Econometrics and Operations Research (MSc)

Vrije Universiteit Amsterdam - Fac. der Economische Wet. en Bedrijfsk. - M Econometrics and Operations Research - 2016-2017

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I

The Master's programme in Econometrics and Operations Research is an academic programme focusing on the development and application of quantitative methods for analysing economic issues in a broad sense. It is a successful preparation for a professional career in which mathematics, statistics and ICT are used in analysing and solving complex issues in general economics, and business and financial economics. Econometricians are also employed as experts in optimizing strategic and operational business processes like transport flows, stock management and operating systems. Econometricians can be found working at the central banks of Europe, at federal banks in the United States, at central government agencies and ministries, financial institutions, consultancy firms, airlines, the railways and other logistic companies, and in the majority of listed companies.

The components of the Master's programme correspond closely with the department's research interests, which means that many of the latest scientific developments in areas like financial econometrics, logistics and game theory find their way directly into the teaching programme. Students also benefit from having the opportunity to study in small groups and work closely with the academic staff.

At the beginning of the programme, students can make a choice for a specialization. There are two areas of specialization: Econometrics and Mathematical Economics and Operations Research and Business Econometrics. However, it is not mandatory to specialize; it is possible to combine courses from either specialization to allow students to pursue their own interests. In that case, no specialization will be mentioned on the degree.

The Master Econometrics and Operations Research is a one year programme en consists of 60 EC.

For talented and ambitious students the master's programme offers an extra opportunity to distinguish themselves with the MSc Honours Programme Operations Research. This Honours Programme allows master's students to broaden and deepen their knowledge on state-of-the-art operations research techniques.

- Course programme 2016-2017 master Econometrics and Operations Research
- Transitional Arrangements MSc Econometrics and Operations Research 2016-2017
- Academic calendar 2016-2017
- Teaching and Examination Regulations 2016-2017 Master programmes FEWEB
- Rules and Regulations 2016-2017 FEWEB

Inhoudsopgave

Vrije Universiteit Amsterdam - Fac. der Economische Wet. en Bedrijfsk. - M Econometrics and Operations Research - 2016-2017

III

Specialization Econometrics and Mathematical Economics

The specialization Econometrics and Mathematical Economics contains
obligatory courses, optional courses, and a thesis.

Opleidingsdelen:

- M Econometrics - Specialization Econometrics and Mathematical Economics - Obligatory courses
- M Econometrics - Specialization Econometrics and Mathematical Economics - Optional courses

M Econometrics - Specialization Econometrics and Mathematical Economics - Obligatory courses

Below are the obligatory courses of the specialization.

Vakken:

Naam	Periode	Credits	Code
Advanced Econometrics	Periode 1	6.0	E_EORM_AECTR
Case Study	Periode 3	6.0	E_EORM_CASE
Dynamic Econometrics	Periode 2	6.0	E_EORM_DE
Thesis	Ac. Jaar (september)	18.0	E_EORM_THS
Time Series Econometrics	Periode 4	6.0	E_EORM_TSE

M Econometrics - Specialization Econometrics and Mathematical Economics - Optional courses

Choose 3 courses from the list, with a maximum of two economics courses.

Opleidingsdelen:

- M Econometrics - Specialization Econometrics and Mathematical Economics - Optional courses from Economics
- M Econometrics - Specialization Econometrics and Mathematical Economics - Optional courses from Mathematics / Computer Science
- M Econometrics - Specialization Econometrics and Mathematical Economics - Optional courses from Operations Research / Business Econometrics

M Econometrics - Specialization Econometrics and Mathematical Economics - Optional courses from Economics

Choose a maximum of 2 courses.

Vakken:

Naam	Periode	Credits	Code
Advanced Corporate Finance	Periode 1	6.0	E_FIN_ACF
Advanced Macroeconomics	Periode 2	6.0	E_EC_AMAEC

Asset Pricing	Periode 1	6.0	E_FIN_AP
Consumer Marketing	Periode 1	6.0	E_MKT_CM
Customer Intelligence	Periode 4	6.0	E_MKT_CI
Derivatives	Periode 2	6.0	E_FIN_DER
Environmental Economics	Periode 2	6.0	E_STR_EEC
Financial Markets and Institutions	Periode 4	6.0	E_FIN_FMI
Globalization, Growth and Development	Periode 4	6.0	E_EC_GGD
Labour Economics	Periode 4	6.0	E_EC_LABEC
Mathematics in Economics and Society	Periode 1	6.0	E_EORM_MES
Regional and Urban Economics	Periode 2	6.0	E_STR_RUE

M Econometrics - Specialization Econometrics and Mathematical Economics - Optional courses from Mathematics / Computer Science

Choose 1, 2 or 3 courses.

Vakken:

Naam	Periode	Credits	Code
Asymptotic Statistics	Periode 1+2	8.0	X_400323
Data Mining Techniques	Periode 5	6.0	X_400108
Mathematical Systems and Control Theory		6.0	X_400180
Stochastic Processes for Finance	Periode 1+2	6.0	X_400352

M Econometrics - Specialization Econometrics and Mathematical Economics - Optional courses from Operations Research / Business Econometrics

Choose 1 or 2 courses.

Vakken:

Naam	Periode	Credits	Code
Advanced Algorithms	Periode 1	6.0	E_EORM_AA
Algorithmic Game Theory	Periode 2	6.0	E_EORM_AGT
Simulation and Stochastic Systems	Periode 4	6.0	E_EORM_SSS

Specialization Operations Research and Business Econometrics

The specialization Operations Research and Business Econometrics
contains obligatory courses, optional courses, and a thesis.

Opleidingsdelen:

- M Econometrics - Specialization Operations Research and Business Econometrics - Obligatory courses
- M Econometrics - Specialization Operations Research and Business Econometrics - Optional courses

M Econometrics - Specialization Operations Research and Business Econometrics - Obligatory courses

Below are the obligatory courses of the specialization.

Vakken:

Naam	Periode	Credits	Code
Advanced Algorithms	Periode 1	6.0	E_EORM_AA
Algorithmic Game Theory	Periode 2	6.0	E_EORM_AGT
Case Study	Periode 3	6.0	E_EORM_CASE
Simulation and Stochastic Systems	Periode 4	6.0	E_EORM_SSS
Thesis	Ac. Jaar (september)	18.0	E_EORM_THS

M Econometrics - Specialization Operations Research and Business Econometrics - Optional courses

Choose 3 courses from the list, with a maximum of two economics courses.

Opleidingsdelen:

- M Econometrics - Specialization Operations Research and Business Econometrics - Optional courses from Economics / Business Administration
- M Econometrics - Specialization Operations Research and Business Econometrics - Optional courses from Econometrics / Mathematical Economics
- M Econometrics - Specialization Operations Research and Business Econometrics - Optional courses from Mathematics / Computer Science

M Econometrics - Specialization Operations Research and Business Econometrics - Optional courses from Economics / Business Administration

Choose a maximum of 2 courses.

Vakken:

Naam	Periode	Credits	Code
Asset Pricing	Periode 1	6.0	E_FIN_AP
Customer Intelligence	Periode 4	6.0	E_MKT_CI
Derivatives	Periode 2	6.0	E_FIN_DER
Environmental Economics	Periode 2	6.0	E_STR_EEC
Institutional Investments and Asset Liability Management	Periode 4	6.0	E_FIN_IIALM

Mathematics in Economics and Society	Periode 1	6.0	E_EORM_MES
Supply Chain Management	Periode 1	6.0	E_BA_SCM
Transport Economics	Periode 4	6.0	E_STR_TREC

M Econometrics - Specialization Operations Research and Business Econometrics - Optional courses from Econometrics / Mathematical Economics

Choose 1, 2 or 3 courses.

Vakken:

Naam	Periode	Credits	Code
Advanced Econometrics	Periode 1	6.0	E_EORM_AECTR
Dynamic Econometrics	Periode 2	6.0	E_EORM_DE
Time Series Econometrics	Periode 4	6.0	E_EORM_TSE

M Econometrics - Specialization Operations Research and Business Econometrics - Optional courses from Mathematics / Computer Science

Choose 1, 2 or 3 courses.

Vakken:

Naam	Periode	Credits	Code
Data Mining Techniques	Periode 5	6.0	X_400108
Evolutionary Computing	Periode 1	6.0	X_400111
Stochastic Optimization	Periode 1+2	6.0	X_400336

Master Econometrics and Operations Research - No specialization

In case you opt for no specialization, choose courses from the two
specializations. Note that the thesis can only be written on a topic
from mathematical economics.

Opleidingsdelen:

- M Econometrics - No specialization - Obligatory courses
- M Econometrics - No specialization - Optional courses

M Econometrics - No specialization - Obligatory courses

Follow the obligatory courses from the specializations. In case an
obligatory course differs between a specialization, choose one of the
two:
- choose EITHER Advanced Econometrics OR Advanced Algorithms
- choose EITHER Dynamic Econometrics OR Algorithmic Game Theory
- choose EITHER Time Series Econometrics OR Simulation and Stochastic
Systems

Vakken:

Naam	Periode	Credits	Code
Advanced Algorithms	Periode 1	6.0	E_EORM_AA
Advanced Econometrics	Periode 1	6.0	E_EORM_AECTR
Algorithmic Game Theory	Periode 2	6.0	E_EORM_AGT
Case Study	Periode 3	6.0	E_EORM_CASE
Dynamic Econometrics	Periode 2	6.0	E_EORM_DE
Simulation and Stochastic Systems	Periode 4	6.0	E_EORM_SSS
Thesis	Ac. Jaar (september)	18.0	E_EORM_THS
Time Series Econometrics	Periode 4	6.0	E_EORM_TSE

M Econometrics - No specialization - Optional courses

Choose 3 courses from the list, with a maximum of two economics courses.

Opleidingsdelen:

- M Econometrics - Specialization Econometrics and Mathematical Economics - Optional courses from Economics
- M Econometrics - Specialization Econometrics and Mathematical Economics - Optional courses from Mathematics / Computer Science
- M Econometrics - Specialization Econometrics and Mathematical Economics - Optional courses from Econometrics

M Econometrics - Specialization Econometrics and Mathematical Economics - Optional courses from Economics

Choose a maximum of 2 courses.

