Econometrics & Operations Research

First year courses

Compulsory Courses Year 1

School of Business and Economics
Linear Algebra

Full course description

Operations with vectors and matrices, systems of linear equations, vector spaces, eigenvalues and linear mapping

Course objectives

- learn the concepts and techniques in the field of linear algebra that are prerequisite for ‘probability theory’, ‘(applied) statistics’, ‘mathematical economics’ and ‘operations research’ - obtain the right attitude with respect to (abstract) mathematics - learn to write down a correct mathematical reasoning - learn to give (simple) proofs

Prerequisites

- perform basic arithmetic operations and simplify algebraic expressions - perform basic arithmetic operations with fractions - solve simple (in)equalities

Recommended reading

Syllabus

**EBC1008**

**Period 1**
5 Sep 2016
22 Dec 2016

[Print course description]

ECTS credits:
6.5

Instruction language:
English

Coordinator:
M.J.M. Jansen

Teaching methods:
Lecture(s), Assignment(s)

Assessment methods:
Participation, Written exam

School of Business and Economics
Microeconomics

Full course description

This course is an introduction to microeconomics, the economics branch concerned with the decisions of individual consumers and firms and how these decisions are connected to, and interact on, markets. Consumer decision-making is analysed first, leading to insights into the demand for goods and services at the market level. The analysis of firm behaviour follows, leading to the study of different factors that determine the supply of goods and services. The two sides are integrated to see how markets act to coordinate supply and demand. The course examines four different market structures: perfect competition, monopoly, oligopoly, and monopolistic competition. The effects of different market structures on prices, quantities traded and welfare are explained. In general, monopoly has undesirable outcomes, and often prompts government intervention under the rubric of competition policy. The literature studied in the course is applied to some recent cases in competition policy. A parallel skills training integrates basic mathematical tools by discussing formal problems from the microeconomics textbook.

Course objectives

"Understand the basic concepts and tools from microeconomics, such as opportunity costs, models and “marginal” analysis. Learn to recognize the potential of these tools in practical applications. Learn to apply basic mathematical tools to help modelling economic problems."

Prerequisites

Basic mathematical principles, especially from calculus (comparable to the mathematics part of course Quantitative Methods 1, code EBC1005/1006/1007).

Recommended reading


School of Business and Economics
Analysis I

Full course description

Logic and mathematical reasoning, sequences, differential and integral calculus of functions of one variable.

Course objectives

learn the concepts and techniques in the field of differential and integral calculus that are prerequisite for ‘probability theory’, ‘(applied) statistics’, ‘mathematical economics’ and ‘operations research’

obtain the right attitude with respect to (abstract) mathematics

learn to write down a correct mathematical reasoning - learn to give (simple) proofs.

Prerequisites

- perform basic arithmetic operations and simplify algebraic expressions.
- perform basic arithmetic operations with fractions.
- solve simple (in)equalities.
- manipulate exponentials and logs.
- recognise the main characteristics of the graph of a function.
- apply the arithmetic rules for differentiating functions.
- optimize a function of one variable.
- evaluate elementary integrals.

Recommended reading

Syllabus.

EBC1016

Period 1
5 Sep 2016
22 Dec 2016

Print course description

ECTS credits:
6.5

Instruction language:
English

Coordinator:
J. de Graaff

Teaching methods:
Lecture(s), Assignment(s)

Assessment methods:
Participation, Written exam

School of Business and Economics

Macroeconomics

Full course description

The course provides an introduction into modern macroeconomic theory and economic policy. This gives basic tools needed to analyse macroeconomic developments. The course covers short-run
fluctuations, medium-run equilibrium, and also long-run growth. It discusses macroeconomic policy in a European context, but in a globalizing world. The course includes training in presentation skills, where small teams present and discuss macroeconomic data for various countries.

Course objectives

- learn how to analyse the macroeconomic performance of a country
- learn to understand how to interpret and understand various types of economic policy
- understand current discussions about fiscal and monetary policy
- training in presentation- and team-skills

Prerequisites

Coverage of basic mathematics, in particular algebra. An advanced level of English

Recommended reading


School of Business and Economics

Probability Theory

Full course description

Probability theory is the branch of mathematics concerned with analysis of random phenomena. It thus forms the mathematical foundation of statistics and is essential for understanding the quantitative analysis of large sets of data. The course covers the key concepts and tools from probability theory that are required at later points in the programme. Important topics are random variables and probability distributions, dependence between multiple random variables, and convergence of random variables. The course starts in period 4 and continues until the end of period 5.
Course objectives

The purpose of the course is to introduce students to formal probabilistic concepts that are required for a theoretical understanding of statistical and econometric concepts. Students should be able to apply the acquired methods to problems in econometrics, economics, finance, and other fields.

Prerequisites

Differential and integral calculus, elements of mathematical analysis, linear algebra, and set theory.

Recommended reading


Full course description

This course provides an introduction to the fundamentals of finance. Students learn how capital markets function and how individuals and companies wishing to raise capital approach financial markets. Students learn how to make investment decisions. The basic concepts of risk and return shall be taught. Equity markets and Bond markets are introduced and the tools with which to price stocks, bonds and other financial assets, which trade on financial markets, are covered. Analytical problems are applied to financial problems during tutorial group meetings to ensure students are provided with a solid grounding in finance from both a corporate and a personal perspective.

Course objectives

Learn how capital markets function. Apply knowledge to financial problems, capital budgeting and
**Prerequisites**

No specific required knowledge requested

**Recommended reading**

Berk & De Marzo, Corporate Finance, Pearson

**School of Business and Economics**

**Analysis II**

**Full course description**

Functions of more than one variable, series, multiple integrals.

**Course objectives**

"can check the topological properties of a subset of the plane. Know how to prove that a function of two variables is continuous. Be able to apply the Implicit Function of Theorem. Know how to prove that a function of two variables has a directional derivative or is (totally) differentiable. Learn to solve constrained and unconstrained optimisation problems."

**Prerequisites**

- differential and integral calculus for functions of one variable (as, for instance, in the course Analysis 1) - elementary linear algebra (as, for instance, in the course Linear Algebra). An advanced level of English.

**Recommended reading**

Syllabus
School of Business and Economics

Quantitative Introduction to Business

Full course description

This course introduces the most important managerial aspects of businesses, with the aim to provide the student with a clear overview of all functions that play a role in running a business. We discuss the functional areas within business with an emphasis on operations, and marketing. We will use a quantitative approach in the sense that for each of the areas one or two concepts are translated into models that can be solved with mathematical and statistical tools. These tools (and their further development during the studies) form an important element of the econometrics and OR study. This course aims at placing the tools in the right perspective from a managerial point of view. The technical level of the problems will be adapted to the knowledge of high school students. The set-up of the course is as follows: In the weeks 1-2: introduction business management and we discuss business strategy in general. In the weeks 3-4 we discuss problems on a strategic level such as strategic capacity management and location decisions. In the weeks 5-6 we discuss problems on the tactical level such as aggregate planning and inventory management. In week 7 we end with problems on the operational level such as job scheduling.

