advanced courses.
- 12 EC: **Free programme**
- 36 EC: **Master Project, possibly with internship**

Structure of the programmes

	Fall	*Spring*
Year 1	*Master Seminars* *basic courses*	*Master Seminar math* *basic courses* *advanced courses*
Year 2	*advanced courses*	*Master Project*

Master Seminar Mathematics

Three local seminars:

- **Algebra, Geometry & Mathematical Physics**
- **Analysis & Dynamical Systems**
- **Stochastics**

Master seminar SFM

The first link with mathematical research in Amsterdam!

Master Seminar

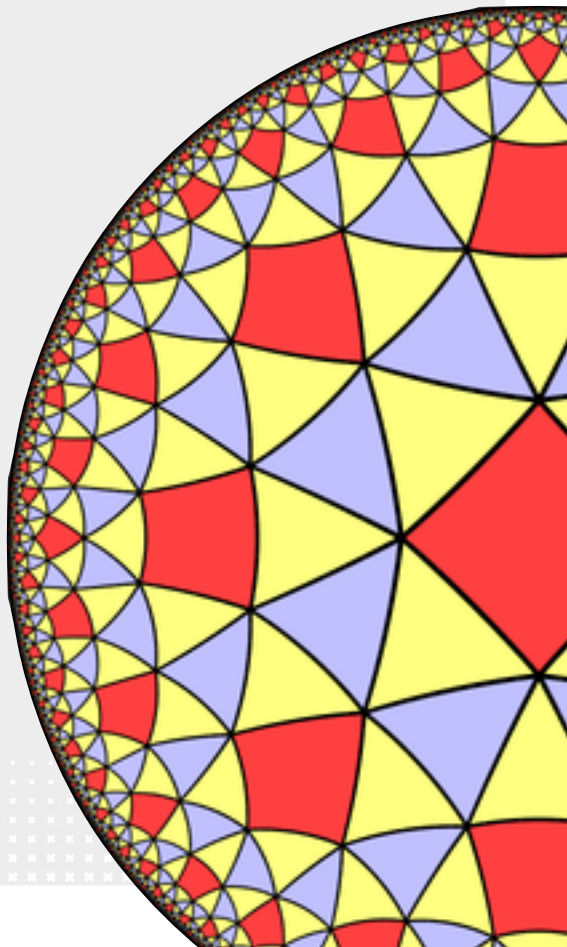
Presentations by:

- 1st year students on topics in the specialisation field
- Staff and PhD students on their research
- 2nd year students on their Master Project
- Alumni
- Potential employers

UNIVERSITY OF AMSTERDAM

Algebra, Geometry & Mathematical Physics

Guus Regts & Michael Walter

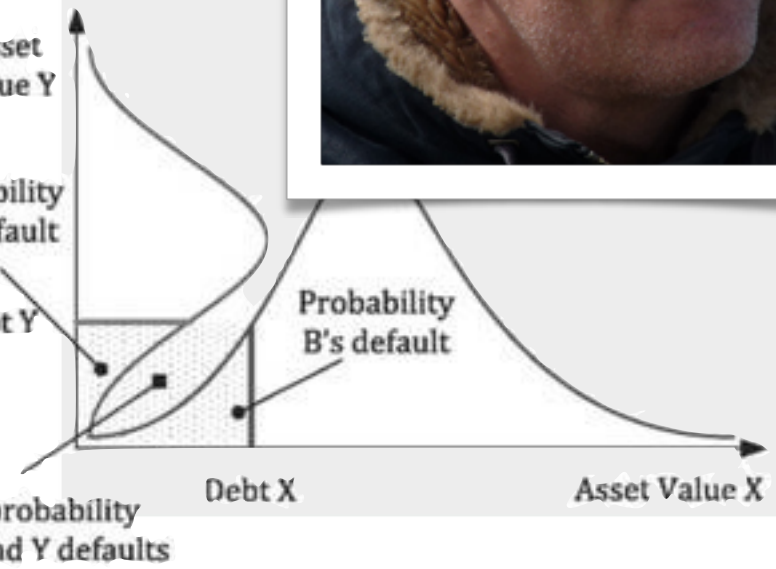


Analysis & Dynamical Systems

Han Peters & Jan Bouwe van den Berg (VU)