Vakken:

Naam	Periode	Credits	Code
Advanced Corporate Finance	Periode 1	6.0	E_FIN_ACF
Advanced Macroeconomics	Periode 2	6.0	E_EC_AMAEC
Asset Pricing	Periode 1	6.0	E_FIN_AP
Consumer Marketing	Periode 1	6.0	E_MKT_CM
Customer Intelligence	Periode 4	6.0	E_MKT_CI
Derivatives	Periode 2	6.0	E_FIN_DER
Environmental Economics	Periode 2	6.0	E_STR_EEC
Financial Markets and Institutions	Periode 4	6.0	E_FIN_FMI
Globalization, Growth and Development	Periode 4	6.0	E_EC_GGD
Labour Economics	Periode 4	6.0	E_EC_LABEC
Regional and Urban Economics	Periode 2	6.0	E_STR_RUE

| Transport Economics | Periode 4 | 6.0 | E_STR_TREC |

M Econometrics - Specialization Econometrics and Mathematical Economics - Optional courses from Mathematics / Computer Science

Choose 1, 2 or 3 courses.

Vakken:

Naam	Periode	Credits	Code
Asymptotic Statistics	Periode 1+2	8.0	X_400323
Data Mining Techniques	Periode 5	6.0	X_400108
Evolutionary Computing	Periode 1	6.0	X_400111
Mathematical Systems and Control Theory		6.0	X_400180
Stochastic Optimization	Periode 1+2	6.0	X_400336

M Econometrics - Specialization Econometrics and Mathematical Economics - Optional courses from Econometrics

Choose 1, 2 or 3 courses.

Vakken:

Naam	Periode	Credits	Code
Advanced Algorithms	Periode 1	6.0	E_EORM_AA
Advanced Econometrics	Periode 1	6.0	E_EORM_AECTR
Algorithmic Game Theory	Periode 2	6.0	E_EORM_AGT
Dynamic Econometrics	Periode 2	6.0	E_EORM_DE
Simulation and Stochastic Systems	Periode 4	6.0	E_EORM_SSS
Time Series Econometrics	Periode 4	6.0	E_EORM_TSE

Honours Programme Operations Research

For talented and ambitious students the master's programme offers an
extra opportunity to distinguish themselves with the MSc Honours
Programme Operations Research. This Honours Programme allows master's
students to broaden and deepen their knowledge on state-of-the-art
operations research techniques.

The programme has a study load of 18 EC and consists of two master's
courses from the program of the LNMB (6 EC per course) and the 'OR
research seminar' (6 EC) organized by the OR-group of the department of
Econometrics and Operations Research at VU University. The LNMB provides
a great variety of high-level courses on deterministic and stochastic
operations research. Students can choose LNMB master's courses
according to their interest. The OR research seminar will run from
September to April. Form and contents of the OR research seminar will

depend on the students interests and ambitions. The aim of this seminar
is to train students to write a PhD grant proposal enabling them to
continue their studies as a PhD.

The honours programme is successfully completed if the student has
finished the master's programme within one year and, in addition, has
successfully finished all courses of the honours programme. The
successful completion of the honours programme will be recorded in the
Diploma Supplement.

Opleidingsdelen:

- Honours Programme Operations Research - Optional courses LNMB Utrecht
- Honours Programme Operations Research - Obligatory course VU

Honours Programme Operations Research - Optional courses LNMB Utrecht

Choose courses at LNMB, with a total of at least 12 EC. For more
information about LNMB, see
http://www.lnmb.nl/pages/courses/mastercourses.

Choose courses from this list:
- Introdcution to Stochastic Processes (Period 1, 4.0 EC)
- Continuous Optimization (Period 1+2, 6.0 EC)
- Discrete Optimization (Period 1+2, 6.0 EC)
- Heuristic Methods in Operations Research (Period 1+2, 6.0 EC)
- Scheduling (Period 4+5, 6.0 EC)
- Advanced Linear Programming (Period 4+5, 6.0 EC)
- Queueing Theory (Period 4+5, 6.0 EC)

Honours Programme Operations Research - Obligatory course VU

Vakken:

Naam	Periode	Credits	Code
OR Research Seminar	Ac. Jaar (september)	6.0	E_EORM_ORRS

Master Econometrics and Operations Research - Additional information

Opleidingsdelen:

- Learning outcomes
- Teaching
- Enrolment for courses and exams

Learning outcomes

A graduate of the master's programme in Econometrics and Operations
Research:

1. has a thorough and practical knowledge of modern econometrics;
2. has a sound grasp of the development of modern econometrics,

operations research and mathematical economics, and has gained experience with research in at least one subfield;

3. is able to gain knowledge on other subfields within a reasonable period;

4. is able to formulate an action plan based on a broad question;

5. is able to analyse and formulate research results and draw conclusions;

6. is able to draw up a report and participate in a debate on a professional subject;

7. is able to consult and make use of international professional literature on relevant subfields;

8. is able to apply knowledge in econometrics, operations research or mathematical economics in a broad, multidisciplinary context and is experienced in modelling problems from other scientific fields;

9. is employable in positions which require knowledge and research skills taken from modern econometrics;

10. has extensive knowledge and understanding of the use of modern econometrics, operations research or mathematical economics in society and can make sound decisions with regard to career possibilities;

11. has a wide sense of social responsibility and an eye for ethical aspects of the scientific and professional practice.

Teaching

Tuition is carried out in plenary lectures and small groups. Much attention is paid to an active method of studying. This includes writing study papers, working out cases and preparing practical assignments. In this way students become familiar with the application of advanced theory to practical work. It also serves to integrate the theory studied in the individual courses into a comprehensive body of knowledge. Papers are written both individually and in groups of two or three students, thus furthering the students' ability to work in teams.

Much time is also devoted to presentation and discussion of one's work to fellow-students and staff and group discussion of e.g. research papers. The small-scale tuition environment provides an excellent opportunity for guidance and feedback by staff and other students. Apart from developing the student's communicative skills in oral and written presentation, much attention is paid to the development of critical judgement in assessing research work of others.

Enrolment for courses and exams

See VUnet for more information about course enrolment.

Advanced Algorithms

Vakcode	E_EORM_AA ()
Periode	Periode 1
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Economische Wet. en Bedrijfsk.
Coördinator	dr. ir. R.A. Sitters
Examinator	dr. ir. R.A. Sitters

Lesmethode(n)	Hoorcollege, Werkcollege
Niveau	400

Doel vak

In this course you will learn how to develop efficient algorithms for
solving fundamental optimization problems in operations research.
The objectives of the course are to:
- learn about fundamental optimization problems (Scheduling, vehicle
routing, facility location, network design, ...)
- learn algorithms for solving these problems
- learn to prove performance guarantees (running time, approximation
ratio)
- apply the theory by implementing some of these algorithms.
- construct and implement your own algorithms for optimization problems.

Inhoud vak

Some of the topics that will be covered in the course are:
- Scheduling problems, routing problems, facility location problems.
- (Integer) linear programming, dynamic programming, local search
algorithm, randomized algorithms.
- Theoretical performance guarantees: approximation ratio, polynomial
running time.
- Computational complexity theory and hardness of approximation.

Onderwijsvorm

Lectures (4hours) and tutorials (2hours).

Toetsvorm

The final grade is determined by a written exam (60%) and an assignment
(40%).
In the assignment you will apply the theory and implement algorithms for
optimization problems. In class we use Python and Matlab.

Literatuur

The material to be covered in class is based on the following books.
Book [1] will be used the most and is freely available for download (you
may consider buying it though). The other books will be used
occasionally and give a good impression of the theory.

[1] D.P. Williamson and D.B. Shmoys, The Design of Approximation
Algorithms, Cambridge University Press, 2011

([2] V. V. Vazirani, Approximation Algorithms, Springer, 1998
[3] C. H. Papadimitriou and K. Steiglitz, Combinatorial Optimization;
Algorithms and Complexity, Prentice-Hall, 1982.
[4] Kleinberg and E. Tardos, Algorithm Design, Addison Wesley, 2005.)

Vereiste voorkennis

Basic knowledge of graph theory and linear programming. Basic
programming skills (for example in java,python, R, or Matlab).

Aanbevolen voorkennis

Basic knowledge on graph theory, linear programming, and combinatorial
optimization is assumed. (For example, the
bachelor courses Combinatorial Optimization (FEWEB, E_EOR3_COMB) and
Combinatorische Optimalisatie (FEW) both are a good match.) Experience
with programming, especially Python or Matlab is very helpful.

See http://personal.vu.nl/r.a.sitters/AdvancedAlgorithms/index.html for
the contents of last years course and a schedule of this years course.
Note that this years course is only one period.

Advanced Corporate Finance

Vakcode	E_FIN_ACF ()
Periode	Periode 1
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Economische Wet. en Bedrijfsk.
Coördinator	prof. dr. ir. H.A. Rijken
Examinator	prof. dr. ir. H.A. Rijken
Docent(en)	prof. dr. ir. H.A. Rijken
Lesmethode(n)	Hoorcollege, Werkgroep
Niveau	400

Doel vak
Achieve advanced knowledge in the theory and practice of corporate
finance. The main objective is to fully understand theoretical concepts
(their strengths and limitations) and to use these theoretical
frameworks to solve in an effective way practical issues in corporate
finance. After following this course, you: - understand basic Corporate
Finance concepts, including their strengths and limitations - have the
quantitative skills to apply these basic concepts - understand the
interrelationship between various concepts and link them in a general
framework - are able to apply this framework in real life cases.

Inhoud vak
This course elaborates on the course corporate finance in the bachelors
program. The course has two focus areas: Corporate Security Design and
Corporate (Financial) Risk Management

We will start off with a short review of the theory of Modigliani and
Miller. Within the framework of these concepts we will pay attention to
the issues on capital structure from the perspective of both the equity
holders and the debt holders. A range of corporate financing options,
like subordinated bond, convertibles and corporate securitization, will
be discussed.