Course objectives

In this course the student will get an overview of the concept of running a business, including the functional areas. In each area we focus on quantitative modelling and the decision making process. Specific learning goals are 1. Get an overview of all functional areas of running a business, and their role in the process. 2. For three specific functional areas a more in-depth discussion is integrated with the course. 3. The use of basic quantitative (both statistical and OR) techniques will be incorporated in the course mainly for showing where quantitative methods can be used to model and solve real-life business problems.
Recommended reading


EBC1036

Period 1
5 Sep 2016
28 Oct 2016

Print course description
ECTS credits: 6.5
Coordinator: C.P.M. van Hoesel
Teaching methods: PBL, Lecture(s), Assignment(s), Presentation(s)
Assessment methods: Attendance, Participation, Written exam

Compulsory Skills Year 1

School of Business and Economics
Orientation

Full course description

This course will be taught in every period except the 3rd. In each period the course covers one particular subfield of the study programme: operations research in period 1, mathematical economics in period 2, econometrics in period 4, and actuarial sciences in period 5. In period 6, a skills period, you will be introduced to a computer algebra tool. During lectures, tutorials and computer sessions students will get to know the basic concepts of each subfield, as well as a preview of the mathematical and statistical toolbox of social sciences, business management, economics and actuarial science.

Course objectives

In this course students will get a basic overview of the main problems, techniques and tools that they will encounter during the Bachelor Programme Econometrics & Operations Research. Students will learn various concepts and applications for practical problem solving, work with actual data, and get to know important software packages, especially for operations research and statistical analysis.

Prerequisites

Ordinary algebra and calculus, set theory, basic probability theory.
Recommended reading


### EBS1008

<table>
<thead>
<tr>
<th>Year</th>
<th>1 Sep 2016</th>
<th>31 Aug 2017</th>
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**ECTS credits:**
4.0

**Instruction language:**
English

**Coordinator:**
J. de Graaff

**Teaching methods:**
PBL, Presentation(s), Lecture(s), Assignment(s)

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School of Business and Economics

**Reflections on academic discourse**

**Full course description**

"The present skills training is about the value of ideas in understanding our environment. The discussions provoked by the economic crisis will help you to consider why some theories are relevant over a certain time period in various cultures and others are not, while at the same time proponents of both sets of theories seem to consider their respective theories as absolutely true. We will encourage you to examine why for many theories that seem to be quite successful, you can find an opposite theory that is adopted by many other academics or practitioners. You have to choose a topical area to which you want to apply this course. All first years students in this School follow this course together (i.e. Economics Econometrics, Fiscal Economics and International Business students will meet each other)."

**Prerequisites**

No specific required knowledge requested

**Recommended reading**

Second year courses

**Compulsory Courses Year 2**

School of Business and Economics

**Optimisation**

**Full course description**

In this course the student will learn to solve both linear and non-linear constrained optimization problems.

**Course objectives**

In this course the student will learn to solve both linear and non-linear constrained optimization problems.

**Prerequisites**

"Basic algebra (for linear programming), and advanced calculus (for nonlinear programming). Exchange students need to be aware that very specific pre-knowledge is required for this course. A solid background in mathematics is necessary. Students should be aware of the following concepts: Algebra: working knowledge of vector computing and matrices (including inverse matrices). Linear equations, and find the solutions of a set of equations etc. Function theory on the level of optimisation of functions of multiple variables under side conditions (Lagrange multipliers) An advanced level of English."
Recommended reading


EBC2105

Period 1
5 Sep 2016
28 Oct 2016

Print course description

ECTS credits:
6.5

Instruction language:
English

Coordinator:
C.P.M. van Hoesel

Teaching methods:
PBL, Lecture(s), Assignment(s)

Assessment methods:
Written exam, Participation, Attendance

School of Business and Economics

Macroeconomics and Finance

Full course description

"The 1st (finance) part deals with basic issues in finance, such as risk diversification and asset pricing, investment valuation, market efficiency, capital structure, derivatives. The 2nd (macro) part of the course deals with models of exchange rate determination, basic macro models of aggregate supply and demand, evaluating the relative effectiveness of government policies within these frameworks, models of financial crises, theory and practical implications of optimum currency areas."

Course objectives

Finance part: - Understand what finance theory says about how risky securities are priced in equilibrium. - Understand the implications of the previously mentioned points for risky investment valuation. - Understand how the optimal capital structure of a firm is determined. Learn about derivatives and their use as risk management tools by firms and investors. Learn about the valuation of derivatives. Macro part: Understand the factors underlying exchange rates - Understand the relative (in)effectiveness of monetary and budgetary policy in open economies - Understand the conditions under which monetary union is sustainable, its advantages and drawbacks - Understand the triggers of financial crises

Prerequisites

Students are expected to understand the following finance concepts: Types of securities (stocks, bonds) and their returns; Markowitz’ portfolio theory (risk-return relationships, efficient frontier, security market line), CAPM (capital market line, beta); definitions and implications of market
efficiency; principles of time value of money; basic statistical concepts like mean, variance, correlation and how to calculate them. Students are expected to master the following macro concepts: standard macro models like the IS-LM model; comparative statics on the equilibria within such models; the relative effectiveness of monetary and fiscal policies under fixed and flexible exchange rates regimes.

**Recommended reading**


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**Full course description**

In the first part of the course students apply basic concepts of the programming language, including functions, selection structures, repetition and loop statements, data structures, and user-defined classes, in order to solve small programming tasks. In the second part the emphasis will be on how to analyse a programming task, how to design a solution and how to transform the solution into a program. Students get to know sorting algorithms and heuristics for simple combinatorial optimisation problems.

**Course objectives**

Students learn to design and implement algorithms in an object-oriented programming language (either C++ or Java). They learn all basic concepts of the programming language, including the implementation of simple classes and the usage of abstract data types as provided in the standard class library. Finally they learn the impact of the choice of data structures on the running time of an algorithm, and how to solve simple combinatorial optimisation problems.
Prerequisites

Analysis I, Linear Algebra, Optimisation, strong mathematical skills.

Recommended reading

Will be announced later.

School of Business and Economics

Operations Research

Full course description

The course concentrates on algorithmic techniques to approach both theory and practice of problem solving in Operations Research. As a foundation, we start with an introduction to problem encoding and analysis of algorithms and computation times. The focus is then on classical problems from Combinatorial Optimisation, namely shortest path problems, minimum spanning trees, maximum flow and minimum cost flow problems and matching problems. For all problems, one or several algorithms will be discussed and analysed in-depth. Along the way, several other classical problems from Operations Research will be mentioned, such as colouring problems, scheduling problems, project management, and facility location. Finally, we study the foundations of stochastic processes and Markov Chains, with applications to the analysis of queues and queueing systems.

Course objectives

Application of deterministic and stochastic techniques to theoretical and practical optimisation problems in OR.

