UNIVERSITY OF AMSTERDAM

Mathematics
Stochastics & Financial Mathematics

UvA Faculty of Science

Why a UvA Mathematics master?

Deepening your knowledge in pure mathematics, gearing towards mathematical research.

And/or

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

"Math skills unlock a world of career opportunities"

Master Programmes (120 EC)

- Mathematics: research variant or variant 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).**

Entry requirement math masters: bachelor Mathematics, proficiency in English.

Master mathematics (research variant)

Four specialisation directions:

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

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

Structure of the programme

- 6 EC: **Master Seminar**
- 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**

Structure of the programme

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

Master Seminar

Three local seminars, per track/subject:

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

The first link with mathematical research in Amsterdam!

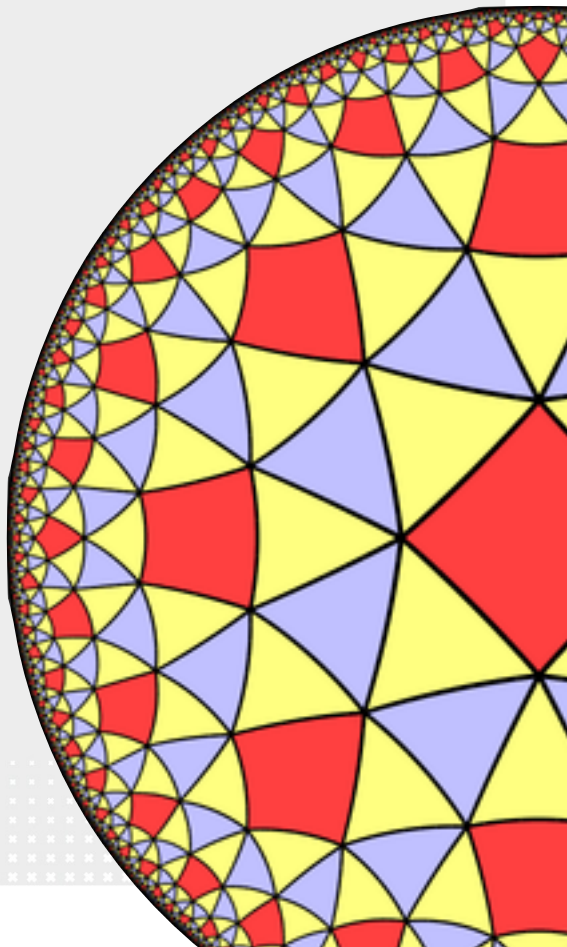
Master Seminar

Lectures by:

- 1st year students on research books or papers
- Staff and PhD students on their research
- 2nd year students on their Master Project
- Alumni
- Potential employers

Algebra, Geometry & Mathematical Physics

Guus Regts & Lenny Taelman

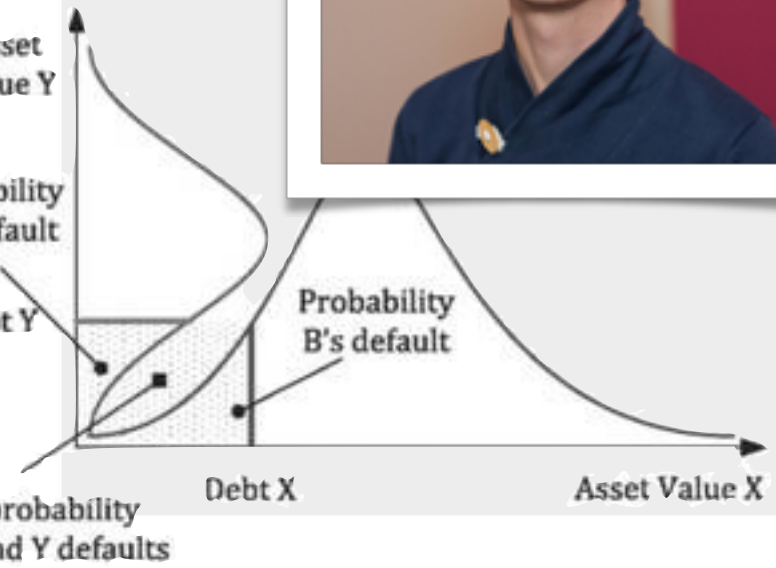


Analysis & Dynamical Systems

Han Peters & Jan Bouwe van den Berg (VU)

