Stochastics and Financial Mathematics MSc

Vrije Universiteit Amsterdam - Faculteit der Exacte Wetenschappen - M Stochastics and Financial Mathematics - 2017-2018

The field of Stochastics covers the areas of science that are concerned with processes in which chance plays a central role.

Usually the field is subdivided into Statistics, Probability Theory and Stochastic Operations Research. Financial Mathematics is an important field of applications of stochastics. The mathematical point of view for questions in finance has its own virtue and is an interesting subject of research. In view of the relevance of the numerous areas of research in which stochastics is applied, and in view of the reach of these areas of research and their challenging theoretical problems, this master offers a broad spectrum of possible specializations. The theoretically inclined, as well as the more applied master student, will have the possibility to choose a program adapted to his/her personal interests.

The Korteweg-de Vries Institute for Mathematics (UvA) and the Department of Mathematics (VU) of the two universities in Amsterdam, and the Mathematical Institute of the University of Utrecht (UU) have joined forces to offer this two year master in Stochastics and Financial Mathematics. The program offers the possibility to specialize in Statistics, Probability Theory, Financial Mathematics or Stochastic Operations Research.

More information

Inhoudsopgave

M SFM constrained choice

Each student has to choose 67 European credits (EC) optional courses.

• at least 12 EC (at least two out of four) from the Financial Mathematics courses:
- Computational Finance (XMU_418045, 6 EC)
- Interest Rate Models (X_418091, 6 EC)
- Portfolio Theory (X_400535, 6 EC)
- Stochastic Processes for Finance (X_400352, 6 EC)

• at least 12 EC (at least two out of eight) from the Advanced SFM list:
- Discrete Choice Analysis: Theory and Application (XMM_0014, 8 EC)
- Interest Rate Models (X_418091, 6 EC)
- Percolation: from Introduction to Frontiers of Current Research (XMM_0012, 8 EC)
- Portfolio Theory (X_400535, 6 EC)
- Queues and Levy Fluctuation Theory (XMU_0002, 6 EC)
- Statistical Theory for High- and Infinite-Dimensional Models (XMM_0008, 8 EC)
- Statistics for High-Dimensional Data (X_405113, 6 EC)
- Statistics for Networks (X_405110, 6 EC) (2018-2019)

• the rest of the 120 EC can be chosen from the list of suggested courses below:

Vakken:

Naam	Periode	Credits	Code
Applied Analysis: Financial Mathematics	Periode 1+2	6.0	X_400076
Applied Stochastic Modeling	Periode 1+2	6.0	X_400392
Asymptotic Statistics	Periode 1+2	8.0	X_400323
Computational Finance	Periode 4	6.0	XMU_418045
Functional Analysis	Periode 1+2	8.0	X_400328
Interest Rate Models	Periode 1+2	6.0	X_418091
Optimization of Business Processes	Periode 4+5	6.0	X_400422
Partial Differential Equations	Periode 1+2	8.0	X_400330
Portfolio Theory	Periode 1+2	6.0	X_400535
Queueing Theory	Periode 4+5	6.0	X_400397
Queues and Levy Fluctuation Theory	Periode 4+5	6.0	XMU_0002
Simulation Methods in Statistics	Periode 1+2	6.0	X_400258
Statistical Models	Periode 1+2	6.0	X_400418
Statistical Theory for High- and Infinite-Dimensional Statistics	Periode 4+5	8.0	XMM_0008
Statistics for High-Dimensional Data	Periode 4+5	6.0	X_405113

Statistics for Networks		6.0	X_405110
Stochastic Differential Equations	Periode 4+5	6.0	X_400454
Stochastic Integration	Periode 4+5	8.0	X_400470
Stochastic Optimization	Periode 1+2	6.0	X_400336
Stochastic Processes	Periode 4+5	8.0	X_400339
Stochastic Processes for Finance	Periode 1+2	6.0	X_400352
Time series	Periode 4+5	8.0	X_400571

M Stochastics and Financial Mathematics constrained choice Financial Mathematics (at least 2 out of 4)

Vakken:

Naam	Periode	Credits	Code
Computational Finance	Periode 4	6.0	XMU_418045
Interest Rate Models	Periode 1+2	6.0	X_418091
Portfolio Theory	Periode 1+2	6.0	X_400535
Stochastic Processes for Finance	Periode 1+2	6.0	X_400352