Prerequisites

Analysis, linear algebra, basic probability theory, linear programming (modelling and solving), C++.
Exchange students need to be aware that very specific pre-knowledge is required for this course. A solid background in mathematics is necessary.

**Recommended reading**

"Network Flows" by Akuja, Magnanti, and Orlin (chapters 2-7, 9, 12, 13). In addition, several chapters of other textbooks in Combinatorial Optimiziation and Operations Research.

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**School of Business and Economics**

**Mathematical Statistics**

**Full course description**

Mathematical Statistics is a sequel to the first-year Probability Theory course. Here we utilise the formal tools of probability distributions to introduce you to the principles of statistical inference. Whereas probability theory can be seen as a branch of deductive mathematics, statistical inference proceeds by inductive reasoning. What this means, in a nutshell, is that general conclusions about entire populations (the “real world”) are based on relatively small samples extracted from it (the “data”). It is impossible to make such generalisations without some risk of being wrong. Indeed, much of the “mathematical” content of statistics serves precisely to evaluate and control that risk. The subject matter covered in the course includes random samples and sampling distributions, methods of point estimation, interval estimation and hypothesis testing, the evaluation of these methods in small and large samples, and some applications, with an emphasis on simple linear regression and the bootstrap.

**Course objectives**

"Understanding of statistical principles: population models and sampling processes; sampling theory in small samples and in large samples. Understanding of main methods of statistical inference: point estimation, hypothesis testing, interval estimation. Working knowledge of linear regression models and bootstrap methods. Some applications of statistical models and methods to practical problem solving."
Prerequisites

Algebra, calculus, mathematical analysis, set theory, and probability theory. ATTENTION: This course is NOT introductory. The material studied in this course relies very heavily on the material from Chapters 1 through 5 of Casella & Berger (2002). These chapters are assumed to have been studied before the course and are therefore not discussed during the course. A thorough prior knowledge of probability theory on the level of Chapters 1 through 5 of Casella & Berger (2002) is therefore required for this course. Basic knowledge of probability theory through an introductory course is not sufficient.

Recommended reading


School of Business and Economics
Information, Markets and Organisations

Full course description

The course covers a number of models and theories dealing with choice under uncertainty. The topics covered by the course are: the expected utility theory, individuals’ attitudes towards risk, dominance criteria, Bayesian updating, portfolio choice problem, and the no-arbitrage principle for financial markets.

Course objectives

"upon the completion of the course, the students will be familiar with the most fundamental ideas and theories in the field Microeconomics of Uncertainty, such as the expected utility theory, and the idea of markets for state--contingent contracts. They will be able to apply their theoretical knowledge to
real–life problems involving risk or uncertainty, such as a portfolio selection problem, the choice of an optimal level of insurance, etc."

**Prerequisites**

"Analysis II (EBC1032), Microeconomics (EBC1012), Probability Theory (EBC1024), Game Theory and Economics (EBC2110). Economics students and exchange students should be aware of the challenging technical level of this course. Required is the knowledge of first-year Quantitative Methods, Microeconomics, and of basic Game Theory."

**Recommended reading**

Information Economics by U. Birchler and M. Bütler; Routledge, 2007

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**School of Business and Economics**

**Game Theory and Economics**

**Full course description**

"This course discusses the main concepts from cooperative and non-cooperative game theory: - Cooperative game theory: core, Shapley value, nucleolus. - Non-cooperative game theory: Nash equilibrium, subgame perfect equilibrium, Bayesian and perfect Bayesian equilibrium. The emphasis will be on concepts and applications. Applications range from oligopoly theory to job market signalling, investment policies, organisational strategies, and cost allocation."

**Course objectives**

Knowledge of the main concepts in cooperative and non-cooperative game theory; skills in applying these concepts in economic models."
Prerequisites

1. The course is open for all students, although Economics students should be aware of the challenging technical level of this course. The course Thinking strategically could be a proper alternative. 2. This course is compulsory for 2nd-year students Econometrics and Operations Research. 3. Exchange students need to follow a Bachelor in economics, not in business and must have a decent level in mathematics, especially calculus. Some prior knowledge about microeconomics would be helpful. An advanced level of English.

Recommended reading


EBC2110

Period 2
31 Oct 2016
23 Dec 2016

ECTS credits:
6.5

Instruction language:
English

Coordinator:
A.J. Vermeulen

Teaching methods:
PBL, Lecture(s), Assignment(s)

Assessment methods:
Written exam, Participation

School of Business and Economics

Econometric Methods I

Full course description

"ECONOMETRIC METHODS I" IS THE NEW TITLE FOR THE COURSE PREVIOUSLY LABELLED "ECONOMETRIC METHODS". This course is part of the programme for second-year econometrics students. The challenge of econometrics is to answer the question, what everyday reality has to tell about economic theories. Here, everyday reality takes the form of numerical observations or 'data', while economic theories are translated into a formal statistical 'model' with corresponding hypotheses. In order to extract as much information as possible out of the former concerning the latter, an appeal is made to statistical induction. These are the 'econometric methods' that are the subject of this course. They comprise mainly the estimation of the model parameters, the testing of the model hypotheses, and making (conditional) predictions with the model. We will study the most frequently used statistical methods and techniques in the first place for the classical linear model, but we mainly focus of the matrix notations of usual linear estimators and test statistics (e.g., OLS, OLS, the t-tests, F-test). Those estimators will be implemented during the tutorial meetings using the
software package GAUSS. Further some important assumptions will be relaxed and alternative estimators (GLS, SURE) will be investigated in the presence of autocorrelation and heteroskedasticity. This course also emphasize dynamic models and time series econometrics (ARMA, VAR, cointegration, unit root, VECM,...). Applied works (GAUSS and Eviews) will be carried out during tutorial meetings. The course Econometrics Methods II in the programme for the third-year econometrics students, covers issues that we do not do in this course (IV, GMM, ML,...).

**Course objectives**

Students will have a good knowledge of econometric methods. They will have the skills to apply these methods to a set of economic data.

**Prerequisites**

A first course in econometrics (see, e.g. Empirical Econometrics). Exchange students should have advanced knowledge of: 1) Mathematical statistics, 2) probability theory, 3) matrix algebra, 4) introduction to quantitative methods with an emphasis to the linear model An advanced level of English.

**Recommended reading**


**EBC2111**

Period 5  
18 Apr 2017  
9 Jun 2017

[Print course description]

ECTS credits:  
6.5

Instruction language:  
English

Coordinator:  
A.W. Hecq

Teaching methods:  
PBL, Lecture(s), Assignment(s)

Assessment methods:  
Written exam, Oral exam

**Compulsory Skills Year 2**

School of Business and Economics
Second-year Project I

Full course description

Students work in teams on two problems each taking one week. In the first week this problem relates to the courses Optimization and Game Theory and Economics. In the second week it is related to Programming and therewith involves the writing of a software program. At the end of each week they have to hand-in a report on their solution and at the end of the second week they have to present some of their results in a seminar.

Course objectives

Students learn how to apply and combine theories and techniques to a complex problem. They learn how to work on such problems in teams, how to summarize the results in a report and a presentation.