Thereafter we introduce comprehensively the concepts of the operational
cash flow and the finance cash flow of a company. The added value of
Corporate (Financial) Risk Management will be discussed from a cash flow
perspective and a capital cost perspective. Links with Short Term
Financial Management, Credit Risk Management and Value Based Management
will be made.

Substantial attention will be given to real life cases (agency questions
and restructuring cases in practice) during the course.

Onderwijsvorm
Lectures (2 times 2 hours per week) and 3 working classes

Toetsvorm
written exam (80%) and two cases (20%)

Literatuur
Custom book "Advanced Corporate Finance" ISBN 9781783651931. This
include a code to have (web) access to 5 online chapters from the book
"Advanced Corporate Finance" (Odgen)

Vereiste voorkennis
Corporate Finance 3.2 or Corporate Financial Management 3.4. For
students with no bachelor VU the admission to the Master of Finance is
sufficient.

Aanbevolen voorkennis
Corporate Finance 3.2 or Corporate Financial Management 3.4. Students
with no VU bachelor in Economics or BA should be familiar with a
standard textbook in Corporate Finance, like "Principles in Corporate
Finance" (Brealey and Myers) or "Corporate Finance" (Berk and DeMarzo).

Advanced Econometrics

Vakcode	E_EORM_AECTR (64412001)
Periode	Periode 1
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Economische Wet. en Bedrijfsk.
Coördinator	dr. F. Blasques Albergaria Amaral
Examinator	dr. F. Blasques Albergaria Amaral
Docent(en)	dr. F. Blasques Albergaria Amaral
Lesmethode(n)	Hoorcollege, Werkgroep
Niveau	400

Doel vak
This course introduces students to advanced econometric theory and
methods. Students will be guided through the frontier of econometric
theory and be introduced to state-of–the-art econometric models and
techniques.

By the end of this course, participants will:
(1) have gained a profound and detailed understanding of advanced
econometric theory and methods;
(2) know how to design, estimate and analyze complex linear and
nonlinear dynamic models;
(3) have solved advanced theoretical and practical econometric
exercises;
(4) understand the interplay between econometric techniques and modeling
assumptions;
(5) understand the proofs of asymptotic properties of important
estimators and test statistics.

Inhoud vak
This course covers both theoretical and practical aspects of complex
dynamic econometric models that are used in the industry, by central
banks, governments, think tanks, and other research institutes.

The students will be introduced to stochastic theory that allows them to fully understand the dynamic properties of complex models featuring nonlinearities, time-varying parameters and latent variables. Important concepts include invertibility, stationarity, dependence, ergodicity and bounded moments

The students will also be introduced to advanced estimation theory that allows them to "bring" state-of-the-art models to the data and conduct inference on parameters under very general conditions. Important topics include the existence, measurability, consistency and asymptotic normality of extremum, M and Z estimators. We also cover advanced topics in nonlinear model selection and specification, estimation and inference under incorrect specification and metric selection.

From a practical perspective, the advanced methods and state-of-the-art models are used for forecasting and policy analysis in a wide number of applications ranging from finance to macroeconomics.

Onderwijsvorm
Lectures and tutorials

Toetsvorm
Final exam and group assignment with Individual assessment.

Literatuur
Lecture notes on "Advanced Econometrics" by F. Blasques

Davidson J., "Econometric Theory", Blackwell Publishing, 2000.

Other sources:
van der Vaart A., "Asymptotic Statistics". Cambridge Series in Statistical
and Probabilistic Mathematics. Cambridge University Press, 2000.

White H., "Estimation, Inference and Specication Analysis". Econometrics Society Monographs, 1996.

Lütkepohl H., "New Introduction to Multiple Time Series Analysis", Springer, 2005.

Hamilton J. D., "Time Series Analysis", Princeton University Press. 1994.
Davidson J., "Stochastic Limit Theory". Advanced Texts in Econometrics, Oxford University Press, 1994.

B. Potscher and I.R. Prucha, "Dynamic Nonlinear Econometric Models: Asymptotic Theory". Springer-Verlag, 1997.

R. Gallant and H. White, "A Uni
ed Theory of Estimation and Inference
for Nonlinear Dynamic Models", Basil Blackwell Ltd., Oxford, 1987.

Hansen, B E, Econometrics. Manuscript, University of Wisconsin.2009.
Current URL: www.ssc.wisc.edu/~bhansen/econometrics/

Aanbevolen voorkennis
This course presumes that students are familiar with basic probability and statistics. The theory and practice behind the simple linear

regression model should be well understood. Furthermore, the students should have been introduced to time-series analysis. In particular, the concept of stationarity and ARMA models should be familiar.

Advanced Macroeconomics

Vakcode	E_EC_AMAEC (60422010)
Periode	Periode 2
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Economische Wet. en Bedrijfsk.
Coördinator	prof. dr. P.A. Gautier
Examinator	prof. dr. P.A. Gautier
Docent(en)	prof. dr. P.A. Gautier
Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak
The students will be able to actively read current literature and embark on their own research projects using the knowledge gained about the analytical, mathematical, and statistical tools of modern dynamic macroeconomics. The tools include dynamic optimization, Nash bargaining, and the basic building blocks of DSGE models. We will also discuss the current big issues like: (i) How can small shocks lead to a large crisis (ii) What explains the increase in inequality and is the analysis of Piketty correct?, (iii) What caused the great recession and the euro crisis?

Inhoud vak
This course provides coverage at an advanced level of the building blocks of macroeconomics. Models of economic growth will be built up from intertemporal optimization decisions of firms and households. Special attention is given to the distribution of income (i.e. the implications of modern growth theory for the theory of Piketty). Next, the course will present the basic tools of Real Business Cycle and New Keynesian models. We also consider modern theories of financial crises and pay a lot of attention to the recent financial and euro crisis. Then, we will consider equilibrium search models which form the core of macro labor. Finally, we discuss budget deficits and Ricardian equivalence plus new political economy models where the behavior of policy makers are part of the model.

Onderwijsvorm
lecture

Toetsvorm
written interim examination
plus problem sets.

Literatuur
Romer, David Advanced Macro Economics. 3rd edition, McGraw Hill.

Vereiste voorkennis

Knowledge of calculus and intermediary macro.

Doelgroep
Msc students

Algorithmic Game Theory

Vakcode	E_EORM_AGT ()
Periode	Periode 2
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Economische Wet. en Bedrijfsk.
Coördinator	prof. dr. G. Schäfer
Examinator	prof. dr. G. Schäfer
Lesmethode(n)	Hoorcollege, Werkgroep
Niveau	400

Doel vak
Students will learn the fundamental results and methodologies in
algorithmic game theory.
Students will be introduced to the phenomena and questions that arise in
algorimthic game theory.
Students will get acquainted with state-of-the-art techniques of the
field.

Inhoud vak
Algorithmic game theory is an interdisciplinary research field that lies
in the intersection of mathematics, theoretical computer science and
economics. It uses game-theoretical models and solution concepts to
study situations of strategic decision making, with a particular focus
on computational and algorithmic issues.

The course covers:

• network routing and the price of anarchy
• Braess paradox and the network design problem
• computation and inefficiency of equilibria
• congestion and potential games
• scheduling games and coordination mechanisms
• smoothness framework and learning in games
• combinatorial auctions and the VCG mechanism
• approximation in mechanism design
• sponsored search auctions

Onderwijsvorm
Lectures and tutorials. Exercises will be given each week and students
are expected to present their solutions during the tutorials. In
addition, students will have to work on and hand in three take-home
assignments (which will be graded).

Toetsvorm
Final exam – Individual assessment
Assignments – Individual assessment

Literatuur
• N. Nisan, T. Roughgarden, E. Tardos, and V. V. Vazirani (Editors),
Algorithmic Game Theory, Cambridge University Press, 2007.
• Y. Shoham and K. Leyton-Brown, Multiagent Systems, Cambridge
University Press, 2009.
• Lecture Notes

Vereiste voorkennis
Students should have some background knowledge of discrete optimization;
in particular, they should be familiar with fundamental optimization
problems (shortest path, matching, flow, scheduling), algorithms and
complexity (exact and approximation algorithms, P vs. NP,
NP-completeness, inapproximability), and linear and convex programming
(duality, complementary slackness, KKT conditions).

Aanbevolen voorkennis
Some basic knowledge of game theory is advantageous but not a
prerequisite for the course.

Asset Pricing

Vakcode	E_FIN_AP ()
Periode	Periode 1
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Economische Wet. en Bedrijfsk.
Coördinator	prof. dr. R.C.J. Zwinkels
Examinator	prof. dr. R.C.J. Zwinkels
Docent(en)	prof. dr. R.C.J. Zwinkels
Lesmethode(n)	Hoorcollege, Werkgroep
Niveau	400

Doel vak
This course aims to deepen your knowledge in the field of asset pricing
and asset allocation.

After completion of the course, you should:
- Have a thorough understanding of how security prices are determined in
equity markets.
- Understand the drivers of equity returns.
- Understand and be able to apply optimal asset allocations for both
individual and institutional investors.
- Acquire an academic and critical attitude towards competing theories
in investment problems.
- Be comfortable with doing advanced analyses in Software such as
Microsoft Excel.

Inhoud vak
Starting from basic (undergraduate) Investments knowledge, this course
centers around the issues of asset pricing and asset allocation. In the
first week we revisit the well-known mean-variance framework and derive
the standard CAPM in this set-up. Starting from the second week, we
carefully study the assumptions underlying the CAPM framework and ask
ourselves what they imply for asset pricing. Examples include the
assumption of mean-variance utility, rational expectations, and complete

arbitrage. In the final week, we take a sidestep towards delegated asset management. Throughout the course, neoclassical and behavioral theories confronted with each other. In addition, the course builds on both theory and empirics.