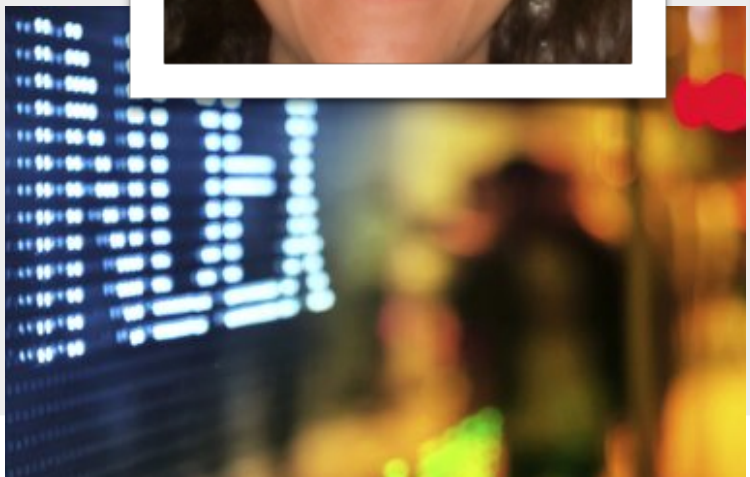
Stochastics

Bas Kleijn & Ronald Meester (VU)



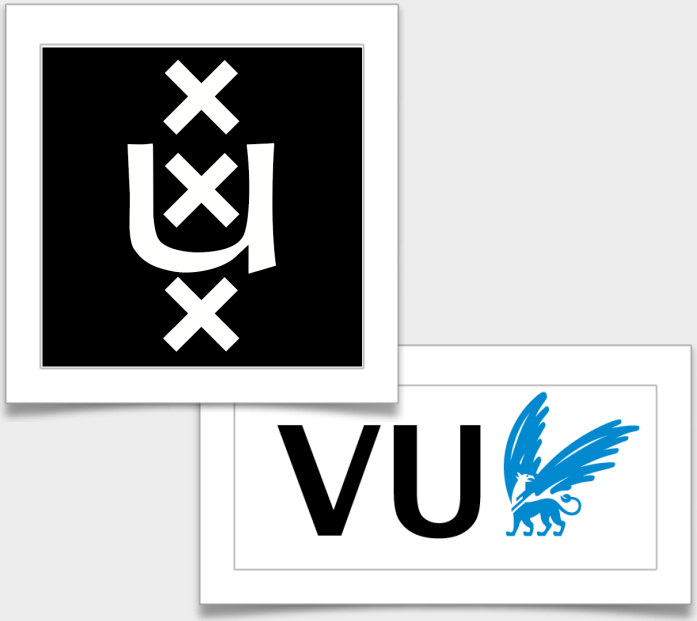
SFM

Asma Khedher & Dennis Dobler (VU)



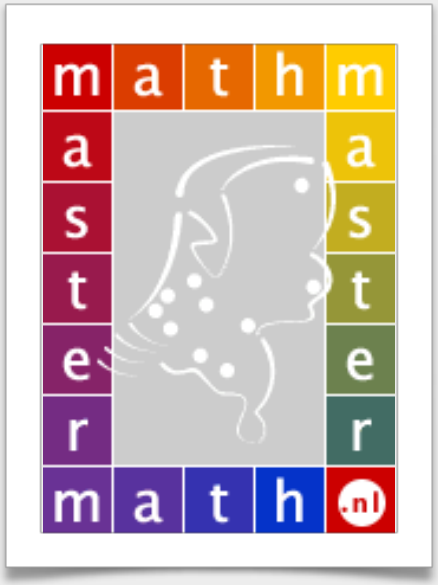
Master courses

Local courses



- at UvA or VU
- topics with local signature
- taught by leading experts

Mastermath



- mostly in Amsterdam or Utrecht
- focussed on basic subjects

Algebra & Geometry 19/20

Basic courses fall

- *Algebraic Topology* **(MM)**
- *Algebraic Geometry 1* **(MM)**
- *Quivers* **(local)**
- Lie groups **(MM)**
- *Differential Geometry* **(MM)**
- *Algebraic Number Theory* **(MM)**
- Commutative Algebra **(MM)**