Prerequisites

First half of second year Econometrics and Operations Research.

Recommended reading

Articles

EBS2002

Period 3
9 Jan 2017
3 Feb 2017

Print course description

ECTS credits:
4.0

Instruction language:
English

Coordinator:
A.J.A. Storcken

Teaching methods:
Presentation(s)

Assessment methods:
Final paper

School of Business and Economics

Second-year Project II
Full course description

Students do practical assignments related to the courses of the second semester.

Course objectives

Apply theory learnt in the courses of periods 3 and 4.

Prerequisites

Econometric Methods.

Recommended reading

Articles.

ECTS credits: 4.0
Instruction language: English
Coordinator: A.W. Hecq
Teaching methods: PBL
Assessment methods: Final paper, Oral exam

Third year courses

Compulsory Courses Year 3

School of Business and Economics

Econometric Methods II

Full course description

"ECONOMETRIC METHODS II" IS THE NEW TITLE FOR THE COURSE PREVIOUSLY LABELLED "DYNAMIC MODELLING". The course is designed as a follow-up to the second-year course Econometric Methods 1 (EBC2111), reviewing known methods somewhat more formally before introducing the new ones. The intended main topics are (1) a quick review of linear models, (2) Instrumental Variable methods (IV),
(3) Maximum Likelihood methods (MLE), (4) Generalised Methods of Moments (GMM), (5) nonlinear models for choices, counts, corner solutions etc., (6) linear models for panel data. These topics will be treated at a fairly advanced level, starting from abstract assumptions about a multivariate world described in terms of vectors and matrices.

Course objectives

(1) Thorough understanding of standard econometric models and methods for the analysis of independent data; independent data are typically cross-sectional, as opposed to time series which are sequential and generally serially dependent. (2) Additionally, some practical experience with the application of the methods, the interpretation of the models, and the evaluation of inferences. (3) In particular, providing background and warming up for students about to write a Bachelor thesis on an empirical topic.

Prerequisites

Linear algebra, mathematical statistics (EBC2107), Econometric Methods 1 (EBC2111) or the equivalent. Familiarity with statistical software like Stata and Gauss, Matlab or R.

Recommended reading

Allocations and Algorithms

Full course description

Economic entities like companies, non-governmental organizations, and municipalities are continuously faced with difficult logistics problems. Finding good solutions to these logistics problems is crucial for improving economic performance, and hence it comes by no surprise that the design of efficient algorithms for all kinds of optimization problems has been a flourishing area of research in computer science and operations research for many decades already. This course will introduce fundamental techniques in algorithm design (e.g., greedy algorithms, graph algorithms, convex programming, and local search) that are used to derive efficient algorithms and heuristics for various optimization problems. It will also be discussed how to translate algorithmic ideas into working code, and many exercises and small cases will be discussed. In the second part of this course a short introduction to algorithmic game theory will be given, a young area at the interface of economics and computer science. It deals with computational questions of economic models, like, for example, the question of how efficient equilibria can be in the worst case and how they are computed efficiently.

Course objectives

The aim of this course is to familiarize students with basic algorithmic techniques and to give a short introduction to the field of algorithmic game theory. The students will also learn how to translate algorithmic ideas into working code.

Prerequisites

Basic courses in linear programming/algebra, basic knowledge of combinatorial optimization (discrete Operations Research).

Recommended reading

Various research papers in the field of location/allocation.

EBC2121

Period 4
6 Feb 2017
7 Apr 2017

Print course description
ECTS credits:
6.5
Instruction language:
English
Coordinator:
A. Berger
Teaching methods:
Work in subgroups, PBL, Presentation(s), Lecture(s), Assignment(s)
Assessment methods:
Attendance, Written exam

School of Business and Economics
**Actuarial Mathematics**

**Full course description**

This course is an Actuarial elective (cannot be used as an IBE/IES/Infonomics elective). The principal aim of this course is to provide students with a solid grounding in the subject of life contingencies for a single life, and experience of its application to the analysis of life insurance and life annuity (including pension) contracts. This subject arises through a fusion of compound interest theory with probability theory, and provides the mathematical framework necessary for analysing such contracts, which are essentially long term financial transactions in which the various cash flows at different times are contingent on the death (life insurance) or survival (life annuities) of one or more specified human lives. Having developed this framework, we can address issues such as how to determine the premium that should be charged for a certain life insurance contract, including allowance for expenses and/or profit, and how to determine the value that should be represented in the balance sheet of a life insurance company in respect of the policies that it has sold. These examples reflect the two main traditional areas of actuarial activity within a life insurance company: pricing and reserving. The course begins with an examination of the various factors that affect mortality, and of how risk classification may be used to address the heterogeneity within a given population. Next, probabilities of survival and death are introduced, and it is shown how these may be represented within and extracted from life tables. Compound interest theory is then combined with such probabilities to analyse and evaluate both life insurance benefits and life annuity benefits. With the relevant theory fully developed, the course then becomes somewhat more applied. Premium calculation is explored in detail first, followed by the determination and application of reserves, and, in both areas, the theory is applied to quite realistic and complex problems.

**Course objectives**

See course contents.

**Prerequisites**

First two years of the Econometrics and OR bachelor program, in particular Mathematics, Probability Theory, and Mathematical Statistics.

**Recommended reading**

School of Business and Economics

Actuarial Modelling

Full course description

Various problems from actuarial sciences such as multiple life insurance, multiple decrement models, crude hazard rate, identifiability issues related to competing risk models, Lexis diagram, population models etc. are proposed to the students that will work on a small scale research project (literature overview, empirical or theoretical analysis, model building and solving, ...) under the supervision of a staff member.

Course objectives

The students learn how to extend their existing theoretical and methodological knowledge by working on a small scale research case/project related to actuarial sciences that will form the basis of the bachelor thesis.

Prerequisites

First two years of the Econometrics and OR bachelor program, in particular Mathematics, Probability Theory, and Mathematical Statistics. Actuarial courses form block 4 and 5 of year 3 are helpful, but not required.

Recommended reading

Research articles.

EBC2124

Period 5
18 Apr 2017
9 Jun 2017

Print course description
ECTS credits:
6.5
Instruction language:
English
Coordinator:
E.A. Beutner
Teaching methods:
Presentation(s), PBL
Assessment methods:
Final paper, Participation
Actuarial Statistics

Full course description

This course is an Actuarial elective. This course treats the basics of actuarial risk theory, in particular: utility theory and (re-)insurance, individual and collective loss models, ruin theory, and premium principles.

Course objectives

See course contents

Prerequisites

Level of first two years of the Econometrics and OR bachelor program, in particular Mathematics, Probability Theory, and Mathematical Statistics.