Onderwijsvorm
Each of the six weeks of the course feature four hours of lectures and two hours of tutorials. The content of the tutorials varies. There will, for example, be guest lectures from finance practitioners, discussions of the assignments (see below), and in-depth discussion of particular technical issues. In addition, there are individual as well as group assignments.
The focus of these assignments is to apply the theoretical knowledge from
class to real world problems using actual stock market data in Excel or other software. In addition to gaining a deeper understanding of the topics in the course, the assignments will train you in quantitative computer skills you will need later in their career and prepare you for similar assignments in other courses and your thesis.

Toetsvorm
To pass this course, you need a minimum final grade of 6.0 and a minimum grade on the written exam of 5.0. If you score less than 5.0 on the written exam, your final grade is equal to that grade. If you score 5.0 or higher, the final grade is given by:

Final grade = 0.75*(Written exam grade) + 0.2*(Average group assignment grades) + 0.05*(Individual assignment grade).

Literatuur
- Selected research articles and news clippings.
- Lecture notes.
- [For background reading] Boadie, Kane, Markus: Investments (2008; MacGraw-Hill)

Vereiste voorkennis
You should be familiar with investments at the level of Bodie, Kane & Marcus, Investments. Undergraduate level knowledge of statistics and mathematics is also required (e.g., Berenson, Levine, Krehbiel: Basic Business Statistics; and Sydsaeter and Hammond (2006; Prentice Hall): Essential Mathematics for Economic Analysis, Sydsaeter, Hammond, Seierstad, and Strom (2005; Prentice Hall): Further mathematics for Economic Analysis (chapters 4 and 11)).

Aanbevolen voorkennis
You are expected to be very versatile in a relevant software package, such as Microsoft Excel (or any other similarly advance package) and use it to perform estimation and optimization. Core texts here are Benninga, Financial Modeling, or (more advanced) Jackson and Staunton, Advanced modeling in Finance using excel and VBA.

Overige informatie
This course may have an in-depth empirical follow-up by choosing an appropriate Investments team-research-project during the January / February period.

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
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.

Case Study

Vakcode	E_EORM_CASE (64422000)
Periode	Periode 3
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Economische Wet. en Bedrijfsk.
Coördinator	dr. L.F. Hoogerheide
Examinator	dr. L.F. Hoogerheide
Docent(en)	prof. dr. G.T. Timmer, prof. dr. S.J. Koopman, dr. L.F. Hoogerheide
Lesmethode(n)	Practicum
Niveau	400

Doel vak

Practicing methods of econometrics and operational research using
real-life case studies.

Inhoud vak

Students can opt for three variants of this course:

- Financial Econometrics, period 3, Hoogerheide: This part focuses on
the measurement and modelling of volatility in time series of financial
returns. An introduction will be given of generalised autoregressive
conditional heteroskedasticity (GARCH) models for the forecasting of
volatility in daily (or lower frequency) financial returns. Moreover, we
use high-frequency data to compute realized volatility measures, that
are used in Realized GARCH models. The merits of these models will be
investigated empirically using up-to-date financial time series. The
final aim is to use the models for forecasting volatility. Case-work is
done in small groups and when a sufficiently large number of groups can

be formed, a volatility forecast
competition can be part of the course.

- Applied Optimization, period 3, Timmer: Participants who chose this
variant will be trained in the design and implementation of
advanced optimization algorithms which make use of proven optimization
technology such as (integer) linear programming solvers. Examples
include the generation of valid inequalities to strengthen formulations
and lead to sophisticated branch and cut algorithms. After explaining
how to implement such techniques in MatLab the participants will be
asked to form small groups and focus on a specific hard problem with
known benchmark instances and design and implement an exact algorithm
for it. Their findings lead to a written essay.

- Allocation Problems, period 3, Van der Laan: In this variant
participants will be trained in solving real-life problems allocating
costs or benefits of joint projects. The training concerns the
formulation of the problem in a manageable quantitative model, to
evaluate the theoretical properties of available solutions and their
computational complexity, to select appropriate and computational
tractable solutions, to develop a software tool for solving the problem,
to carry out the required calculations and to report the results in an
essay. Participants work on a real-life case in small groups of 2 or 3
students.

Standard lectures will guide the student through the computational
aspects of statistical estimation, simulation and optimisation methods.
To gain further insights in the practical detail, computer programs for
the implementation of some computer-intensive methods will be developed.

Onderwijsvorm
lecture
working group

Toetsvorm
essay

Literatuur
Selection of articles and papers

Consumer Marketing

Vakcode	E_MKT_CM ()
Periode	Periode 1
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Economische Wet. en Bedrijfsk.
Coördinator	dr. J. Eelen
Examinator	dr. J. Eelen
Docent(en)	drs. I.J.C. Leijen, dr. J. Eelen
Lesmethode(n)	Hoorcollege, Werkgroep
Niveau	400

Doel vak

- Demonstrate a critical understanding of the concepts and theories
used, as well as key topics covered, in the top academic journals that
are important to effective consumer marketing management (e.g., consumer
decision making processes, social influences, customer engagement, and
sustainability).
- Effectively apply consumer behavior and consumer psychology
theories both to understand real-life consumer marketing problems and to
design solutions to those problems.
- Communicate and collaborate effectively with an international
cohort of classmates to design and produce case solutions or other
presentations, provided in English, to both academic and professional
audiences.

Inhoud vak

In business, the importance of what is known as 'customer insights'
cannot be overstated. It is widely recognized that focusing on consumers
is a key to success in the marketplace. This course provides insight
into how consumers behave and discusses the theoretical and managerial
implications of such behavior for firms. Specifically, the learning
objectives involve the attainment of understanding of the concepts and
theories of consumer marketing through a literature review and through
selected articles. In addition, the course focuses on competence
development, i. e., the ability to effectively use and apply these
concepts in the business problem. The course will focus exclusively on
consumer markets and will address in greater depth a selection of
consumer marketing concepts introduced in bachelor Consumer Behavior
courses. In addition, the course will introduce a number of recent
developments in consumer marketing.

Onderwijsvorm

Lectures, workgroups

Toetsvorm

Written examination: 70%;
Assignment: 30%;
each to be completed with a minimum score of 5.0

Literatuur

Academic articles

Vereiste voorkennis

Third- year courses Consumer Behavior, Marketing 3.1, Marketing Research
and Research tutorial Marketing or equivalent.

Customer Intelligence

Vakcode	E_MKT_CI ()
Periode	Periode 4
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Economische Wet. en Bedrijfsk.
Coördinator	dr. A. Aydinli
Examinator	dr. A. Aydinli
Docent(en)	dr. A. Aydinli
Lesmethode(n)	Hoorcollege, Werkgroep

Niveau	400

Doel vak

The overarching objective of this course is to equip students with the knowledge and skills on how to approach marketing-related problems from a rigorous, analytical, data-based perspective.

During the course, students will get acquainted with the various practical customer intelligence questions that managers may struggle with (e.g.; how to segment the market based on usage and attitudes; how to determine customers' preferences over product attributes; how to evaluate the effects of marketing activities). Students will learn to work with different types of customer intelligence data (e.g.; customer survey data, transactional data, marketing expenditure data) and obtain rigorous knowledge of the data analysis techniques (e.g.; factor analysis, conjoint analysis, cluster analysis, multiple regression, and logistic regression) for solving the salient customer intelligence questions. Students will excel in applying these techniques in the statistical software package SPSS and interpreting the output of such applications in terms of the marketing research problem at hand.

On completion of this course, students will be able to:
- Demonstrate a command of a range of research skills and the ability to apply those skills to address a customer intelligence research problem.
- Demonstrate a critical understanding of the applicability of quantitative (multivariate) methods and techniques commonly used in the fields of academia and business
- Effectively apply appropriate multivariate data analysis methods to solve practical customer intelligence problems.
- Communicate and collaborate effectively with an international cohort of classmates to design and produce case solutions or other presentations, provided in English, to both academic and professional audiences.

Inhoud vak

The past couple of decades have witnessed an unprecedented explosion in the quantity and quality of information available to managers. To reach well-informed decisions, marketing research practitioners and marketing academics have developed and implemented a wide variety of analytical tools and models. This course will familiarize students with the state-of-art techniques and approaches that have become fundamental to marketing decision making in order to collect, analyse, and act on customer information. While the course guides students through the use of quantitative methods, it is not a statistic or math course. Through a combination of lectures and computer exercises, the course aims that students gain the expertise and confidence to analyse real marketing problems in rigorous manner, and support their analysis using appropriate analytical tools. The course also forms a preparation for the empirical research to be conducted for the Master's thesis.

Onderwijsvorm

The course uses a combination of lectures and tutorials. The lectures focus on probing, extending and applying the course concepts and methods. Importantly, the lectures discuss for which marketing problems the techniques are typically used and how conclusions can be made for marketing management. The tutorials enable students to practice the concepts and methods discussed during the lectures.

Toetsvorm
Written examination: 70%;
Assignment: 30%;
each to be completed with a minimum score of 5.0

Literatuur
- Hair, Joseph F., William, C. Black, Barry J. Babin and Rolph E.
Anderson (2014), Multivariate Data Analysis (7th edition) – Pearson New
International Edition, Harlow (UK): Pearson Education Limited. ISBN 10:
1-292-02190-X.

Data Mining Techniques

Vakcode	X_400108 (400108)
Periode	Periode 5
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	dr. M. Hoogendoorn
Examinator	dr. M. Hoogendoorn
Docent(en)	dr. M. Hoogendoorn
Lesmethode(n)	Hoorcollege
Niveau	500

Doel vak
The aim of the course is that students acquire data mining knowledge and
skills that they can apply in a business environment. How the aims are
to be achieved: Students will acquire knowledge and skills mainly
through the following: an overview of the most common data mining
algorithms and techniques (in lectures), a survey of typical and
interesting data mining applications, and practical assignments to gain
"hands on" experience. The application of skills in a business
environment will be simulated through various assignments of the course.

Inhoud vak
The course will provide a survey of basic data mining techniques and
their applications for solving real life problems. After a general
introduction to Data Mining we will discuss some "classical" algorithms
like Naive Bayes, Decision Trees, Association Rules, etc., and some
recently discovered methods such as boosting, Support Vector Machines,
and co-learning. A number of successful applications of data mining will
also be discussed: marketing, fraud detection, text and Web mining,
possibly bioinformatics. In addition to lectures, there will be an
extensive practical part, where students will experiment with various
data mining algorithms and data sets. The grade for the course will be
based on these practical assignments (i.e., there will be no final
examination).