Basic courses spring

- *Lie Algebras* **(MM)**
- *Riemann Surfaces* **(MM)**
- Elliptic Curves **(MM)**
- Topology in Physics **(double MSc)**
- Quantum computing **(MM)**

Advanced local courses

- Blowing Ups and Deformations: an Introduction to the Theory of Singularities
- Advanced Combinatorics: zeros of graph polynomials, Markov chains and algorithms
- Topics in Algebraic Geometry

Some typical SFM courses

Mastermath

- Measure Theoretic Probability
- Asymptotic Statistics
- Machine Learning Theory
- Stochastic Processes

Local

- Stochastic Integration
- Statistical Models (VU)
- Queues and Levy Fluctuation Theory
- Stochastic Simulation
- Advanced Machine Learning (VU)
- Summer internship

Local (fin.math.)

- Interest Rate Models
- Stochastic Processes for Finance (VU)
- Portfolio Theory
- Computational Finance

eks 2/3/4/5 2020

	time	course	level	lecturer(s)	EC
	10:00 - 12:45	Systems and Control (week 45: intensive week UT)	M1	Jan Willem Polderman (UT)	6
	13:15 - 15:00	Continuous Optimization	M1	Daniel Dadush (CWI)	6
	15.15 - 17.00	Discrete Optimization	M1	Marc Uetz (UT)	6
	10:00 - 12:45	Random Walks	M2	Daniel Valesin (RuG), Evgeny Verbitsky (RuG/UL)	8
	14:00 - 16:45	Probabilistic and Extremal Combinatorics	M1	Tobias Müller (RuG) & Ross Kang (RU)	8
	10:00 - 12:45	Category Theory and Topos Theory	M1	Benno van den Berg (ILLC)	8
	14:00 - 16:45	Set Theory	M1	K.P. Hart (TUD), Benedikt Löwe (UvA/ILLC)	8
y	10:15 - 13:00	Forensic Probability and Statistics	M1	Ronald Meester (VU), Klaas Slooten (VU), Marjan Sjerps (UvA)	8
y	14:00 - 16:45	Machine Learning Theory	M1	Peter Grünwald (CWI), Rianne de Heide (UL), Wouter Koolen (CWI)	8
y	10:15 - 13:00	Dynamical Systems	M1	Ale Jan Homburg (UvA), Bob Rink (VU)	8
y	10:15 - 13:00	Algebraic Geometry 1	M1	Martijn Kool (UU) & Lenny Taelman (UvA)	8
y	14:00 - 16:45	Mathematical Biology	M1	Bob Planque (VU), Sander Hille (UL)	8
y	14:00 - 16:45	Partial Differential Equations	M1	Joost Hulshof (VU), Hermen Jan Hupkes (LU)	8
y	14.00 - 16.45	Commutative Algebra	M1	David Holmes (UL), Arno Kret (UvA)	8
sday	10:00 - 12:45	Differential Geometry	M1	Hessel Potshuma (UvA)	8
sday	14:00 - 16:45	Algebraic Topology 1	M1	Lennart Meier (UU)	8
sday	10:00 - 12:45	Asymptotic Statistics	M1	Harry van Zanten (UvA)	8
sday	14:00 - 16:45	Measure Theoretic Probability	M1	Sonja Cox (UvA)	8
sday	10:00 - 12:45	Parallel Algorithms	M1	Rob Bisseling (UU)	8
sday	14:00 - 16:45	Numerical Linear Algebra	M1	Jan Brandts (UvA)	8
dag	18:00 - 20:45	Fundamenten (leraren)		Bas Edixhoven (UL)	6
ay	10:15 - 13:00	Functional Analysis	M1	Onno van Gaans (UL), Marcel de Jeu (UL)	8
ay	10:15 - 13:00	Poisson Geometry	M2	Marius Crainic (UU), Ioan Marcut (RU)	8
ay	14.00 - 16.45	Lie Groups	M1	Erik van den Ban (UU)	8
ay	10:15 - 13:00	Algebraic Number Theory	M1	Peter Stevenhagen (UL), Bart de Smit (UL)	8
ay	14:00 - 16:45	Advanced Algebraic Geometry	R	Bas Edixhoven (UL), Mingming Shen (UvA)	8
ay	14:00 - 16:45	Diophantine Approximation	M1	Jan-Hendrik Evertse (UL), Damaris Schindler (UU)	8
	10:00 - 12:45	Stochastiek (leraren)		Eric Cator (RU) & Cor Kraaikamp (TUD)	6
	14:00 - 16:45	Meetkunde (leraren)		Gerard Jeurnink (UT) & Jeroen Spandaw (TUD) & Hans Sterk (TU/e)	6
		Cryptology	M1	T. Lange (TU/e)	5