M Stochastics and Financial Mathematics constrained choice Advanced Stochastics and Financial Mathematics (at least 2 out of 7)

Vakken:

Naam	Periode	Credits	Code
Interest Rate Models	Periode 1+2	6.0	X_418091
Percolation: from Introduction to Frontiers of Current Research	Periode 4+5	8.0	XMM_0012
Portfolio Theory	Periode 1+2	6.0	X_400535
Queues and Levy Fluctuation Theory	Periode 4+5	6.0	XMU_0002
Statistical Theory for High- and Infinite-Dimensional Statistics	Periode 4+5	8.0	XMM_0008
Statistics for High-Dimensional Data	Periode 4+5	6.0	X_405113
Statistics for Networks		6.0	X_405110

M Stochastics and Financial Mathematics compulsory courses

Compulsory courses (53 EC):

Vakken:

Naam	Periode	Credits	Code
Master Project Stochastics and Financial Mathematics	Ac. Jaar (september)	36.0	XM_400502
Master Seminar in Stochastics	Periode 1+2, Periode 4+5	6.0	XM_41011
Measure Theoretical Probability	Periode 1+2	8.0	X_400244
Scientific Writing in English	Periode 4	3.0	X_400512

Applied Analysis: Financial Mathematics

Vakcode	X_400076 (400076)
Periode	Periode 1+2
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. A.C.M. Ran
Examinator	prof. dr. A.C.M. Ran
Docent(en)	prof. dr. A.C.M. Ran
Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak
The course aims to introduce the student to several aspects of the mathematical theory of option pricing.

Inhoud vak
This course gives an introduction to financial mathematics.
The following subjects will be treated:
- introduction in the theory of options;
- the binomial method;
- introduction to partial differential equations;
- the heat equation;
- the Black-Scholes formula and applications;
- introduction to numerical methods, approximating the price of an (American) option.

Onderwijsvorm
Lectures, exercises, discussion of exercises.

Toetsvorm
Homework exercises and final examination

Literatuur
The Mathematics of Financial Derivatives, A Student Introduction, by Paul Wilmott, Sam Howison, Jeff Dewynne. Cambridge University Press.

In addition, lecture notes will be made available for several topics

which are not treated in the book.

Aanbevolen voorkennis
Calculus and Linear Algebra

Doelgroep
3W, mMath, mBA, 3Ect

Applied Stochastic Modeling

Vakcode	X_400392 (400392)
Periode	Periode 1+2
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. R. Bekker
Examinator	dr. R. Bekker
Docent(en)	dr. R. Bekker
Lesmethode(n)	Hoorcollege, Werkcollege
Niveau	400

Doel vak
During this course you will get acquainted with the most often used stochastic models and how they are applied in practice. The emphasis is on the variety of stochastic models (and their analysis) that appear in practice, rather than an in-depth study of a single-class of models.
During the course you learn to handle such practically motivated problems as an independent researcher; this means that you:
- learn to determine the appropriate model
- are able to formulate the problem mathematically correct
- are able to solve the stochastic model
- know how to interpret the outcome.

Inhoud vak
This course deals with a number of stochastic modeling techniques that are often used in practice. They are motivated by showing the business context in which they are used. Topics we deal with are: time-dependent Poisson processes and infinite-server queues, renewal processes and simulation, birth-death-processes, basic queueing models, and inventory models. We also repeat and extend certain parts of probability theory.

Onderwijsvorm
Lecture and instruction.

Toetsvorm
Written examination and two hand-in assignments (one in each period).

Literatuur
Lecture notes of Ger Koole (made available via Canvas).
Recommended: H.C. Tijms, A First Course in Stochastic Models, 2003. This is available as e-book via the VU library (ubvu), free of charge.
Additional material will be announced in due time.

Aanbevolen voorkennis

Probability theory, Poisson process, Markov chains in continuous time

Doelgroep
mBA, mMath

Asymptotic Statistics

Vakcode	X_400323 (400323)
Periode	Periode 1+2
Credits	8.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Niveau	500

Inhoud vak
This course is part of the joint national master programme in mathematics. For schedules, course locations and course descriptions see https://elo.mastermath.nl. Registration is required via https://elo.mastermath.nl/login

Doelgroep
mMath

Intekenprocedure
You have to register your participation in each Mastermath course via https://elo.mastermath.nl/login
Registration is mandatory and absolutely necessary for transferring your grades from Mastermath to the administration of your university.