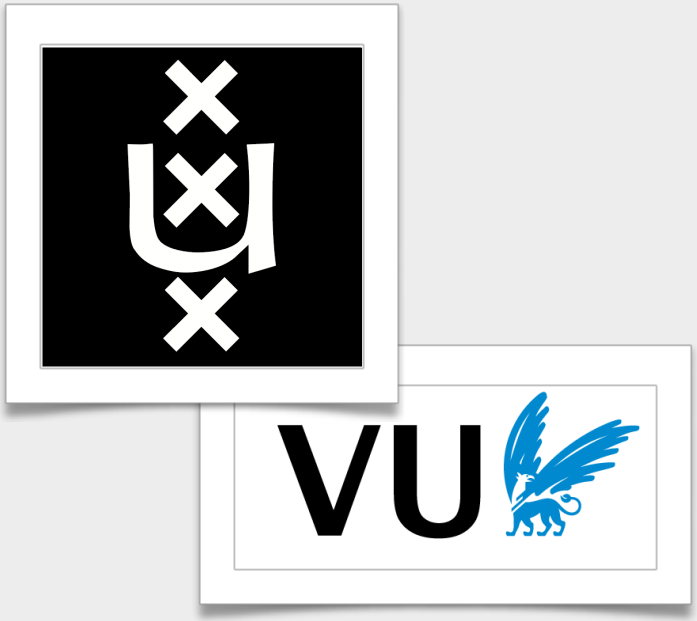
Stochastics

Arnoud den Boer & Ronald Meester (VU)



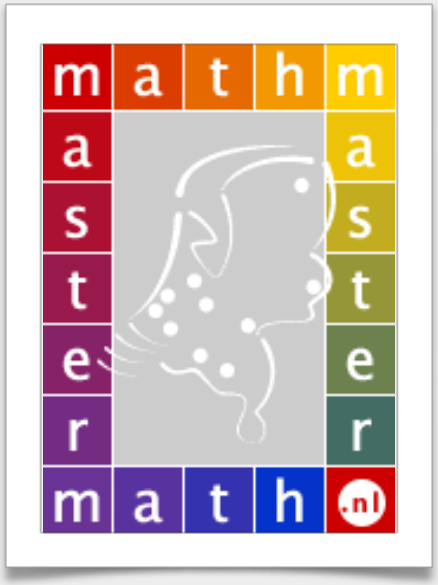
Master courses

Local courses



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

Mastermath



- mostly in Amsterdam or Utrecht
- focussed on basic subjects

Courses: Algebra & Geometry 18/19

Basic courses

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

Advanced local courses

- Mirror Symmetry **(local)**
- Topics in Number Theory **(local)**

Basic courses

- *Lie Groups and Lie Algebras* **(MM)**
- *Riemann Surfaces* **(MM)**
- Elliptic Curves **(MM)**
- Topology in Physics **(double MSc)**
- Operator Algebras **(MM)**
- *Alg. meth. in combinatorics* **(MM)**