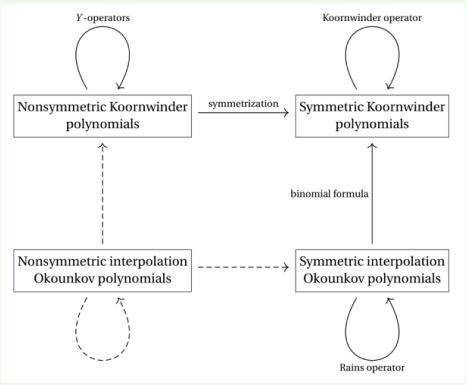
Master project (36EC)

Research Project in Mathematics on modern research topics.

- Under supervision of a staff member of the Korteweg-de Vries Institute for Mathematics.
- Obtain 6 months of research experience in mathematics.
- Possibility to combine with internship (SFM)

N. Disveld	Master programme: Mathematics		October 25th, 2017
Institute: UvA / Other	Research group: Korteweg-de Vries Institute for Mathematics	Graduation thesis	Supervisor: Jasper Stokman

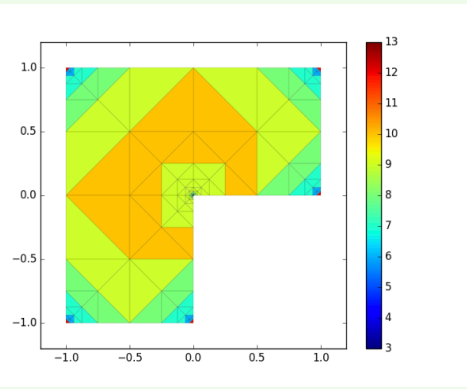
Nonsymmetric Interpolation Okounkov Polynomials
There exist (non-)symmetric interpolation polynomials that are connected to the famous (non-)symmetric Macdonald polynomials. With Laurent polynomials, the role of the (non-)symmetric Macdonald polynomials is being played by the (non-)symmetric Koornwinder polynomials. There exist symmetric interpolation Laurent polynomials that are connected to the symmetric Koornwinder polynomials, we give a new proof of this existence. Also, we give a definition of the non-symmetric interpolation Laurent polynomials that are connected to the non-symmetric Koornwinder polynomials and prove their existence.



Scientific abstract (pdf 1K) For more info or full text, mail to: j.v.stokman@uva.nl

J.H. Westerdiep	Master programme: Mathematics		June 27th, 2017
Institute: KdVI	Research group: Dynamical Systems and Numerical Analysis	Graduation thesis	Supervisor: Rob Stevenson

Two-dimensional hp-adaptive finite elements in theory and practice
Partial differential equations (PDEs) describe many processes in nature, from the flow of water to the shape of a soap bubble. Often, it is hard (or even impossible) to find the function that solves such a PDE. In such cases, one looks for numerical solutions that approximate the true solution. In this thesis, we look at a finite element method: The domain of the function is partitioned into a large number of elements—in our two-dimensional case, we will subdivide a polygon into triangular elements. Endowing each triangle with a fixed polynomial degree, our finite element method aids in finding an approximate solution to the PDE that is continuous globally, and a polynomial on each triangle locally. Given such an approximate solution, we often want to refine some of the triangles into smaller ones, so that we may construct a better solution on this refined grid. In this thesis, we analyse a novel algorithm for an even more complex case—hp-adaptive finite elements—where we allow increasing the polynomial degree on each triangle separately. We will prove that, under mild circumstances, the size of the global error will decay exponentially in the total number of degrees of freedom.