Computational Finance

Vakcode	XMU_418045 ()
Periode	Periode 4
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Lesmethode(n)	Hoorcollege
Niveau	400

Inhoud vak
http://studiegids.uva.nl/xmlpages/page/2017-2018/zoek-vak/vak/32277

Doelgroep
mSFM

Overige informatie
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Functional Analysis

Vakcode	X_400328 (400328)
Periode	Periode 1+2
Credits	8.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. B.W. Rink
Lesmethode(n)	Hoorcollege
Niveau	500

Inhoud vak
This course is part of the joint national master programme in mathematics.
For schedules, course locations and course descriptions see https://elo.mastermath.nl.

Doelgroep
mMath

Intekenprocedure
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Interest Rate Models

Vakcode	X_418091 ()
Periode	Periode 1+2
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Docent(en)	prof. dr. G.J.B. van den Berg
Lesmethode(n)	Hoorcollege
Niveau	500

Inhoud vak
http://studiegids.uva.nl/xmlpages/page/2017-2018/zoek-vak/vak/37723

Doelgroep
mSFM, mMath

Intekenprocedure
Registration is required via https://www.sis.uva.nl during the registration term before the start of the semester.

Master Project Stochastics and Financial Mathematics

Vakcode	XM_400502 (400502)
Periode	Ac. Jaar (september)
Credits	36.0
Voertaal	Engels

Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. C.M. Quant
Examinator	dr. C.M. Quant
Niveau	600

Doel vak
The objectives of the master project are:
- to explore a research problem in the area of Stochastics and/or Financial Mathematics, or to distill such a mathematical problem formulation from the context of the host organisation.
- to study relevant papers from the (mathematical) literature, to combine those, and to add an original contribution.
- to put the results and conclusions in proper perspective, also in relation to results obtained by others.
- to present the research both in writing and in an oral presentation.

Inhoud vak
The Master's programme is concluded by an internal or external master project.

An external project ("internship") is carried out within a business, industry or research facility other than the departments of Mathematics.

For an internal research project, the student starts by identifying a research topic in consultation with his/her supervisor. This leads to a research plan, which is recorded in the 'master project planner' and a copy is given to the master
coordinator. The planner can be found in VUnet (search for 'assesment form') The project itself usually starts with a literature study, leads towards the boundaries of mathematical knowledge, and ideally culminates in original research by the student. The work is carried out by the student individually, while there are weekly or biweekly meetings with the supervisor to discuss progress and scientific questions. The work is presented in a master thesis, an interim presentation in the master seminar of your track and in a final presentation (mandatory).

Onderwijsvorm
Either the student performs individual research or the student is an intern at a host organization.

Toetsvorm
Assessment is based on attitude and execution (35%), the written master thesis (50%), the interim presentation in the master seminar (5%) and the final presentation (10%)
The form used for the assessment of a master project can be found in VUnet (search for 'assessment form')

Literatuur
assigned individually

Vereiste voorkennis
78 EC of the master program need to be completed before starting the final project

Doelgroep
mSFM

Overige informatie
If you are planning to start your external project within four months,
please make an appointment with Annemieke van Goor (vangoor@few.vu.nl)
at the Internship Office. Additional information can be found at

http://www.few.vu.nl/en/current-students/internship-office-for-mathemati

Master Seminar in Stochastics

Vakcode	XM_41011 ()
Periode	Periode 1+2, Periode 4+5
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. R.W.J. Meester
Examinator	prof. dr. R.W.J. Meester
Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak
The aim of this course is to learn to read papers at a research level, organize the material for a seminar talk, and practice presentation skills for such talk, as well as to learn to constructively participate in a research seminar. The Master Seminar is intended for first-year master students. It replaces the course "Seminar Mathematics" of preceding years.

Inhoud vak
The Master Seminar consists of lectures on a broad range of research topics in Stochastics.
There will be three types of lectures:
- by the participating first-year students on research literature (students will have a choice from a list, or can propose their own sources);
- by staff members and PhD students in Amsterdam on topics closely related to their research;
- by second-year students on their ongoing master projects.