Recommended reading


EBC2125

Period 5
18 Apr 2017
9 Jun 2017

Print course description

ECTS credits:
6.5

Instruction language:
English

Coordinator:
H.J.M. Peters

Teaching methods:
PBL, Lecture(s), Assignment(s)

Assessment methods:
Participation, Written exam

Applied Research Project

Full course description

This course provides supervision to bachelor students who do an internship in Operations Research, Econometrics, Mathematical Economics or Actuarial Sciences. Students have to find an appropriate internship themselves. Interested students have to contact the coordinator for more information and terms and conditions well in advance of the beginning of the course.
Course objectives

Hands-on experience with developing models and algorithms for practical problems in Operations Research.

Prerequisites

For bachelor students in Operations Research.

School of Business and Economics

Econometrics, OR and Actuarial Modelling

Full course description

The students will extend and apply the methods learned and will have the opportunity to specialize to a certain extent in one of the main areas of the programme. Various problems from these fields are proposed to the students that will work on a research project (literature overview, empirical or theoretical analysis in economics, econometrics, OR, an actuarial science model building and solving, optimisation,...) under the supervision of a staff member.

Course objectives

The students learn how to extend their existing theoretical and methodological knowledge in mathematical economics, operations research econometrics or actuarial science by working on a research case/project that will form the basis of the bachelor thesis.
Compulsory Skills Year 3

School of Business and Economics

Introduction to Software in Econometrics, Operations Research and Actuarial Science

Full course description

Students will be trained to use software R or to use a software for modelling and solving (integer) linear programs. Applications using software R will be based on Bayesian inference of a set of standard econometric models. Special attention will be given to the development of computational algorithms such as Markov chain Monte Carlo.

Course objectives

Development of Econometric and OR methods

Prerequisites

Econometric Methods

Recommended reading

Lecture notes

EBS2043

Period 3
9 Jan 2017
3 Feb 2017

Print course description
ECTS credits:
4.0
Instruction language:
English
School of Business and Economics

**Writing a Bachelor Thesis Econometrics**

**Full course description**

The students write their bachelor thesis in either econometrics, mathematical economics, operations research or actuarial science under supervision of a staff member of Department KE.

**Course objectives**

Students will learn how to conduct a research, exploiting the technical tools learned during the first 2 years of Bachelor econometrics.

**Prerequisites**

Courses of the first 2 years of Bachelor Econometrics.

**Recommended reading**

Articles related to the chosen topic will be distributed.
Business and Economics Electives

School of Business and Economics

Productivity

Full course description

While the business cycle is a short-run phenomenon, productivity growth is fundamentally a long-run phenomenon. Therefore, this course takes a long-run, comparative view on the relationship between economic growth, productivity and global economic leadership. In week 1, we have a closer look at the phenomenon “productivity” and its measurement, and we briefly discuss the shifts in economic leadership during the past millennium. At this stage, our discussions are mostly verbal and empirical. In week 2, we switch gear to a more theoretical approach, starting with an extensive discussion of the neoclassical growth model or Solow model. Since this model fails to provide convincing answers to some important questions, we augment it in week 3: and in this context we also discuss the so called convergence debate, mainly an empirical issue. In week 4, we have a closer look at endogenous growth models. We continue this discussion in week 5, where we also address the growth issue at a deeper level of causality than normally expected in an economics course: this in fact brings us back to the historical analyses discussed in week 1. In weeks 6 and 7, after a brief discussion of some further endogenous growth models, we apply our tools to some hotly debated real-world issues: the “sustainability” problem, the rapid growth in some East-Asian economies in the past few decades, and the sluggish growth in most of the euro area. While Jones constitutes the backbone of the course, we sometimes take time out to have a closer look at empirical studies by other authors, who invariably use either the Maddison dataset, or the Summers and Heston dataset. Additionally, we occasionally dig more deeply into specific theoretical models, and also address more verbal, historical analyses.

Course objectives

Develop basic historical knowledge about the process of productivity growth since the Middle Ages. Introduction to the standard neoclassical (Solow) growth model and some augmentations, and basic endogenous growth models. Applying empirical techniques to analyse the process of productivity growth.

Prerequisites

Knowledge and understanding of introductory microeconomics and macroeconomics (comparable to courses Microeconomics, code EBC1010/1011/1012, and Macroeconomics, code EBC1018/1019/1020). Knowledge and understanding of mathematical and statistical techniques at an intermediate level, especially differential equations / dynamic systems and regression analysis (comparable to course Quantitative Methods III, code EBC2011). Exchange students need to major in economics.

Recommended reading

Selected chapters from 5 additional books, and 5 original articles from scientific journals.
School of Business and Economics

Institutions, Behaviour and Welfare

Full course description

Institutions have always been an important subject in economics. A relatively recent approach to the study of institutions in economics is the so-called New Institutional Economics (NIE). What is new in NIE as compared to the ‘old’ institutional economics is its emphasis on a firm theoretical foundation and systematic reasoning. It tries to analyse the role of institutions in society in a systematic and structured way, which is comparable to the structured approach of neoclassical economics. On the other hand, its themes are essentially different from those in neoclassical economics. One important theme of NIE are the impacts of imperfect information, bounded rationality and transaction costs. Transaction costs are ‘the costs of running the economic system’, like costs of search for information, bargaining, making and enforcing contracts, monitoring, etc. Another main theme of NIE are the effects and origins of property rights. For example, the care and effort that you spend on your apartment or house will strongly depend on whether you own or rent it. This course offers an introduction to the basic theories of transaction costs, property rights, and contracts, and applies these theories to the functioning and performance of markets, firms, and the state. Moreover, the roles of intrinsic motivation, trust, social norms, and endogenous preferences are highlighted.

Course objectives

Acquiring a structured insight into the important role of institutions in the performance of the economy Learning about the crucial roles of imperfect information, bounded rationality, transaction costs and property rights in the functioning of the economy Being able to apply the above insights to real-life developments in the economy

Prerequisites

Intermediate knowledge and understanding of microeconomics (level comparable to: course Microeconomics: Choices, Markets and Welfare ) and macroeconomics (level comparable to: course Macroeconomics and Economic Policy) An advanced level of English

Recommended reading

- Articles and chapters from books
School of Business and Economics

Digital Supply Networks

Full course description

Companies such as Amazon, Airbnb, and LinkedIn build and manage powerful supply networks to create value. The goal of this course is to provide students with an understanding of these networks and their relationships with customers as well as suppliers. We also zoom in on the digitization and innovation processes that govern these relationships. Students will critically evaluate cutting-edge thinking on these topics and discuss implications for supply chain management, strategy, and marketing.

Course objectives

This course not only provides students with concepts to understand recent digitization processes but also prepares them with the conceptual tools to manage future in supply chain, marketing, and strategy innovations.

Prerequisites

A holistic understanding of Supply Chain Management, Marketing and Strategy; a keen interest in technology and innovation; Knowledge of Internet technologies and a good command of English

EBC2045

Period 5
18 Apr 2017
9 Jun 2017

Print course description
ECTS credits:
School of Business and Economics

Options and Futures

Full course description

The basic valuation models such as the binominal Option Pricing Model and the Black and Scholes Model will be presented and discussed. Investment and hedging strategies, involving stock indices, currencies and interest rates with these new financial instruments will be studied in detail.