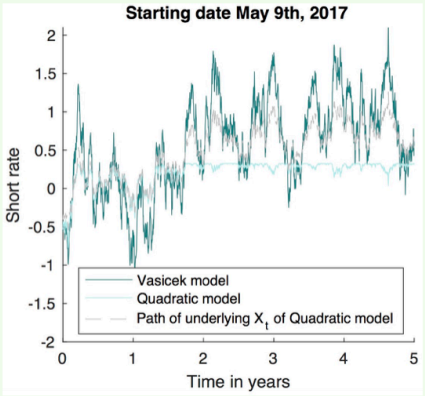
Scientific abstract (pdf 1K) For more info or full text, mail to: r.p.stevenson@uva.nl

Many examples at: Science in Progress

UNIVERSITY OF AMSTERDAM

I.S. Liesker	Master programme: Stochastics and Financial Mathematics		August 22nd, 2017
Institute: KdVI	Research group: Stochastics and Financial Mathematics	Graduation thesis	Supervisor: Peter Spreij

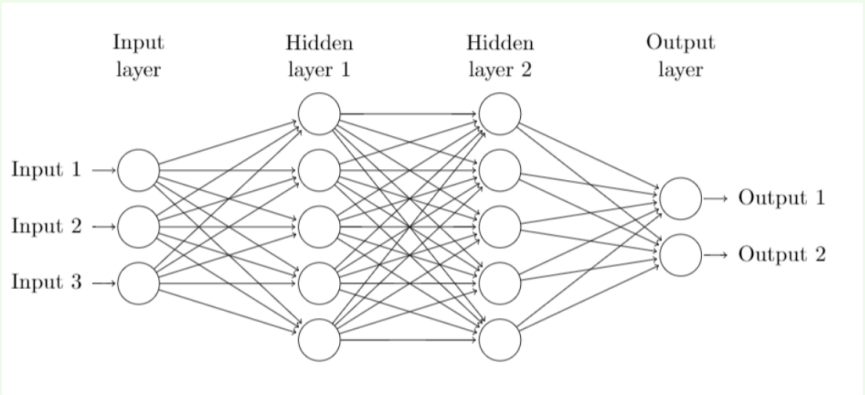
Affine and quadratic interest rate models: A theoretical and empirical comparison
In the financial world people try to speculate about the financial market. There are many variables that are unknown and that one wants to describe by, for example, stochastic models. These models help to get insight in the financial variables and are sometimes even used to predict the future development of the variable in order to do proper investments or protect themselves against risk. The latter, in form of interest rate risk modeling, is studied in this thesis. One of the popular interest rates models is the affine model. Affine models are becoming increasingly popular due to their analytical and computational tractability. Affine processes have a nice pricing formula for multiple financial products. Quadratic processes are, to some extent, an extension of affine models and have similar properties as affine models. This thesis compares these affine and quadratic models on a theoretical and an empirical level. For the theoretical level, the mathematics of affine and quadratic interest rate models is explained. For both affine and quadratic models analytical ('nice') formulas for some financial products are provided using admissible parameters and Riccati equations. Also, using the analytical bond prices, a small empirical comparison is performed where some computational examples are discussed.



Scientific abstract (pdf 1K) Full text (pdf 3861K)

R.Q. Riksen	Master programme: Stochastics and Financial Mathematics		August 22nd, 2017
Institute: KdVI	Research group: Stochastics and Financial Mathematics	Graduation thesis	Supervisor: Peter Spreij

Using Artificial Neural Networks in the Calculation of Mortgage Prepayment Risk
A client with a mortgage loan has the possibility to pay back part of his mortgage before the end of the contract. Because this poses a risk to the bank due to the loss of future interest payments, it is very important to predict the probability that a client will prepay on his mortgage. There are many parameters that can influence these mortgage prepayments in a complicated way. Artificial neural networks are used as approximators. A network consists of many connected nodes, that are grouped into layers. Each node takes a weighted sum of all the input it receives, applies a certain function to it and sends it on to all neurons in the next layer. The key to making a neural network approximate the target function, is to make it `learn' the correct weights. It gets to see a lot of input values and makes predictions. If the prediction was incorrect, all weights are changed a little in the direction that will make the network give a better prediction next time. This way, the network learns by making mistakes. In this thesis at ABN AMRO, we explore



Many examples at: Science in Progress

Master math or SFM with major or minor

Focus: mathematics in industry, society and education.