Throughout the year, the students will have the opportunity to propose topics and speakers to invite at the Master Seminar.

Onderwijsvorm
Lecture, seminar, self-study

Toetsvorm
Attendance is compulsory. The course will be graded based on the presentations of the students, and their attendance and active participation. There will be no opportunity for a resit exam for this course.

Aanbevolen voorkennis
Good overall knowledge of various fields of stochastics.

Doelgroep
mMath, mSFM

Overige informatie
Lecturers: dr. E.N. Belitser, dr. A.V. den Boer
In the fall semester, this seminar takes place at the UvA; in the spring semester it is hosted at the VU.

Measure Theoretical Probability

Vakcode	X_400244 (400244)
Periode	Periode 1+2
Credits	8.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Lesmethode(n)	Hoorcollege
Niveau	400

Inhoud vak
This course is part of the joint national master programme in mathematics.
For schedules, course locations and course descriptions see http:/www.mastermath.nl.
Registration required via http:/www.mastermath.nl.

Doelgroep
mMath, mSFM

Intekenprocedure
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Optimization of Business Processes

Vakcode	X_400422 (400422)
Periode	Periode 4+5
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. G.M. Koole
Examinator	prof. dr. G.M. Koole
Docent(en)	prof. dr. G.M. Koole
Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak
To learn about applications of stochastic operations research in the context of a number of important application areas, especially manufacturing and services.

Inhoud vak
We deal with a number of application areas of stochastic modeling: production logistics, call centers, health care and revenue management. For each area we present quantitative problems and discuss how they can be solved using mathematical models. We also discuss a number of new models. Several guest lectures are given by people from industry.

Onderwijsvorm
Lectures and practical work.

Toetsvorm
Written examination, individual assignments, and a book presentation.

Literatuur
Lecture notes.

Aanbevolen voorkennis
Applied Stochastic Modeling or equivalent knowledge

Doelgroep
mBA, mBA-D, mMath

Overige informatie
Attendance mandatory.

Partial Differential Equations

Vakcode	X_400330 (400330)
Periode	Periode 1+2
Credits	8.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. J. Hulshof
Examinator	prof. dr. J. Hulshof
Docent(en)	prof. dr. J. Hulshof
Lesmethode(n)	Hoorcollege
Niveau	500

Inhoud vak
This course is part of the joint national master programme in mathematics.
For schedules, course locations and course descriptions see http://www.mastermath.nl.
Registration required via http://www.mastermath.nl.

Doelgroep
mMath

Intekenprocedure
You have to register your participation in each Mastermath course via http://www.mastermath.nl/registration/
Registration is mandatory and absolutely necessary for transferring your grades from Mastermath to the administration of your university.

Percolation: from Introduction to Frontiers of Current Research

Vakcode	XMM_0012 ()
Periode	Periode 4+5
Credits	8.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. A.C.M. Ran
Lesmethode(n)	Hoorcollege, Werkcollege
Niveau	500

Doel vak
To give an introduction to percolation theory, and study some of the newest developments.

Inhoud vak
Percolation theory deals with the connectivity properties of large, possibly infinite, networks (for instance a hexagonal lattice) from which a certain fraction q of the nodes or bonds is randomly removed. It is inspired by phenomena in physics and life sciences, but has become a mathematical topic of independent interest. It provides one of the mathematically most elegant examples of critical behaviour: there is a critical value of the parameter q at which the global properties of the system change drastically.

The first part of the course gives a general introduction and treats several classical results, in particular the uniqueness of the infinte cluster (in any dimension) and a proof that the critical probability for bond percolation on the square lattice is 1/2. Then we turn to more recent exciting developments, which started around 2000 and where work by Fields medalist Stanislav Smirnov on conformal invariance plays a key role. Finally we discuss current research and open problems, including the question of absence of percolation at the critical point. This is known for dimension 2 and for sufficiently high dimensions. For other dimensions (e.g. 3) this is one of the biggest current open problems.

Onderwijsvorm
Lecture

Toetsvorm
Written exam

Literatuur
Some chapters from the book "Probability on graphs" by Geoffrey Grimmett (Cambridge University Press, 2010). Further I will use (and provide) lecture notes, and some material which is freely available from the internet.