Fall 2018 (weeks 37 - 51) Exams in weeks 2/3/4/5 2019				
provider	place	day	time	course
LNMB/4TU	UU	Monday	11:00 - 12:45	M1: Discrete Optimization
LNMB/4TU	UU	Monday	13:15 - 15:00	M1: Continuous Optimization
LNMB	UU	Monday	15:15 - 17:00	M1: Heuristic Methods in Operations Research
DISC/4TU	UU/ UT	Monday	10:00 - 12:45	M1: Systems and Control (week 45: intensive week UT)
Logica	UvA	Monday	10:00 - 12:45	M2: Topos Theory
Logica	UvA	Monday	14:00 - 16:45	M1: Set Theory
STAR	UvA	Tuesday	10:15 - 13:00	M1: Machine Learning Theory
NDNS+	VU	Tuesday	10:15 - 13:00	M1: Dynamical Systems
NDNS+	VU	Tuesday	14:00 - 16:45	M1: Partial Differential Equations
Diamant, GQT	VU	Tuesday	10:15 - 13:00	M1: Algebraic Geometry 1
Diamant, STAR	VU	Tuesday	14:00 - 16:45	M1: Ergodic Theory
Diamant, GQT	VU	Tuesday	14.00 - 16.45	M1: Commutative Algebra
GQT	UU	Wednesday	10:15 - 13:00	M1: Differential Geometry
GQT	UU	Wednesday	14:00 - 16:45	M1: Algebraic Topology 1
STAR	TUD	Wednesday	10:15 - 13:00	M2: Interacting Particle Systems: Theory and Applications
STAR	UvA	Wednesday	10:00 - 12:45	M1: Asymptotic Statistics
STAR	UvA	Wednesday	14:00 - 16:45	M1: Measure Theoretic Probability
Num. Wisk.	UU	Wednesday	10:00 - 12:45	M1: Parallel Algorithms
Num. Wisk.	UU	Wednesday	14:00 - 16:45	M1: Numerical Linear Algebra
Leraren	UU	Woensdag	18:00 - 20:45	Fundamenten (leraren)
NDNS+/GQT	VU	Thursday	10:15 - 13:00	M1: Functional Analysis
GQT	VU	Thursday	14.00 - 16.45	M2: Symmetries and conservation laws of nonlinear PDE
Diamant	VU	Thursday	10:15 – 13:00	M1: Algebraic Number Theory
Multi	VU	Thursday	10:15 - 13:00	M1: Forensic Probability and Statistics
Diamant/GQT	VU	Thursday	14:00 - 16:45	R: Advanced Algebraic Geometry: Abelian Varieties
Diamant	VU	Thursday	14:00 - 16:45	M1: Analytic Number Theory
Diamant	UU	Friday	10:00 - 12:45	M1: p-Adic numbers
Diamant	UU	Friday	14:00 - 16:45	M1: Probabilistic and Extremal Combinatorics
Leraren	UU	Vrijdag	10:00 - 12:45	Stochastiek (leraren)
Leraren	UU	Vrijdag	14:00 - 16:45	Meetkunde (leraren)
Diamant	online			M1: Cryptology

Local course: TFT and Moduli Spaces

- Sergey Shadrin (UvA)
- **Algebra & Geometry, Mathematical Physics**

Local course: Finite Element Methods for Partial Differential Equations

- Rob Stevenson (UvA)
- **Analysis & Dynamical Systems**

Local course: Queues and Levy Fluctuation Theory

- Michel Mandjes (UvA)
- **Stochastics** & **SFM**

Master project (36EC)

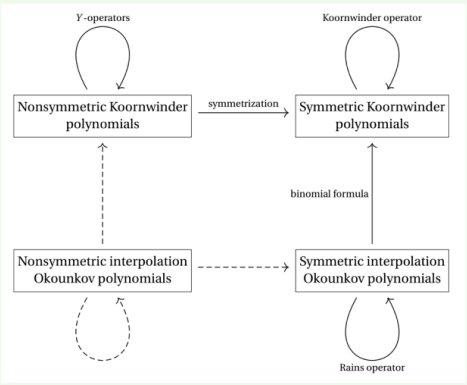
Individual literature study in mathematics often relating to open math research problems.

* Under supervision of a staff member of the Korteweg-de Vries Institute for Mathematics.
* Possibility to combine with internships (master SFM).

The second link with mathematical research in Amsterdam!

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

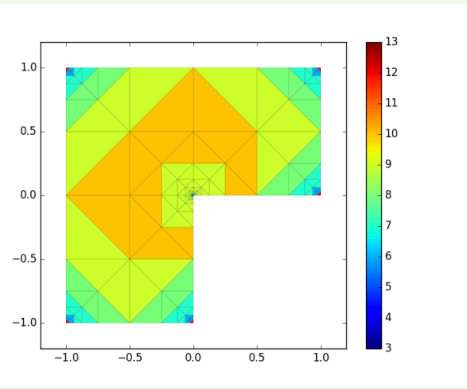
Nonsymmetric Interpolation Okounkov Polynomials
There exist (non-)symmetric interpolation polynomials that are connected to the famous (non-)symmetric Macdonald polynomials. With Laurent polynomials, the role of the (non-)symmetric Macdonald polynomials is being played by the (non-)symmetric Koornwinder 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

Master Stochastics & Financial Mathematics (SFM)

Focus: Stochastics and its applications in Financial Mathematics.