60EC major programmes:

Science in Society,
Teaching (in dutch),
Science Communication (in dutch).
Math component: 36 EC courses, 24EC master project.

30EC minor programmes:

Tesla,
Science for Sustainability.
Math component: 6EC master seminar, 60EC courses,
24EC master project.

Teaching major

Proper science education at high schools is vital for society

Obtain a first degree teaching qualification within your master programme!

Tesla minor

The Tesla minor bridges the gap between science, business and society through complex consultancy projects

Double Master
Mathematics & Theoretical Physics (180EC)

"The unreasonable effectiveness of Mathematics in the Natural Sciences" 1960 (Eugene Wigner, physicist)

"The unreasonable effectiveness of Quantum Physics in Modern Mathematics" 2014
(Robert Dijkgraaf, mathematical physicist).

Double Master
Mathematics & Theoretical Physics (180EC)

- Balanced **three-year** programme.
- **Special math-phys course**: *Topology in Physics*
- **Goal***:* become bilingual in mathematics and theoretical physics.
- **Entry requirements**: double bachelor Mathematics + Physics
- **Integrated Master Project (72EC):** advisors from Mathematics and Physics.

Double Master
Mathematics/SFM & Econometrics (150EC)

- Balanced programme in development, combining financial mathematics, data analysis and econometrics.
- **Entry requirements**: bachelor Mathematics + minor Econometrics, or bachelor econometrics + Measure Theory, Analysis 4, Topology, Functional Analysis.
- **Integrated Master Project (36EC):** advisors from Mathematics/SFM and Econometrics.

Master Mathematics: practical matters

Entry requirements: Bachelor Mathematics, Proficiency in English.

Start: February or September.

Application: via studielink.nl and datanose.

More information:
http://gss.uva.nl/content/masters/mathematics/mathematics.html

Master SFM: practical matters

Entry requirements: Proficiency in English,
Bachelor Mathematics
or
Bachelor Econometrics, including Measure Theory, Analysis 4, Topology and Functional Analysis.

Start: September.

Application: via studielink.nl and datanose.

More information:
http://gss.uva.nl/content/masters/stochastics-and-financial-mathematics/stochastics-and-financial-mathematics.html

APPLICATION & ADMISSION (sept. enroll.)

1. Check the deadlines (www.uva.nl)
   - Dutch students: **1 July**
   - EU/EEA students: **1 May**
   - Non-EU/EEA students: **1 February**

2. Register in Studielink (www.studielink.nl)

3. Receive your UvA-net ID + further instruction by email (check your spam folder)

4. Apply for the programme in Datanose **before the deadline!** Log in with your UvA-net ID and upload all necessary documents

5. The Admissions Board will consider your request

What do math & SFM alumni do?

“Math skills unlock a world of career opportunities”

Example: 24 math master students that started in 2014

6 students finished a ***different*** master programme at UvA
1 student did not finish master at UvA.
17 students finished the master Mathematics.

6: PhD student (*Netherlands, Belgium, UK*)
3: Trainee (*Nederlands investeringsinstelling, Impact Institute, Itility*)
2: Data analyst (*Marsh, McLennan)*
1: Math high school teacher **(***Ichthus Lyceum***)**
1: Teacher at Wiskunde Bijles Amsterdam
1: Associate (*HAL Investments)*
1: Systems developer (*FormsVision*)
1: Software developer (*DSW zorgverzekeraars*)
1: unknown

For more information…

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How is life as master student?

Facts or myths

- The master is fun because of the many choices.
- The master Math/SFM is more difficult compared to bachelor Mathematics.
- It is hard to finish the master.

Femke Madsen: Analysis & Dynamical Systems
Raviar Karim: Stochastics

What's next?

- Talk to people! (coordinators, students, "meeloop-dag"…)
- Talk to students Femke Madsen and Raviar Karim.
- Online course info: http://www.studiegids.uva.nl
- Get a copy of the presentation from my website https://staff.fnwi.uva.nl/j.v.stokman/