Vereiste voorkennis
Basic knowledge of probability and analysis. Some knowledge of conformal maps
is useful in the second half of the course, nut not necessary (what we use will be introduced and explained).

Aanbevolen voorkennis
Basic knowledge of probability and analysis. Some knowledge of conformal maps
is useful in the second half of the course, nut not necessary (what we use will be introduced and explained).

Doelgroep
mMath, Master Mathematics, Master SfM.

Intekenprocedure
https://elo.mastermath.nl/login/

Portfolio Theory

Vakcode	X_400535 (400535)
Periode	Periode 1+2
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Niveau	500

Inhoud vak
http://studiegids.uva.nl/xmlpages/page/2017-2018/zoek-vak/vak/34857

Doelgroep
mSFM, mMath

Overige informatie
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Queueing Theory

Vakcode	X_400397 (400397)
Periode	Periode 4+5
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. B.W. Rink
Examinator	prof. dr. B.W. Rink
Niveau	400

Inhoud vak
This course is part of the joint national master programme in Mathematics.
For schedules, course locations and course descriptions see https://elo.mastermath.nl/

Doelgroep

mMath

Intekenprocedure
You have to register your participation in each Mastermath course via https://elo.mastermath.nl/
Registration is mandatory and absolutely necessary for transferring your grades from Mastermath to the administration of your univesity.

Queues and Levy Fluctuation Theory

Vakcode	XMU_0002 ()
Periode	Periode 4+5
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen

Inhoud vak
http://studiegids.uva.nl/xmlpages/page/2017-2018/zoek-vak/vak/40282

Overige informatie
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Scientific Writing in English

Vakcode	X_400512 ()
Periode	Periode 4
Credits	3.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	M. van den Hoorn
Examinator	M. van den Hoorn
Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak
The aim of this course is to provide Master's students with the essential linguistic know-how for writing a scientific article in English that is well organized, idiomatically and stylistically appropriate and grammatically correct.
At the end of the course students
- know how to structure a scientific article;
- know what the information elements are in parts of their scientific article;
- know how to produce clear and well-structured texts on complex subjects;
- know how to cite sources effectively;
- know how to write well-structured and coherent paragraphs;
- know how to construct effective sentences;
- know what collocations are and how to use them appropriately;
- know how to adopt the right style (formal style, cohesive style,

conciseness, hedging)
know how to avoid the pitfalls of English grammar;
know how to use punctuation marks correctly;
know what their own strengths and weaknesses are in writing;
know how to give effective peer feedback.

Final texts may contain occasional spelling, grammatical or word choice errors, but these will not distract from the general effectiveness of the text.

Inhoud vak
The course will start with a general introduction to scientific writing in English. Taking a top-down approach, we will then analyse the structure of a scientific article in more detail. As we examine each section of an article, we will peel back the layers and discover how paragraphs are structured, what tools are available to ensure coherence within and among paragraphs, how to write effective and grammatically correct sentences and how to choose words carefully and use them effectively.

Topics addressed during the course include the following:
Structuring a scientific article
Considering reading strategies: who is your readership? How do they read your text? What do they expect? How does that affect your writing?
Writing well-structured and coherent paragraphs
Composing effective sentences (sophisticated word order, information distribution).
Arguing convincingly – avoiding logical fallacies
Academic tone and style: hedging – why, how, where?
Using the passive effectively
Understanding grammar (tenses, word order, etc.)
Understanding punctuation
Referring to sources: summarising, paraphrasing, quoting (how and when?)
Avoiding plagiarism
Vocabulary development: using appropriate vocabulary and collocations

Onderwijsvorm
Scientific Writing in English is an eight-week course and consists of 2 contact hours a week. Students are required to spend at least 6 to 8 hours of homework per week. They will work through a phased series of exercises that conclude with the requirement to write several text parts (Introduction, Methods, Discussion and Abstract). Feedback on the writing assignments is given by the course teacher and by peers.

Toetsvorm
Students will receive the three course credits when they meet the following requirements:
Students hand in three writing assignments (Introduction, Methods, Discussion)
Students get a pass mark for all writing assignments;
Students provide elaborate peer feedback (Introduction, Methods, Discussion, Abstract);
Students attend at least 7 out of 8 sessions;
Students are well prepared for each session (i.e. do all homework assignments);
Students participate actively in class;
Students do not plagiarise or self-plagiarise.