Structure: similar as the research variant of the master Mathematics, with following characteristic features:

* Seminar SFM in first semester of first year.
* Significantly more local UvA/VU courses.
* Many international students.
* Possibility to do summer internships.
* Master projects often combined with internships (banks, consultancy agencies, insurance companies).

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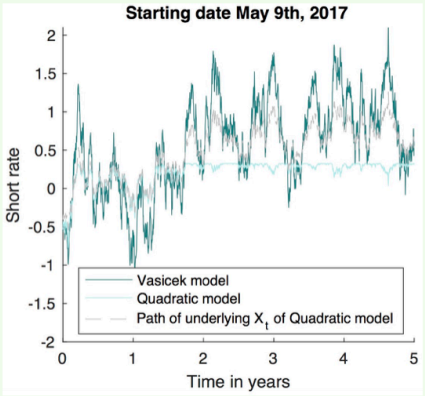
I.S. Liesker	Master programme: Stochastics and Financial Mathematics		August 22nd, 2017
Institute: KdVI	Research group: Stochastics and Financial Mathematics	Graduation thesis	Supervisor: Peter Spreij

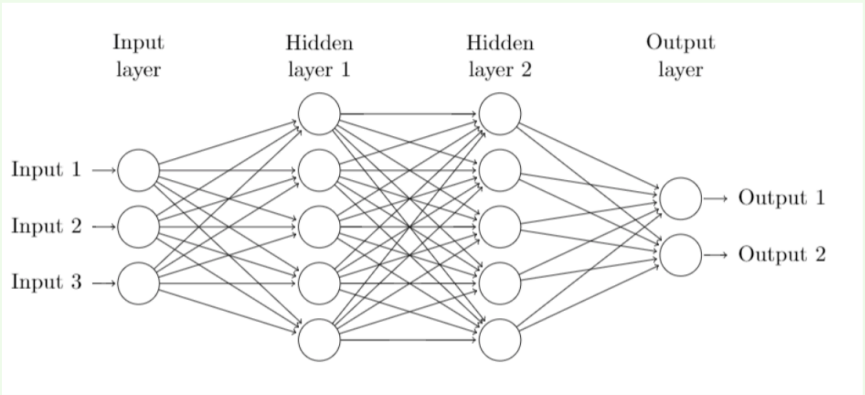
Affine and quadratic interest rate models: A theoretical and empirical comparison
In the financial world people try to speculate about the financial market. There are many variables that are unknown and that one wants to describe by, for example, stochastic models. These models help to get insight in 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 our future"

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 joint 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 stochastics/financial mathematics with 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

7 students finished a ***different*** master programme
1 student stopped before finishing.
16 students finished the master successfully.

5: University (*Netherlands,UK*)
1: High school (*Ichthus Lyceum*)
1: Consultancy companies (*FormsVision*)
2: Investment companies (*NLII, HAL Investments*)
1: Insurance company (DSW *insurances*)
2: Data analytics (*Marsh, True Price*)
3: recently finished the master
1: unknown

For more information…

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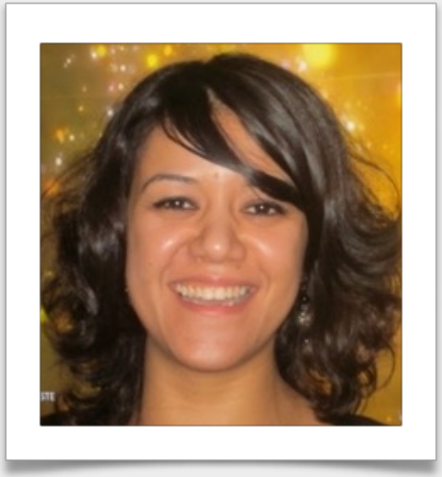

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Facts or myths?

* Master Math/SFM is much more difficult compared to bachelor Mathematics.
* The master mathematics programme is only geared to mathematical research.
* As a master math/SFM student you drawn in all the choices.
* All Dutch master mathematics programmes are the same due to mastermath.

What's next?

- Talk to people! (coordinators, students, …)
- Talk to students Gideon Jager and David de Boer on the Information Market.
- 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/