Course objectives

This course offers an introduction to options, forward and futures contracts, the organisation of their markets, their properties, the determination of their price and their use in trading strategies.

Prerequisites

Second-year finance course. Students should be familiar with risk and return and asset pricing concepts. Exchange students need to have taken at least one introductory finance course.

Recommended reading


EBC2053

Period 5
18 Apr 2017
9 Jun 2017

Print course description
ECTS credits:
6.5
Instruction language:
English
Coordinator:
P.J. Mauricio Rodrigues
Teaching methods:
PBL, Presentation(s), Assignment(s)
Assessment methods:
Participation, Written exam
School of Business and Economics
Investment Analysis and Portfolio Management

Full course description
The purpose of this course is to study how investors (both retail and institutional) construct and manage portfolios. We follow the investment process investors follow in real life. That is from Asset Liability Management to Strategic and Tactical Asset Allocation to Portfolio Management, Security Selection and finally Trading. Each week we study a different asset class. Next to traditional assets like listed stocks we look at the added value of real estate, mutual funds, hedge funds and private equity in order to build diversified portfolios. Finally the course will introduce you to a new development in professional asset management; Socially Responsible Investing (SRI). We study the impact of SRI on portfolio return and risk. All topics are explored via real life cases using actual data.

Course objectives
Learn to manage portfolio of financial assets. Apply to real life cases.

Prerequisites
Knowledge and understanding of: portfolio theory (CAPM), basics of derivatives (options futures, forward) and basics of statistics (OLS regression). Exchange students need to have taken at least one introductory finance course. An advance level of English.

Recommended reading

EBC2054
Period 1
5 Sep 2016
28 Oct 2016

Print course description

ECTS credits:
6.5

Instruction language:
English

Coordinator:
R.R.A.E. Otten

Teaching methods:
PBL, Presentation(s), Lecture(s), Assignment(s)

Assessment methods:
Written exam

School of Business and Economics
International Financial Accounting

Full course description

The course covers corporate financial accounting and reporting. The objectives of and international differences in financial accounting are discussed. However, the focus of the course will be on the understanding and application of financial accounting methods required by IAS/IFRS in various areas. During the meetings the required literature, questions, and assignments will be discussed.

Course objectives

"Understanding the sources and implications of international differences in accounting approaches, Becoming familiar with IAS/IFRS, but more importantly, Developing the conceptual knowledge of financial accounting in order to facilitate the understanding (i) of current financial accounting practice, (ii) of why IAS/IFRS prescribes certain accounting methods, and (iii) of why other standard setters (such as the US FASB) may have chosen to prescribe alternative methods"

Prerequisites

"2nd year courses Accounting II (EBC2002) or Finance and Accounting (EBC2007) . Students from outside the UM should have sufficient knowledge of the topics discussed in chapters 1, 2, 3, 4, 6, 7, 8, 13, 14 of the textbook of Libby, Libby, & Short "Financial Accounting".

Recommended reading

Auditing

Full course description

The course is aimed at giving students a solid introduction to auditing. The evolution of the auditing function, the role of auditing in a modern economy, the audit process of auditing, as well as the most elementary auditing techniques are discussed. The course is linked to audit practice by means of case-studies, a workshop in collaboration with a large audit firm and a guest lecture.

Course objectives

Solid understanding of the audit process; Basic knowledge of the literature on auditing; Obtain problem solving skills in auditing settings and develop experience in using and interpreting data in common decision contexts.

Prerequisites

"Internal control & accounting systems Knowledge and understanding of internal control and accounting systems (level comparable to: course Internal control & accounting systems). An advanced level of English"

Recommended reading

Textbook and articles

### EBC2058

**Period 5**
18 Apr 2017
9 Jun 2017

[Print course description](#)

**ECTS credits:**
6.5

**Instruction language:**
English

**Coordinators:**
A. Vanstraelen
L.E. Timmermans

**Teaching methods:**
PBL, Lecture(s)

**Assessment methods:**
Participation, Written exam

School of Business and Economics
**Full course description**

"The focus of this course will be on how firms (re)organise their information structures by using information technologies such as ERP-systems (e.g. SAP and Oracle), data warehouses and Business Intelligence systems. Over the last 2 decades, the availability of these systems have profoundly changed the way in which management information is produced and used within organisations. As a result, new and dynamic ways of meeting the information needs of management are emerging. But also, these developments result in new problems within firms which, again, result in new approaches in trying to face these problems. It is important to understand that this course will take a management approach to Information and Communication Technology (ICT). There will be no technical analysis of the information systems that will be discussed during this course. Also, as far as ERP systems are concerned there is no focus on a logistics point of view. However, the emphasis of this course will be on the impact these systems have on organisations and people within these organisations. More specifically, we will address the issue on how these ICT developments change the role of information within organisations, focussing on a managerial level of decision making."

**Course objectives**

"This course will build on the literature on ERP systems and Business Intelligence systems, in order to introduce students to two recently developed concepts in the IT practice: digitized platforms and big data. Could the enterprise become a full-time laboratory? What if you could analyse every transaction, capture insights from every customer interaction, and didn’t have to wait for months to get data from the field? Data are flooding in at rates never seen before as a result of greater access to customer data from public, proprietary, and purchased sources, as well as new information gathered from Web communities and newly deployed smart assets. These trends are broadly known as “big data.” Web-based companies, such as Amazon.com, eBay, and Google, have been early leaders, testing factors that drive performance—from where to place buttons on a Web page to the sequence of content displayed—to determine what will increase sales and user engagement. Companies selling physical products are also exploiting big data for rigorous experimentation using Business Intelligence technology. Ford Motor, PepsiCo, and Southwest Airlines, for instance, analyse consumer postings about them on social-media sites such as Facebook and Twitter to gauge the immediate impact of their marketing campaigns and to understand how consumer sentiment about their brands is changing. Most companies are far from accessing all the available data. Many haven’t even mastered the digital platform needed to capture and analyse the valuable information they can access. More commonly, they don’t have the right talent and processes to design experiments and extract business value from big data, which require changes in the way many executives now make decisions: trusting instincts and experience over experimentation and rigorous analysis. Graduates have academic, evidence-based knowledge and understanding of theories, methods and tools in business/economics. Graduates can apply their knowledge and understanding to identify and solve real life business/economic problems. This includes demonstrating analytical skills and a problem-solving attitude. Graduates can effectively function in a multicultural environment and work in multicultural teams. This includes demonstrating interpersonal skills and a high proficiency of English."  