Writing assignments:
1. If students have a BSc thesis in a traditional thesis form (e.g., 20+ pages) and written in English, they may use this for the writing assignments.
2. If students have a BSc thesis in a traditional form (e.g., 20+ pages) written in another language than English, they may use this for the writing assignments.
3. If students have written a paper or report in English that's not already in article form, they may use this for the writing assignment.
4. If students are working on their MSc thesis or internship report when taking Scientific Writing in English, they may use this for the writing assignments. They will have to notify their supervisor to make sure that they won't be accused of self-plagiarism.
5. If students cannot or do not wish to use any of the above-mentioned texts for the writing assignments (1-4), they are expected to do a limited Literature Review on a topic in their field of research, using at least 5 articles.

Students are not allowed to use the following texts for the writing assignments:
1. A BSc thesis written in English that's already in article form.
2. A MSc thesis written in English that's already in article form (and that has already been marked).
3. An internship report written in English that's already in article form (and that has already been marked).
4. A paper or report written in English that's already in article form.

Literatuur
Effective Scientific Writing: An Advanced Learner's guide to Better English, 4th edition (February 2016) (A. Bolt & W. Bruins, ISBN 978 90 8659 617 1). VU bookstore: €27.95.

Doelgroep
This course is only open to students of the two-year Master's programmes of the Faculty of Sciences. These students are only eligible to the course if they have already conducted scientific research (e.g. for their Bachelor's thesis) or if they will be working on a research project when taking Scientific Writing in English.

Overige informatie
- To do well, students are expected to attend all lessons. Group schedules are to be found at rooster.vu.nl and on Canvas.
- A VUnet registration for this course automatically gives access to the corresponding Canvas site. Group registration only takes place via Canvas (general groups: registration by students following FALW programmes offering this course; groups assigned to specific studies: registration through programme and course coordinator).
- Make sure Scientific Writing in English does not overlap with another course.
- If you have registered for a group in Canvas, you are expected to attend all sessions (eight). If you decide to withdraw from the course, do so in time in VUnet. This will avoid a 'fail' on your grade list for not taking part in this course and allows other students to fill in a possible very wanted group spot.
- For specific Canvas matters concerning this course, please contact canvas.beta@vu.nl.
- Full time students with their main registration at VU will be given preferential treatment for placement in this course. For secondary

students proof of enrollment is not a guarantee of placement.

Simulation Methods in Statistics

Vakcode	X_400258 (400258)
Periode	Periode 1+2
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Niveau	400

Inhoud vak
http://studiegids.uva.nl/xmlpages/page/2017-2018/zoek-vak/vak/31393

Doelgroep
mMath, mSFM

Overige informatie
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Statistical Models

Vakcode	X_400418 (400418)
Periode	Periode 1+2
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. E.N. Belitser
Examinator	dr. E.N. Belitser
Docent(en)	dr. E.N. Belitser
Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak
The goals of this course are to get acquainted with some of the most commonly used statistical models, to learn how to apply these models in valid settings, and to understand the basic theory behind these models.

Inhoud vak
Analysis of Variance, Generalized Linear Models, Non-linear Models, Time Series.

Onderwijsvorm
Lectures and tutorials.

Toetsvorm
Assignments and examination.

Literatuur
Lecture notes "Statistical Models" by M.C.M. de Gunst.

Vereiste voorkennis
Statistics course.

Aanbevolen voorkennis
Linear Algebra, Probability Theory and Statistics. Statistical Data Analysis (X_401029)

Doelgroep
mBA, mBA-D, mMath

Overige informatie
Students will use statistical package R (www.r-project.org/) for data analysis.

Statistical Theory for High- and Infinite-Dimensional Statistics

Vakcode	XMM_0008 ()
Periode	Periode 4+5
Credits	8.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. A.C.M. Ran
Lesmethode(n)	Hoorcollege, Werkcollege
Niveau	500

Inhoud vak
This course is part of the joint national master programme in mathematics.
For schedules, course locations and course descriptions see https://elo.mastermath.nl.
Registration required via https://elo.mastermath.nl/login/.