Onderwijsvorm
Lectures (h) and compulsory practical work (pra). Lectures are planned
to be interactive: there will be small questions, one-minute
discussions, etc.

Toetsvorm

Practical assignments (i.e. there is no exam). There will be two assignments done in groups of three. There is a possibility to get a grade without doing these assignments: to do a real research project instead (which will most likely to involve more work, but it can also be more rewarding). For the regular assignments the first assignment counts for 40% and the second for 60%. The grade of both assignments needs to be sufficient to pass the course.

Literatuur

Ian H. Witten, Eibe Frank, Mark A. Hall, Data Mining: Practical Machine Learning Tools and Techniques (Third Edition). Morgan Kaufmann, January 2011
ISBN 978-0-12-374856-0

Aanbevolen voorkennis

Kansrekening and Statistiek or Algemene Statistiek (knowledge of statistics and probabilities) or equivalent. Recommended: Machine Learning.

Doelgroep

mBA, mCS, mAI, mBio

Derivatives

Vakcode	E_FIN_DER (60442060)
Periode	Periode 2
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Economische Wet. en Bedrijfsk.
Coördinator	dr. N.J. Seeger
Examinator	dr. N.J. Seeger
Docent(en)	dr. N.J. Seeger
Lesmethode(n)	Hoorcollege, Werkgroep
Niveau	400

Doel vak

The primary objective of this course is to provide students with an advanced introduction to derivative instruments. By the end of the course students should have a sound understanding of the pricing concepts, practical applicability, operational complexity, and risks of several linear and non-linear derivatives.

Inhoud vak

In todays financial world, the role of derivatives gets increasingly important. Banks and pension funds use derivatives to manage their balance sheet risk, corporate treasuries need derivatives for mitigation of international trade risk, insurance companies actively apply derivatives strategically in order to hedge long term interest rate exposures. Worldwide derivatives trading has exploded to unprecedented levels in the last decades. Therefore, a sound understanding of derivatives is indispensable for anyone pursuing a job in finance.

The course aims to help students in developing a general understanding of the fundamental principles related to derivative instruments. When we

try to understand derivative instruments we will ask questions like:

1. How do derivative instruments work?
2. Is it possible to decompose derivatives in basic assets?
3. How to determine the fair value of derivative instruments?
4. What are the risks of using derivative instruments?
5. How are derivative instruments applied in practice and are there any relevant operational issues in the real world?

Hence, the course focuses on facilitating conceptual understanding of derivative instruments and of the methods that are needed to apply derivatives in different settings of finance applications; whether it is for trading purposes, structuring products, risk management, etc.

The field of derivatives is one of the most mathematically sophisticated in finance. Therefore, to understand derivatives it is inevitable to deal with mathematical methods. However, we want to emphasize that in the course mathematical methods are primarily used as tools to understand derivatives. We intend to serve a balanced mix of theory, intuition and practical aspects.

The course will treat the following subjects:

- Why derivatives?
- Forwards, futures and options
- Pricing concepts of derivative instruments
- Discrete and continuous time option pricing models
- Understanding Black-Scholes formula
- Beyond Black-Scholes (stochastic volatility and jumps)
- Hedging strategies
- Estimating model parameters
- Credit derivatives / Financial Crisis

Onderwijsvorm
The course spans a period of six weeks. There will be 12 lecture sessions of 2 x 45 minutes each (for dates and times see course schedule), in which the course material is presented. There will be two additional tutorial sessions in which solutions to programming problems related to derivatives topics will be discussed.

Toetsvorm
The final grade of the course is the grade of the written exam.

Literatuur
- Lecture slides
- John Hull: Options, Futures and other Derivatives, 8th Edition, 2011

Further References:
- Das, R.K. and S.R. Sundaram: Dervatives: Principles and Practice, McGRAW-Hill International Edition, 2010
- Jarrow, R. and A. Chatterjea: An Introduction to Derivative Securities, Financial Markets, and Risk Management, W. W. Norton & Company, 2013
- Baxter/Rennie: Financial Calculus, Cambridge, 1996. - Neftci: Principles of Financial Engineering, Elsevier, 2nd edition, 2008.
- Bingham/Kiesel: Risk-Neutral Valuation: Pricing and Hedging of Financial Derivatives, Springer, 2004.
- Björk, T.: Arbitrage Theory in Continuous Time, Oxford University Press, 2004.

Vereiste voorkennis

Students entering this course should be familiar with the basic corporate finance principles and techniques (e. g. Berk/DeMarzo, Corporate Finance. 2013) and investment management concepts (e. g. Bodie, Investments. 2010). In order to follow the course material right from the start it is recommended to review the derivatives material that has been covered in the courses: Financiering 2.5 and Investments 3.4. For solving the assignments, programming experience with Excel/VBA is required. A very good introduction to Excel/VBA can be found on the homepage http://xlvu.weebly.com; provided by Dr. Arjen Siegmann.

Dynamic Econometrics

Vakcode	E_EORM_DE ()
Periode	Periode 2
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Economische Wet. en Bedrijfsk.
Coördinator	dr. F. Blasques Albergaria Amaral
Examinator	dr. F. Blasques Albergaria Amaral
Lesmethode(n)	Hoorcollege, Werkgroep
Niveau	400

Doel vak

This course introduces students to advanced econometric theory and methods for analyzing linear multivariate non-stationary time-series and panel data.

By the end of this course, participants will:
(1) have detailed knowledge of VAR, VECM and dynamic panel-data models.
(2) understand the limit theory behind spurious regression and cointegration;
(3) be familiar with advanced unit-root and cointegration tests;
(4) understand the challenges in designing, estimating and analyzing linear econometric models for non-stationary time-series and panel data.

Inhoud vak

This course covers both theoretical and practical aspects of modeling multivariate non-stationary time-series and panel data, with special emphasis on unit-root processes and cointegration.

The students will be introduced to linear multivariate time-series models and linear panel data models used in econometrics. Important topics include marginalizing, conditioning, exogeneity, vector autoregressive (VAR) models, and vector error correction models (VECM).

Important limit results will be carefully derived providing the students with a deep understanding of the theory and practice behind a wide range of advanced unit roots test, spurious regression, cointegration, and dynamic panels.

Onderwijsvorm

Lectures and tutorials

Toetsvorm
Final exam and group assignment – Individual assessment

Literatuur
Lecture notes and other material provided by teacher.

Davidson (2000), "Econometric Theory". Wiley.

Hamilton (1994), "Time Series Analysis". Princeton University Press.

Aanbevolen voorkennis
This course presumes that students are familiar with basic probability and statistics. The theory and practice behind the simple linear regression model should be well understood. Furthermore, the students should have been introduced to time-series analysis. In particular, the concepts of stationarity and ARMA models should be familiar.

Environmental Economics

Vakcode	E_STR_EEC (60442040)
Periode	Periode 2
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Economische Wet. en Bedrijfsk.
Coördinator	prof. dr. C.A.A.M. Withagen
Examinator	prof. dr. C.A.A.M. Withagen
Docent(en)	dr. G.C. van der Meijden, prof. dr. C.A.A.M. Withagen
Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak
The course aims to learn students that natural resource management should not be left to the free market. After following this course, students are able to characterize several types of market failure and to explain how each of these causes environmental problems, such as air pollution and overexploitation of natural resources. Moreover, students will be capable of explaining which policy instruments can be used by the government to tackle environmental problems that arise in a market economy. Finally, students will be taught how renewable resources (such as forestries and fisheries), and non-renewable resources (such as fossil fuels) should optimally be exploited from a social welfare perspective and how their socially optimal exploitation differs from the exploitation in a market equilibrium.
The course consists of lectures, homework assignments, tutorials, and presentation/discussion sessions. The lectures are aimed at developing a thorough understanding of key economic, environmental and ethical aspects of environmental problems, and of the link between theory, methods and empirical analysis. The goal of the homework assignments that will be discussed during the tutorials, is to practice modern economic methods to analyse and solve problems in the field of environmental economics. The presentation/discussion sessions are intended to improve the participants' economic reasoning and communication skills. In these sessions, students will present a journal article in class, and they are expected to participate in a group

discussion afterwards.

After following this course, you:
• are able to describe the most important interactions between the economy and the environment, and their relationship with sustainable development.
• can explain why, and under which conditions, the free market does not result in an efficient outcome.
• are capable of showing how externalities can be 'internalized' by using market instruments, like Pigouvian taxes, quotas and tradable permits, etc.
• are able to advise environmental policy makers on which policy instruments to use under different circumstances in order to correct the market outcome
• can explain how non-renewable resources like fossil fuels, are exploited in a market economy and how the exploitation differs from the optimum
• can show how renewable resources, like fisheries and forestries, are exploited in a market economy and how the exploitation differs from the social optimum
• are able to describe and explain the optimal climate policy in the global economy
• can explain how sub-optimal climate policies can lead to a 'Green Paradox', in the sense that the problem of climate change is aggravated instead of diminished upon the introduction of those policies
• are able to explain why resource rich countries often suffer from low rates of economic growth, and what they can do to avoid this so-called Resource Curse.
• can explain the theoretic measures of 'willingness to pay' (WTP) and 'willingness to accept' (WTA) to obtain a monetary valuation of environmental changes
• are able to use stated preference methods (e.g., contingent valuation) and 'revealed preference' methods (e.g., travel cost model) to determine the WTA and WTP for environmental changes
• are able to work with simple mathematical models to analyse the effects of environmental policy and to determine the time profile of renewable and non-renewable resources, both in the optimum and in the market equilibrium
• have improved your presentation and discussion skills

Inhoud vak
The following topics will be dealt with in the course:
- interaction between the economy and the environment
- sustainable development
- welfare economics and market failures
- environmental policy: Pigouvian taxes, quotas, and tradable emission permits
- non-renewable resource use: scarcity and market structure
- renewable resource use: fishery and forestry
- non-renewable resource use and climate change
- climate policy and the 'Green Paradox'
- resource-rich economies and the 'Resource Curse'
- theory and methods for environmental valuation
The topics for the group discussions and student presentations can be chosen by the participants. They should be based on articles published in scientific journals.