**Prerequisites**

"This course requires a basic knowledge on the role of information systems in organisations. Students should be aware of the various types of information systems that are used within large organisations (e.g. operational information systems versus decision support systems). Therefore an introductory course on management information systems is recommended as a prerequisite. No technical IT knowledge is required. An advanced level of English"
Recommended reading


**EBC2061**

**Period 5**
18 Apr 2017
9 Jun 2017

[Print course description](#)

**ECTS credits:**
6.5

**Instruction language:**
English

**Coordinator:**
A.S. Joshi

**Teaching methods:**
PBL, Presentation(s), Lecture(s), Assignment(s)

**Assessment methods:**
Participation, Written exam

**School of Business and Economics**

**Operations Management**

**Full course description**

The course focuses on methodologies that have shown to be indispensable for decision making in both production and service organisations. Topics which are covered include Process Analysis, Project Management, Quality Control, Capacity Planning, Supply Chain Management, Inventory Management, Scheduling & Aggregate Planning, Material Requirements Planning, Lean Production/JIT, and Queueing Theory. Addressing these topics, several quantitative techniques that have shown to be successful in these areas will be discussed using examples and exercises. The course combines cases and exercise discussions, facilitated by students themselves.

**Course objectives**

Ability to understand and judge the role and functioning of quantitative models for decision making in the management of operations. Ability to use such models and derive managerial decisions.

**Prerequisites**

Basic knowledge of the role and scope of Operations Management within Business. Moderate mathematical skills; ability to understand quantitative models and concepts. An advanced level of English.
Recommended reading


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School of Business and Economics

Auctions and Electronic Markets

Full course description

The course is divided into three parts. Part (I) deals with fundamental results on single-item auctions under strong assumptions about the bidders and their preferences. It should not be a surprise that this classical theory is by far not sufficient when designing auctions for real applications. For example, in frequency auctions, like the UMTS auctions in Europe, or in reverse auctions like they are used in procurement, many items are sold at the same time. Furthermore, we may face problems like the winner's curse when there is uncertainty about the valuation of the items sold in an auction. Part (II) gives a detailed insight in such issues and how they can be dealt with. In Part (III), theoretical insights from part (I) and (II) are applied to particular markets for which auctions have been proposed, or are already used. We broaden our knowledge thereby by investigating the interaction between auction design and specific properties of the market. Examples of markets are electric power, highway franchising, emission rights, and listings in online search engines. Each student writes a final paper about one of these markets, in which they make proposals for an auction design in these markets.

Course objectives

(1) Being familiar with the game theoretic analysis of classical single-item auctions; (2) get insight in recent and classical auction literature and learn to interpret the main results; (3) be aware of the most important issues of auction design and how they can be addressed in various contexts; (4) learn how to set up an auction design for a particular application.
Prerequisites

Exchange students need to major in economics. An advanced level of English.

Recommended reading

Course book.

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**EBC2091**

Period 4  
6 Feb 2017  
7 Apr 2017

[Print course description](#)

**ECTS credits:**  
6.5

**Instruction language:**  
English

**Coordinator:**  
A.J. Vermeulen

**Teaching methods:**  
PBL, Presentation(s), Lecture(s), Paper(s)

**Assessment methods:**  
Final paper, Participation

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School of Business and Economics

**International Competition Policy**

Full course description

The course starts with an overview of international antitrust institutions, thereby covering the major systems of competition policy in the EU and the US, as well as suggested or recently implemented frameworks in developing countries and transition economies. We will continue with a theoretical and empirical identification of market power – a necessary condition for any anticompetitive practice. The following sessions will provide an economic analysis of the major fields of competition policy such as the fight against collusion, merger regulation, and the abuse of a dominant position. For each field we will apply modern theories of strategic firm behaviour to explain when and why firms indeed act in an anticompetitive way. These insights are then utilized to develop guidelines for antitrust authorities. Finally, these recommendations are taken as a benchmark for an evaluation of existing antitrust policy schemes. The course will make excessive use of case studies to illustrate and test the policy recommendations.

Course objectives

The course is an introduction into the objectives and implementations of Competition Policy. Students will be introduced to antitrust institutions all over the world with some emphasise on the European Union, its member states, and the US. Participants will learn how to evaluate the goals and their legal implementation from an economic point of view. Such an (empirical and theoretical) economic analysis enables participants to criticize existing Competition Law and to suggest improvements.
These findings will be applied to landmark antitrust cases and ongoing controversies among competition policy scholars.

**Prerequisites**

Courses 1.2 and 2.1 in microeconomics. Knowledge and understanding of microeconomics (level comparable to: course Microeconomics). Exchange students need a major in economics.

**Recommended reading**


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**EBC2093**

**Period 4**

6 Feb 2017

7 Apr 2017

[Print course description](#)

**ECTS credits:**

6.5

**Instruction language:**

English

**Coordinators:**

P. Parrotta

A.M. Riedl

**Teaching methods:**

PBL, Presentation(s), Paper(s)

**Assessment methods:**

Final paper, Participation

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**School of Business and Economics**

**Behavioural Economics**

**Full course description**

"The traditional model of the homo economicus is ubiquitous in microeconomic theory. Economic agents are assumed to be rational utility maximisers with self-regarding preferences and unlimited processing capacities. Common sense and the results of economic experiments show that this is not always the case. Often people behave differently than predicted by theory. In this course, we will deal with the following problem statements: 1) When does microeconomic theory apply and when does it lose its predictive power? 2) If it does not apply, what concepts and models can be used to either extend or to substitute the current theory in order to describe human behaviour? Specifically, we will discuss the following issues: · Non-expected utility theory · Intertemporal choice · Social preferences · Reciprocity · Levels of analytical reasoning · The role of mistakes In addition, we will touch on the following topics: · Mental accounting · Heuristics · Neuroeconomics"

**Course objectives**

The goal of the course is to provide the students with the necessary sensitivity when applying
theoretical models. After the course students should be able to identify the most important reasons why humans deviate from behaviour predicted by the commonly used model of the homo oeconomicus. Moreover they should be able to understand formal modelling of deviant behaviour.

**Prerequisites**

Microeconomics Ability to think analytically Basic game theory is not necessary but helpful: simple equilibrium concepts such as (pure and mixed strategy) Nash equilibrium and subgame perfect Nash equilibrium. Exchange students need to major in Economics

**Recommended reading**

There is not one textbook that will cover the course. References and papers will be made available to the students at the beginning of the course.

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**EBC2094**

**Period 2**
31 Oct 2016
23 Dec 2016

[Print course description](#)

**ECTS credits:**
6.5

**Instruction language:**
English

**Coordinator:**
A. Baranski Madrigal

**Teaching methods:**
PBL

**Assessment methods:**
Participation, Final paper, Written exam

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**School of Business and Economics**

**Economics and Sociology**

**Full course description**

Economic behaviour is generally situated in a social environment. The course “Economics and Sociology” focuses on the role played by social relations, norms, habits etc. in economic life. Sociologists and psychologists have criticized the economic approach for not taking into account the influence of tradition, social norms and habits in economic analyses. Economists claim that the economic approach is also useful in explaining human behaviour and social interactions in settings that are not traditionally covered by economics, such as marriage, education, religion, neighbourhoods etc. and have responded to the critique of sociologists and psychologists by enriching their models to include psychological factors and interpersonal relations. In the course various topics at the borderline between economics and sociology are discussed looking at the difference in perspective that sociology/psychology and economics take. Topics covered are for example the division of labour, love and marriage, paternalism, etc.
Course objectives

"• to learn how social relations, norms, values, attitudes and institutions emerge and how they effect human behaviour, both from an economic and a sociological point of view • to apply the theories and concepts learned in the course to think about social issues, both from an economic and from a sociological point of view"

Prerequisites

Intermediate level of economics

Recommended reading

A reading list containing a few classical papers and recent literature concerning the topics mentioned

School of Business and Economics

Information, Justice and the Political Process

Full course description

This course studies politics (the theory of the state, voting rules, voting behaviour, party politics, etc.) using the methodology of microeconomics, i.e., taking as a starting point utility maximizing agents. Furthermore, methods to evaluate market outcomes and political outcomes on the basis of (distributive) justice will be considered.