Doelgroep
mMath

Intekenprocedure
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Statistics for High-Dimensional Data

Vakcode	X_405113 ()
Periode	Periode 4+5
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. M. van de Wiel
Examinator	dr. M. van de Wiel

Docent(en)	dr. M. van de Wiel
Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak
Teaching students the adjustments to classical statistical methodology, necessary to tackle high-dimensional data.

Inhoud vak
This course gives an overview of statistical methods that are used for analyzing high-dimensional data sets in which many variables (often thousands) have been measured for a limited number of subjects. This type of data arises in genomics, where genetic information is measured for many thousands of genes simultaneously, in functional MRI imaging of the brain, and also in economic applications. The course covers some of the most important statistical issues for high-dimensional data, including: a) initial processing of the data; b) model-based statistical inference for Gaussian and count data (classical and Bayesian methods); c) multiple testing (family-wise error rate and false discovery rate control); d) prediction of binary endpoints (e.g. recurrence of a tumor) and survival; e) clustering of samples (e.g. to find tumor subtypes). Several specific types of high-dimensional data will be discussed and used during the course. In terms of applications the course focuses on cancer genomics, but theoretical aspects will apply to other fields as well.

Onderwijsvorm
Lectures + practical exercises

Toetsvorm
Written exam

Literatuur
Tutorial in biostatistics: multiple hypothesis testing in genomics" by Goeman & Solari (article in Statistics in Medicine) plus handouts provided by the lecturer

Aanbevolen voorkennis
Algemene statistitiek, Statistical Data Analysis

Doelgroep
mMath, mSFM

Statistics for Networks

Vakcode	X_405110 ()
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. M.C.M. de Gunst
Examinator	prof. dr. M.C.M. de Gunst
Docent(en)	prof. dr. M.C.M. de Gunst, dr. E.N. Belitser
Lesmethode(n)	Hoorcollege
Niveau	600

Doel vak
After this course students are acquainted with the main statistical methods and models for network analysis.

Inhoud vak
Researchers from diverse disciplines as biology, physics, sociology, economics, computer science and mathematics, are more and more involved with the collection, modeling and analysis of network data. The relational nature of network data means that statistical analysis of such data is generally more involved than the `standard' statistical analysis, that different mathematical models and different statistical methods are needed, and that different problems need to be faced. The aim of this course is to get students acquainted with the main methods and models for network analysis. The course focuses on the mathematical aspects of statistical modeling and statistical analysis of networks; computational aspects of network analysis will not be covered. Topics that will be discussed are: descriptive statistics for networks, network sampling, network modeling, inference for networks, and modeling and prediction for processes on network graphs.

Onderwijsvorm
Lectures, presentations, homework assignments.

Toetsvorm
Assignments, presentations.

Literatuur
- Statistical Analysis of Network Data by E.D. Kolaczyk, Springer, 2010.
- Additional material will be provided during the course.

Vereiste voorkennis
An introductory probability course, like Kansrekening 1 (X_400189) plus Kansrekening 2 (X_400190), and an introductory statistics course, like Algemene Statistiek (X_400004).

Aanbevolen voorkennis
Statistical Data Analysis (X_401029)

Doelgroep
XM_MAT_S 1, XM_MAT_AG 1, XM_SFM

Overige informatie
This course will not be taught in the academic year 2017-2018.

Stochastic Differential Equations

Vakcode	X_400454 (400454)
Periode	Periode 4+5
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. B.W. Rink
Examinator	prof. dr. B.W. Rink
Niveau	500

Inhoud vak
This course is part of the Joint National Master Programme in Mathematics.
For schedules, course locations and course descriptions see https://elo.mastermath.nl.

Doelgroep
mMath

Intekenprocedure
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Stochastic Integration

Vakcode	X_400470 (400470)
Periode	Periode 4+5
Credits	8.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Niveau	400

Inhoud vak
http://studiegids.uva.nl/xmlpages/page/2017-2018/zoek-vak/vak/31653

Doelgroep
mMath, mSFM

Overige informatie
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Stochastic Optimization

Vakcode	X_400336 (400336)
Periode	Periode 1+2
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. S. Bhulai
Examinator	prof. dr. S. Bhulai
Docent(en)	prof. dr. S. Bhulai
Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak
The goal of the course is to discuss techniques from the field of stochastic optimization and their applications.