Onderwijsvorm

Lectures, assignments, student presentations, and group discussions.

Toetsvorm
Written exam (60%), assignments (30%), and presentation/participation (10%). Passing the course is conditional on the exam grade being 5.0 or higher.

Literatuur
- Perman, R., Yue, M., Common, M., Maddison, D., and McGilvray, J., Natural Resource and Environmental Economics, 4th Edition, Addison Wesley, 2011.
- Additional articles from the economics literature, to be announced on Blackboard

Aanbevolen voorkennis
Advanced microeconomics.

Evolutionary Computing

Vakcode	X_400111 (400111)
Periode	Periode 1
Credits	6.0
Voertaal	Engels
Faculteit	Faculteit der Exacte Wetenschappen
Coördinator	prof. dr. A.E. Eiben
Examinator	prof. dr. A.E. Eiben
Docent(en)	prof. dr. A.E. Eiben, J.V. Heinerman MSc
Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak
To learn about computational methods based on Darwinian principles of evolution. To illustrate the usage of such methods as problem solvers and as simulation tools.To gain hands-on experience in performing experiments.

Inhoud vak
The course is treating various algorithms based on the Darwinian evolution theory. Driven by natural selection (survival of the fittest), an evolution process is being emulated and solutions for a given problem are being "bred". During this course all "dialects" within evolutionary computing are treated (genetic algorithms, evolutiestrategieën, evolutionary programming, genetic programming, and classifier systems). Applications in optimisation, constraint handling, machine learning, and robotics are discussed. Specific subjects handled include:
various genetic structures (representations), selection techniques, sexual and asexual variation operators, (self-)adaptivity. Special attention is paid to methodological aspects, such as algorithm design and tuning. If time permits, subjects in Artificial Life will be handled. Hands-on-experience is gained by a compulsory programming assignment.

Onderwijsvorm
Oral lectures and compulsory programming assignment (in teams of 3).
Highly motivated students can replace the programming assignment by a
special research track under the personal supervision of the lecturer
(s).

Toetsvorm
Written exam and pogramming assignment (weighted average).

Literatuur
Eiben, A.E., Smith, J.E., Introduction to Evolutionary Computing.
Springer, 2015, 2nd edition, ISBN 978-3-662-44873-1.

Vereiste voorkennis
Programming skills are necessary to do the practical assignment.

Doelgroep
mBA, mAI, mCS, mPDCS

Financial Markets and Institutions

Vakcode	E_FIN_FMI (60442080)
Periode	Periode 4
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Economische Wet. en Bedrijfsk.
Coördinator	prof. dr. I.P.P. van Lelyveld
Examinator	prof. dr. I.P.P. van Lelyveld
Docent(en)	prof. dr. I.P.P. van Lelyveld
Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak
The purpose of this course is to develop an understanding of the
economics underlying financial intermediation, financial markets and
banking, with a particular regard for current market developments and
their consequences.

Inhoud vak
We start by discussing the traditional role of commercial banks in the
financial system and how banks manage risks. Topics include the major
risks faced by banks, lending and asymmetric information, credit
rationing, and securitisation. This leads us into a discussion of
financial fragility covering, inter alia, liquidity provision, bank
runs, deposit insurance and opacity. Then we discuss how various
regulations could be helpful or not.

Given the depth of the Great Financial Crisis (2007-2009), there has
been a flurry in new regulation. What are the objectives of these
regulations, are these or will these be met. Since traditionally
regulation has been focussed on solvency will dedicate a lecture on
liquidity as well as this has proven to be quite a separate type of
risk. In addition we will discuss macroprudential and systemic risk
regulations.

The next two lectures cover the plumbing of the system and other large institutional participants. The former lecture will provide us some understanding of how risks in the system not only originate with the actions (i.e., trades) but also with the markets are set up. The latter will discuss how, next to (investment) banks, other large institutional investors are coming to the fore.

In the final part of the course we will turn to three distinct markets: the derivatives market, the interbank and the international banking market. How do these markets operate, particularly in the crisis, and how are they evolving.

Two guest lectures from practitioners will provide more colour: DNB President Klaas Knot will cover central bank policy complemented by a lecture from a practitioner.

Onderwijsvorm
The lectures will be complemented by a writing assignment (see below) All information regarding the timetable of the course can be found at http://rooster.vu.nl.
To facilitate the Writing Assignment a non-compulsory lecture on writing in English will be organised in the second week.
In the second week there will be an additional non-compulsory lecture to discuss question for those without a banking background
(e.g. econometrics students).
Question should be raised on the Blackboard forum.

Toetsvorm
Final grade is based on a closed-book written final exam (80%) and the grade on an open-book essay to be written in groups of at most three students (20%). More details regarding the topics and the structure of the essay will be provided during the lectures and tutorials. If no essay was submitted, it will be graded 0 (zero). In the case of a resit in later periods (i.e., in 2018 or later), the essay result will be disregarded and the resit grade will be based 100% on the examination. The exam questions will cover the topics and the exercises treated in the class. The lecture notes and solutions published on Blackboard can be used as a faithful guide for the required material and level of difficulty.
Part of understanding is being able to present your findings. In many cases, getting the form right is just as important as the actual content. Findings can be presented in many ways. For example, as an academic article, a thesis, a Powerpoint or a column. In this writing assignment we will aim for a contribution to a policy oriented blog such as VoxEU (www.voxeu.org).
Currently the topic is set to be the split between investment banking (the casino) from retail banking (the utility). Such a split has been argued to increase financial stability and reduce moral hazard. However, if a more interesting policy question arises closer to the course, the topic might change.
The assignment should be written in groups of at most three. Please use the appropriate sign up tool on Blackboard. Further details will be given in the first lecture. Note that a non-compulsory lecture on writing in English will be planned in the first week.
The deadline for the assignment will be announced in the first lecture.

Literatuur
We will make use of the following non-mandatory textbook:
• Mishkin, F., K. Matthews, and M. Giuliodori, The Economics of

Money, Banking and Finance, European edition. From this book we will cover all of Chapters 8 through 12.

In addition several mandatory academic papers will posted to Blackboard.
Lecture notes will be available on Blackboard just before each class.
Solutions for all exercises will be available after lectures.
Other non-mandatory (but useful) materials such as academic papers, press articles or book titles will be posted on Blackboard.

Vereiste voorkennis
Students should have followed a bachelor course in Money and Banking.

Globalization, Growth and Development

Vakcode	E_EC_GGD (60442050)
Periode	Periode 4
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Economische Wet. en Bedrijfsk.
Coördinator	prof. dr. C.T.M. Elbers
Examinator	prof. dr. C.T.M. Elbers
Docent(en)	prof. dr. C.T.M. Elbers
Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak
Aim of the course is to study aspects of globalization, growth and development that are fruitfully studied from the perspective of the economics discipline. After following the course the student will

- know the basic facts concerning the topics discussed in the course
- have a thorough understanding of these topics, in particular their economic dimension
- have learnt various empirical research techniques that can be applied within this field of economics
- be able to present and discuss current journal articles and book chapters on globalization

Inhoud vak
Globalization poses both challenges and offers opportunities to rich, emerging and
poor countries. The course focuses on a number of themes that have been central in the academic and public discussion of recent trends in the world economy. Among them are:
• Relationship between growth, trade and poverty
• Globalization and inequality
• International migration
• International trade and capital flows
• Environmental and labour standards
• Institutions
• Trade shocks, resources and civil conflict
• Financial stability
More topics in globalization are introduced in the course in the form of student presentations. The course stresses the importance of empirical research and devotes significant time to the empirical strategies that

have been used by researchers in studying globalization.

Onderwijsvorm
Lectures, Student Presentations and Discussions

Toetsvorm
Written exam at the end of the course

Literatuur
Selected articles

Vereiste voorkennis
Advanced Macroeconomics 4.2 and International Economics 3.2

Doelgroep
Students specialising in economics

Institutional Investments and Asset Liability Management

Vakcode	E_FIN_IIALM ()
Periode	Periode 4
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Economische Wet. en Bedrijfsk.
Coördinator	dr. M. Boes
Examinator	dr. M. Boes
Lesmethode(n)	Hoorcollege, Werkgroep
Niveau	400

Doel vak
Achieve advanced knowledge of the investment process of institutional
investors, like pension funds and insurers. The main objective is to
fully understand the most important theoretical concepts in the
institutional investment process and the way these concepts are used in
practice.

After following the course, you:
- Have a good oversight and thorough understanding of the theory of
strategic asset allocation (SAA).
- Have insight in the way the theory of strategic asset allocation is
(or not) implemented by institutional investors.
- Have insight in the way the most important inputs for SAA, VaR models
and assumptions for expected returns and risks, and Asset and
Liability Management (ALM) are generated. Have a good oversight and
thorough understanding of the ALM process within financial institutions,
including the determination of the risk appetite.
- Have a good oversight of the (academic) studies on the debate "Active
vs. Passive investing" and a thorough understanding of the main issues
in this debate.
- Have a good oversight why pension reform is necessary in almost every
country in the world, and gain insight the various pension reform policy
measures.
- Are able to apply theoretical concepts in real life cases.

Inhoud vak

The course starts with a description of the investment management
process for institutional investors. After this description we focus in
the first week on the theory and practice of strategic asset allocation.
We first lay down the basic framework of Markowitz and Samuelson/Merton.
We then look at the most important violation of the conditions in the
basic framework that leads to the concept of life cycle investing. We
will focuson how this concept works in practice and will ask ourselves
if the practical implementation is in accordance with academic theory?.
In the second week we focus on the important inputs we need for SAA and
ALM. The main subjects are VAR models and answers to the question "how
we get estimations for expected returns, risk and correlations for the
main asset classes?".In the thrid week we focus on implementation issues
in the institutional investment management process. The main focus is on
the debate "active versus passive investing?".