Course objectives

The students will gain insight in problems of economic justice and collective decision making.

Prerequisites

The level of this course is relatively high and preferably third year students should register. Knowledge and understanding of microeconomics [level comparable to "Microeconomics"] and quantitative methods [level comparable to "Quantitative Methods III"] is required. Exchange students
need to follow a Bachelor in economics. Exchange students should have a good background in microeconomics to benefit optimally from the course.

**Recommended reading**

Reader and literature will be announced on EleUM.

**EBC2117**

Period 5  
18 Apr 2017  
9 Jun 2017

Print course description

ECTS credits:  
6.5

Instruction language:  
English

Coordinator:  
J. Linde

Teaching methods:  
PBL, Presentation(s), Assignment(s)

Assessment methods:  
Final paper, Participation, Written exam

**Actuarial Science Electives**

**School of Business and Economics**

**Actuarial Mathematics**

**Full course description**

This course is an Actuarial elective (cannot be used as an IBE/IES/Infonomics elective). The principal aim of this course is to provide students with a solid grounding in the subject of life contingencies for a single life, and experience of its application to the analysis of life insurance and life annuity (including pension) contracts. This subject arises through a fusion of compound interest theory with probability theory, and provides the mathematical framework necessary for analysing such contracts, which are essentially long term financial transactions in which the various cash flows at different times are contingent on the death (life insurance) or survival (life annuities) of one or more specified human lives. Having developed this framework, we can address issues such as how to determine the premium that should be charged for a certain life insurance contract, including allowance for expenses and/or profit, and how to determine the value that should be represented in the balance sheet of a life insurance company in respect of the policies that it has sold. These examples reflect the two main traditional areas of actuarial activity within a life insurance company: pricing and reserving. The course begins with an examination of the various factors that affect mortality, and of how risk classification may be used to address the heterogeneity within a given population. Next, probabilities of survival and death are introduced, and it is shown how these may be represented within and extracted from life tables. Compound interest theory is then combined with such
probabilities to analyse and evaluate both life insurance benefits and life annuity benefits. With the relevant theory fully developed, the course then becomes somewhat more applied. Premium calculation is explored in detail first, followed by the determination and application of reserves, and, in both areas, the theory is applied to quite realistic and complex problems.

**Course objectives**

See course contents.

**Prerequisites**

First two years of the Econometrics and OR bachelor program, in particular Mathematics, Probability Theory, and Mathematical Statistics.

**Recommended reading**

bachelor thesis.

**Prerequisites**

First two years of the Econometrics and OR bachelor program, in particular Mathematics, Probability Theory, and Mathematical Statistics. Actuarial courses form block 4 and 5 of year 3 are helpful, but not required.

**Recommended reading**

Research articles.

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**EBC2124**

**Period 5**

18 Apr 2017
9 Jun 2017

[Print course description](#)

**ECTS credits:**

6.5

**Instruction language:**

English

**Coordinator:**

E.A. Beutner

**Teaching methods:**

Presentation(s), PBL

**Assessment methods:**

Final paper, Participation

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**School of Business and Economics**

**Actuarial Statistics**

**Full course description**

This course is an Actuarial elective. This course treats the basics of actuarial risk theory, in particular: utility theory and (re-)insurance, individual and collective loss models, ruin theory, and premium principles.

**Course objectives**

See course contents

**Prerequisites**

Level of first two years of the Econometrics and OR bachelor program, in particular Mathematics, Probability Theory, and Mathematical Statistics.

**Recommended reading**

Econometrics & OR Electives

School of Business and Economics
Allocations and Algorithms

Full course description

Economic entities like companies, non-governmental organizations, and municipalities are continuously faced with difficult logistics problems. Finding good solutions to these logistics problems is crucial for improving economic performance, and hence it comes by no surprise that the design of efficient algorithms for all kinds of optimization problems has been a flourishing area of research in computer science and operations research for many decades already. This course will introduce fundamental techniques in algorithm design (e.g., greedy algorithms, graph algorithms, convex programming, and local search) that are used to derive efficient algorithms and heuristics for various optimization problems. It will also be discussed how to translate algorithmic ideas into working code, and many exercises and small cases will be discussed. In the second part of this course a short introduction to algorithmic game theory will be given, a young area at the interface of economics and computer science. It deals with computational questions of economic models, like, for example, the question of how efficient equilibria can be in the worst case and how they are computed efficiently.

Course objectives

The aim of this course is to familiarize students with basic algorithmic techniques and to give a short introduction to the field of algorithmic game theory. The students will also learn how to translate algorithmic ideas into working code.

Prerequisites

Basic courses in linear programming/algebra, basic knowledge of combinatorial optimisation (discrete Operations Research).
Recommended reading

Various research papers in the field of location/allocation.

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**EBC2121**

**Period 4**
6 Feb 2017
7 Apr 2017

[Print course description]

**ECTS credits:**
6.5

**Instruction language:**
English

**Coordinator:**
[link]

**Teaching methods:**
Work in subgroups, PBL, Presentation(s), Lecture(s), Assignment(s)

**Assessment methods:**
Attendance, Written exam

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School of Business and Economics

**Applied Research Project**

**Full course description**

This course provides supervision to bachelor students who do an internship in Operations Research, Econometrics, Mathematical Economics or Actuarial Sciences. Students have to find an appropriate internship themselves. Interested students have to contact the coordinator for more information and terms and conditions well in advance of the beginning of the course.

**Course objectives**

Hands-on experience with developing models and algorithms for practical problems in Operations Research.

**Prerequisites**

For bachelor students in Operations Research.

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**EBC2150**

**Period 5**
18 Apr 2017
9 Jun 2017

[Print course description]

**ECTS credits:**
6.5
Full course description

The students will extend and apply the methods learned and will have the opportunity to specialize to a certain extent in one of the main areas of the programme. Various problems from these fields are proposed to the students that will work on a research project (literature overview, empirical or theoretical analysis in economics, econometrics, OR, an actuarial science model building and solving, optimisation,...) under the supervision of a staff member.

Course objectives

The students learn how to extend their existing theoretical and methodological knowledge in mathematical economics, operations research econometrics or actuarial science by working on a research case/project that will form the basis of the bachelor thesis.