Inhoud vak
This course deals with the theory and algorithms for stochastic optimization with an application to controlled stochastic systems (e.g., call center management, inventory control, optimal design of communication networks). We discuss aspects of semi-Markov decision theory and their applications in certain queueing systems. In a programming assignment, students learn to implement optimization algorithms and experiment with them. Experience with and insight into the more theoretical subject is obtained through homework exercises.

Onderwijsvorm
Lectures.

Toetsvorm
Programming and written exercises, final exam.

Literatuur
Lecture notes will be posted on Canvas.

Vereiste voorkennis
A programming language.

Aanbevolen voorkennis
Stochastische Processen (X_400646) and Wachtrijmodellen (X_401061) or equivalent courses on Stochastic Processes and Queueing Theory.

Doelgroep
mBA, mBa-D, mMath, mSFM.

Stochastic Processes

Vakcode	X_400339 (400339)
Periode	Periode 4+5
Credits	8.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. B.W. Rink
Examinator	prof. dr. B.W. Rink
Lesmethode(n)	Hoorcollege
Niveau	400

Inhoud vak
This course is part of the joint national master programme in Mathematics.
For schedules, course locations and course descriptions see https://elo.mastermath.nl/

Doelgroep
mMath

Intekenprocedure
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Stochastic Processes for Finance

Vakcode	X_400352 (400352)
Periode	Periode 1+2
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. E.N. Belitser
Examinator	dr. E.N. Belitser
Docent(en)	prof. dr. J. van den Berg
Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak
Learn basics of stochastic processes in continuous time, including the concepts of martingales and stochastic integration; apply these concepts to price options on stocks and interest rates by the no-arbitrage principle.

Inhoud vak
Financial institutions trade in risk, and it is therefore essential to measure and control such risks. Financial instruments such as options, swaps, forwards, etc. play an important role in risk management, and to handle them one needs to be able to price them. This course gives an introduction to the mathematical tools and theory behind risk management.

A "stochastic process" is a collection of random variables, indexed by a set T. In financial applications the elements of T model time, and T is the set of natural numbers (discrete time), or an interval in the positive real line (continuous time). "Martingales" are processes whose increments over an interval in the future have zero expectation given knowledge of the past history of the process. They play an important role in financial calculus, because the price of an option (on a stock or an interest rate) can be expressed as an expectation under a so-called martingale measure. In this course we develop this theory in discrete and continuous time. Most models for financial processes in continuous time are based on a special Gaussian process, called Brownian motion. We discuss some properties of this process and introduce "stochastic integrals" with Brownian motion as the integrator. Financial processes can next be modeled as solutions to "stochastic differential equations". After developing these mathematical tools we turn to finance by applying the concepts and results to the pricing of derivative instruments. Foremost, we develop the theory of no-arbitrage pricing of derivatives, which are basic tools for risk management.

Onderwijsvorm
Lectures and discussion of exercises

Toetsvorm
Assignments and written examination.

Literatuur
Lecture notes

Additional literature:
Shreve, "Stochastic Calculus for Finance I: The Binomial Asset Pricing Model", Springer;
Shreve, "Stochastic Calculus for Finance II: Continuous-time models", Springer.

Vereiste voorkennis
Probability (X_400622) and Analysis 1 (X_400005), or their equivalents.

Aanbevolen voorkennis
Measure Theory.

Doelgroep
mBA, mBA-D, mMath, mSFM, master Econometrics.

Overige informatie
A significant part of the course is used to introduce mathematical subjects and techniques like Brownian motion, stochastic integration and Ito calculus. In view of this, the course is NOT meant for students who already followed the master course "Stochastic Integration" or "Stochastic differential equations". On the other hand, after completing this course, students may be motivated to follow other courses (like the two mentioned above) where stochastic calculus is treated in a deeper and more rigorous way.

Time series

Vakcode	X_400571 (400571)
Periode	Periode 4+5
Credits	8.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. B.W. Rink
Lesmethode(n)	Hoorcollege
Niveau	500

Inhoud vak
This course is part of the Joint National Master Programme in Mathematics.
For schedules, course locations and course descriptions see https://elo.mastermath.nl.

Doelgroep
mMath

Intekenprocedure
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