In the fourth, fifth and sixth week of the course the focus is on ALM.
In the fourth week we focus on the ALM decision making process,
including the determination of the risk profile, and the specification
of the policy measures that pension funds and insurance companies have
at their disposal. In the fifth week the student work on a case using an
ALM model that is also uses by ALM specialists in practice. The course
is concluded with the worldwide issues and approaches of pension reform.

Onderwijsvorm

Lectures (2 times 2 hours per week) and working class

Toetsvorm

Written exam (70%) and two cases (30%).

Labour Economics

Vakcode	E_EC_LABEC (60422030)
Periode	Periode 4
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Economische Wet. en Bedrijfsk.
Coördinator	dr. S. Dobbelaere
Examinator	dr. S. Dobbelaere
Docent(en)	dr. S. Dobbelaere
Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak

This course is an introduction to labor economics with an emphasis on
applied microeconomic theory and empirical analysis. The aim of the
course is to acquaint students with traditional and contemporary topics
in labor economics. The following course objectives are defined:
• Demonstrating a theoretical understanding of how labor markets operate
(disciplinary knowledge).
• Understanding the recent developments of wage determination in
imperfectly competitive labor markets and of human capital theory
(disciplinary knowledge & analytical and quantitative skills).
• Understanding how institutional forces and technological change shape
labor market performance (disciplinary knowledge & analytical and

quantitative skills).
• Understanding the impact of policy instruments on the search behavior
of individuals (disciplinary knowledge & societal and contextual
relevance).
• Being able to discuss critically existing empirical evidence (critical
readership).
• Learning how to distinguish alternative theories empirically and how
key parameters are obtained from data (disciplinary knowledge &
analytical and quantitative skills).
• Performing own empirical analysis by means of a replication exercise
(analytical and quantitative skills).
• Understanding the crucial role of better data and a better match
between theory and empirics in finding pertinent answers to societal and
economic problems in contemporary labor markets (societal and contextual
relevance).

Inhoud vak
The course covers a systematic development of theories of wage
determination over the past decades. We focus on the two traditions of
modelling wage determination in imperfectly competitive labor markets:
ex post wage bargaining and ex ante wage posting. We study employment in
a dynamic context, emphasizing the role of search frictions. We
concentrate on earnings inequality and technological change. These
topics are politically and economically important and underscore a lot
of modern labor economics. We focus on human capital investment models.
We conclude with an analysis of labor market institutions, in particular
the design of active labor market policies.

Onderwijsvorm
Lectures and tutorials (in-class presentations of assignments).

Toetsvorm
Interim assessment: Case/paper individual, Case/paper group and
Presentation.
End of period: Open exam. Conditional on the exam grade exceeding 5.0,
assignments count for 40% of the final grade and the exam for 60%. If
the exam grade is lower than 5.0, the final grade is equal to the exam
grade.

Literatuur
Selected main readings (papers) and chapters of the textbook "Cahuc P.,
Carcillo S. and A. Zylberberg. 2014. Labor Economics (2nd edition). MIT
press".

Mathematical Systems and Control Theory

Vakcode	X_400180 ()
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, Werkcollege
Niveau	400

Doel vak

The course aims to introduce the student to the mathematical theory of control systems.

Inhoud vak

Many phenomena are characterized by dynamic behaviour where we are interested in a certain input/output behaviour. Examples are to be found in the exact and natural sciences (mechanics, biology, ecology), in engineering (air- and spacecraft design, mechanical engineering) as well as in economics and econometrics (macro- economical models, trend and seasonal influences in demand and supply, production systems). Systems theory is concerned with modeling, estimation and control of dynamical phenomena. During the course the following subjects will be treated: models and representations (linear systems, input-output, state space, transfer function, stochastic systems, spectrum), control (stabilisation, feedback, pole placement, dynamic programming, the LQ problem), and identification and prediction (parameter estimation, spectral analysis, Kalman- filter, model reduction). Applications are in the area of optimal control and prediction.

Onderwijsvorm

There is a lecture of two hours each week. In addition, there is another session which will be half lecture and half practicum, in which there is the possibility to ask questions about the compulsary computerpracticum. The practicum makes use of the Matlab package.

Toetsvorm

The computerpracticum counts for 70%, the oral examination concerns the theory and counts for 30%.

Literatuur

Chr. Heij, A.C.M. Ran and F. van Schagen, Introduction to Mathematical Systems Theory, Birkhauser Verlag.

Aanbevolen voorkennis

Analysis, probability theory, statistics.
Complex analysis and Fourier theory would be useful, but are not absolutely necessary.

Doelgroep

3W, mBA, mMath

Mathematics in Economics and Society

Vakcode	E_EORM_MES ()
Periode	Periode 1
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Economische Wet. en Bedrijfsk.
Coördinator	dr. I.D. Lindner
Examinator	dr. I.D. Lindner
Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak

In this course the student learns to translate economic and societal problems into a mathematical model and derive policy implications. The student will gain insight into the complex "connectedness" of modern society and economic systems. In particular, the student will learn and apply insights from network and game theory.

The aim of this course is the student being able to manage the whole process of (1) identifying the problem (2) translating it into a mathematical model (3) analyzing the model (4) concluding with a policy implication.

Inhoud vak

• Complex Network Models
• Diffusion through a connected society
• Social Learning
• Decision, Behavior and Games on Networks
• Observing and Measuring Social Interaction
• Communication and cooperation in a network
• Optimization and cooperation with an underlying network:

- Fixed and spanning tree games
- Traveling salesman and routing games
- Sequencing games
- Flow games

Onderwijsvorm

Lectures and tutorials. Exercises will be given each week. At the end of the course, students will have to submit a research proposal (which will be part of the final grade).

Toetsvorm

Final exam – Individual assessment
Assignments – Individual assessment

Literatuur

• M.O. Jackson, Social and economic Networks, Princeton University Press, Available as paperback or e-book, 2010 .
• Lecture Notes

Aanbevolen voorkennis

Students should have some background knowledge of game theory; Markov chains and discrete optimization.

OR Research Seminar

Vakcode	E_EORM_ORRS ()
Periode	Ac. Jaar (september)
Credits	6.0
Faculteit	Fac. der Economische Wet. en Bedrijfsk.
Coördinator	prof. dr. B.F. Heidergott
Niveau	400

Regional and Urban Economics

Vakcode	E_STR_RUE (60442140)
Periode	Periode 2
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Economische Wet. en Bedrijfsk.
Coördinator	prof. dr. H.L.F. de Groot
Examinator	prof. dr. H.L.F. de Groot
Docent(en)	prof. dr. H.L.F. de Groot, prof. dr. J. Rouwendal
Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak

The aim of this course is to provide students with an advanced
introduction in the field of regional and urban economics. Students
learn the theoretical and empirical methods applied in the field, and
get a good understanding of the fundamental questions that are addressed
in the field and the current state of affairs in the literature. They
are trained to critically read and properly understand contributions in
the leading journals in the field. At a more specific level, after
having taken this course, students have a good understanding of the New
Economic Geography Model, are familiar with the theoretical foundations
of agglomeration economies and their empirical relevance, understand the
theoretical foundations of and can apply spatial interaction modelling,
are familiar with regional growth theories, understand the function of
regional labour and housing markets, and have a good understanding of
the determinants of urban structures.

Inhoud vak

This course covers advanced topics in theoretical and empirical research
on regional and urban economics. Key issues are location and potential
reasons for clustering of economic activity, spatial interaction
(migration, trade, FDI and commuting), patterns of regional economic
convergence and divergence, the role of geographic factors in explaining
regional economic growth performance, the impact of (spatial)
externalities of knowledge production, urban size and growth, urban land
use, housing markets and the functioning of regional labour markets. The
topics are addressed from a theoretical as well as an empirical
perspective.

Onderwijsvorm

Lectures and Tutorials

Toetsvorm

Written exam (70 percent; individual assessment) and Assignments (30
percent; group assessment). A minimum grade of 5.0 for the exam is
required.

Literatuur

• Brakman, S., J.H. Garretsen and C. van Marrewijk (2009): The New
Introduction to Geographical Economics, Cambridge University Press,
Cambridge.
• Ciccone, A. and R.E. Hall (1996): 'Productivity and the Density
of Economic Activity', American Economic Review, 86, pp. 54-70.
• Gallup, J.L., J.D. Sachs and A.D. Mellinger (1999): 'Geography
and Economic Development', International Regional Science Review, 22,

pp. 179-232.
• Glaeser, E.L. and M.E. Kahn (2003): 'Sprawl and Urban Growth',
in: J.V. Henderson and J.-F. Thisse (eds), Handbook of Urban and
Regional Economics, Volume 4, Chapter 56, Elsevier, Amsterdam.
• Glaeser, E.L., H.D. Kallal, J.A. Scheinkman and A. Shleifer
(1992): 'Growth in Cities', Journal of Political Economy, 100, pp. 1126-
1151.
• Krugman, P. (1991): 'History and Industry Location: The Case of
the US Manufacturing Belt', American Economic Review, 81, pp. 80-83.

Simulation and Stochastic Systems

Vakcode	E_EORM_SSS (64412010)
Periode	Periode 4
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Economische Wet. en Bedrijfsk.
Coördinator	dr. A.A.N. Ridder
Examinator	dr. A.A.N. Ridder
Docent(en)	dr. A.A.N. Ridder
Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak
The main objective of this course is to learn how to develop and execute
a simulation study of a stochastic system. This incorporates all aspects
of an operations research study: data collecting, modeling, analyzing,
programming, writing a report and presenting the results. A second goal
is to learn advanced simulation techniques in financial and oprational
systems.

Inhoud vak
The course gives a broad treatment of the important aspects of
stochastic simulation and its applications to queuing, reliability,
manufacturing, risk analysis, and financial models. The topics covered
include random number generators, generating random variates, generating
sample paths of diffusion processes, statistical output analysis,
steady-state simulation, variance reduction techniques, importance
sampling, quasi-Monte Carlo methods, and stochastic optimization. The
emphasis is on the mathematical analysis and properties of these
simulation methods. There will be assignments in which the students
apply simulation issues to problems either by theoretical analysis, or
by programming. The simulation programs are written in a software
language (allowed are C, C++, Java, Julia, Matlab, Ox, Python and R) and
not by using a simulation package. Towards the end of the course the
student studies a scientific paper on a simulation topic and gives a
presentation of it.

Onderwijsvorm
lecture and tutorial

Toetsvorm
1. Written exam (50%)
2. homework problems (30%)
3. Paper presentation (20%)

Literatuur
Paul Glasserman, Monte Carlo Methods in Financial Engineering, Springer
2003 (paperback version 2010)

Vereiste voorkennis
Probability and Statistics, Stochastic models, Programming experience.

Doelgroep
graduate students in econometrics, operations research, applied
mathematics, quantitative finance

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 BlackBoard.

Vereiste voorkennis
A programming language.

Aanbevolen voorkennis
Stochastische Processen (X_401026) and Wachtrijmodellen (X_401061) or
equivalent courses on Stochastic Processes and Queueing Theory.

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	prof. dr. J. van den Berg
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
The following books will be used:

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.

Supply Chain Management

Vakcode	E_BA_SCM ()
Periode	Periode 1
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Economische Wet. en Bedrijfsk.
Coördinator	dr. E. Spiliotopoulou
Examinator	dr. E. Spiliotopoulou
Lesmethode(n)	Hoorcollege, Werkcollege
Niveau	400

Doel vak
During the Master TSCM courses, the context will be expanded to
encompass multiple companies. The central theme is cooperation between
shippers, customers and logistics service providers. The objective of
this course is to introduce students to the topic of demand & supply
chain management and to discuss relevant concepts to matching supply and
demand in these chains. More specifically, upon completion of this
course you will be able to:
- Analyse the strategy, structure and planning of a supply chain in a
fact-based and structured manner;
- Develop recommendations for improving the strategy, structure and
planning of a supply chain.

Inhoud vak

After an introduction to the concepts of SCM, we will discuss the design and implementation of SCM concepts taking into account the flow of information, money and materials across the supply chain. Amongst other issues, the following questions will be dealt with in this course:
- What is the interaction among general business strategy and logistics strategy? What is the effect of logistics trends on managing the value chain?
- How can you manage inventories to minimize costs without compromising your customer service level?
- What are the different forecasting techniques and how to choose a forecasting method?
- How can supply chains be supported by supply contracts and what is the value of information in a supply chain?
- What concepts exist to match supply and demand in value chains? How to plan inbound, internal and outbound logistics in an integrated way?
- What is the role of strategic alliances in supply chain management? (both in sourcing and distribution)

Onderwijsvorm

Hearing lectures and tutorials
In small groups, the students will work on an assignment for a specific supply chain. Separate assignment meetings will be scheduled. Additional relevant theory and literature has to be searched for by the groups.

Toetsvorm

Written exam and assignments

Literatuur

Simchi-Levi, D., Kaminsky, P., Simchi-Levi, E. (2008). Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies (3rd ed). Irwin: McGraw-Hill.
Additional material (via blackboard)

Vereiste voorkennis

All non-TSCM Master students (including all exchange students) are required to contact the course coordinator before enrolling; permission from the course coordinator is obligatory prior to participating in this course.

Aanbevolen voorkennis

The contents of Chopra & Meindl (Supply Chain Management: strategy, planning and operation)

Thesis

Vakcode	E_EORM_THS ()
Periode	Ac. Jaar (september)
Credits	18.0
Voertaal	Engels
Faculteit	Fac. der Economische Wet. en Bedrijfsk.
Coördinator	dr. A.A.N. Ridder
Examinator	dr. A.A.N. Ridder
Niveau	500

Doel vak

The thesis is the final stage of the MSc program in EOR in which the student demonstrates her/his abilities to conduct independent academic research on a specific topic in the field of EOR. The goals are (1) to practice the art of conducting independently academic research; and (2) to record the results of this work in an academic paper.

As part of goal (1) the student needs to formulate the research question, to find the appropriate literature, to develop a mathematical model of the problem, to collect data for validating and or estimating the model, to analyse the model using acquired skills and techniques, to implement and verify scientific computer programs, and finally to come up with solutions that could be based on analytical, numerical, or empirical methods.

As part of (2) the student needs to be able to write a professional paper that describes clearly the research questions, the research design, the contribution of the work, the used methodology, and the conclusions.

Inhoud vak

The thesis research is supervised by a faculty member. The research starts at the beginning of the second Semester of the master program by proposing a research topic and supervisor. It might also be possible to choose a research topic that is suggested by a faculty member. These matters are dealt with during a meeting with the contact person of the EOR department in the field of specialization and interest. In some cases it is possible to write the thesis based on an internship. This is assessed by the contact person and by the supervisor.

When you know your thesis topic and thesis supervisor, you immediately inform these to the thesis coordinator dr. A.A.N. Ridder (a.a.n.ridder@vu.nl) and the secretary of the department mrs Hedda Werkman (secretariaateconometrie.feweb@vu.nl). Also, make sure that you are enrolled in the Blackboard site of the thesis. This site contains important information on the thesis procedures, and the thesis editing style.

Every month a seminar (the so-called thesis seminar) is arranged for all faculty and for all students who are engaged in producing a thesis. At the beginning of his/her thesis research, the student gives an introductory talk of about five minutes in which (s)he briefly accounts the thesis statement and problem. Students whose theses have been approved by the thesis supervisor hold a final presentation lasting at most half an hour. For each thesis presentation one student acts as designated discussant.All students engaged in a thesis receive a monthly invitation to the seminars, and are expected to attend these seminars.

Since you need to give the co-reader and the opponent enough time to read your thesis, you submit the final version at least ten days before the presentation. However, for theses that will be presented after 10 August, you have to
submit before 1 August! Submitting means that your thesis should be final and ready to upload to the thesis database of the university library.

In case you do not meet the deadline of 1 August and you decide to

continue working for submission and presentation in the next academic year, the grade will be capped at 6.0. You may apply for an exemption of the grade cap when there are good reasons for the delay. Send an email to the thesis coordinator dr. A.A.N. Ridder (a.a.n.ridder@vu.nl) accompanied by an endorsement of your supervisor.

The following aspects are part of the assessment criteria and shall receive due consideration.
- Research question: formulate clearly an original research problem (maybe with subproblems).
- Positioning in literature: review relevant studies.
- Research design: address the methodological issues, the data collection and the application of theory.
- Description and analysis of results: show understanding of the research question and present a readable derivation of the complex analysis.
- Conclusion and discussion: succeed putting the findings in a wide context.
- Editorial quality: compile a sound academic paper, typeset in LaTeX.
- Degree of independence: show your own work and do not always wait for input of your supervisor.
- Oral presentation: present the main findings of your thesis in a structured and timely manner that is easy to follow; answer questions well and clear.

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Onderwijsvorm
Individual supervision by a faculty member.

Toetsvorm
Written thesis and oral presentation.

Doelgroep
masters EOR.

Time Series Econometrics

Vakcode	E_EORM_TSE (64432000)
Periode	Periode 4
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Economische Wet. en Bedrijfsk.
Coördinator	prof. dr. S.J. Koopman
Examinator	prof. dr. S.J. Koopman
Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak
To gain insights in economic time series modelling with a focus on theory, methods and computations.

Inhoud vak

This course focuses on the advances of theory and computational methods
for time series econometrics. A methodology of econometric programming
is explored for a number of selected topics in time series analysis. In
particular, time series properties in time and frequency domains,
different modeling strategies, likelihood evaluations, filtering methods
and Monte Carlo simulation methods are studied. Theory and methods are
studied thoroughly while some computer programs need to be developed for
the implementation of the methods.

Onderwijsvorm

lecture
tutorial

Toetsvorm

written interim examination
50 percent
written assignments
50 percent

Literatuur

Selection of literature:
- Brockwell, P.J. & R.A. Davis, Time Series: Theory and Methods.
Springer-Verlag, 1991,2nd edition.
- Durbin, J. & S.J. Koopman, Time Series Analysis by State Space
Methods. Oxford University Press, 2001.
- Kim, C-J & C.R. Nelson, State-Space Models with Regime Switching. The
MIT Press, 1999.

Transport Economics

Vakcode	E_STR_TREC (60432050)
Periode	Periode 4
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Economische Wet. en Bedrijfsk.
Coördinator	dr. A.J.H. Pels
Examinator	dr. A.J.H. Pels
Docent(en)	dr. A.J.H. Pels
Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak

The aim of this course is to provide students with an advanced knowledge
of contemporary transport economics, considering both intra-city
transport (e.g. congested road traffic, urban transit) and inter-city
transport (notably aviation). Students

- learn theoretical and empirical methods applied in the field of
transport economics and in related fields, such as transport planning.
- get a good understanding of the fundamental policy questions that are
addressed in the field, and the methods with which these are addressed.
- learn the current state of affairs in the literature.
are trained to critically read and properly understand contributions in

the leading journals in the field.

Inhoud vak

This course covers advanced topics in theoretical and empirical research on urban transport economics. Key issues are demand analysis; cost functions and scale economies for various modes; congestion analysis in static and dynamic formulations; network equilibrium and optimum for deterministic and stochastic network models; first-best and second-best pricing in static and dynamic networks; investment analysis under first-best and second-best pricing; and industrial organization aspects of intra-city (e.g. roads and transit) and inter-city (e.g. airports and airlines) transport. The topics are addressed from a theoretical as well as an empirical perspective.

Toetsvorm

written interim examination: 70 percent
assignments: 30 percent (paper review tutorial 10 percent, network optimization tutorial 10 percent, methods tutorial 10 percent)

Literatuur

- Small, K.A. and E.T. Verhoef, The Economics of Urban Transportation. Routledge, 2007.
- Additional literature for more specialized topics will be announced at the start of the course.

Aanbevolen voorkennis

Microeconomics for spatial policy or a similar course