June 2019

Lectures and Seminars in Insurance Mathematics and related fields at ETH Zurich

Autumn Semester 2019

Non-Life Insurance: Mathematics and Statistics, by Prof. Dr. Mario Wüthrich, #401-3925-00L

The lecture aims at providing a basis in non-life insurance mathematics which forms a core subject of actuarial sciences.

The following topics are treated:
- Collective Risk Modeling
- Individual Claim Size Modeling
- Approximations for Compound Distributions
- Ruin Theory in Discrete Time
- Premium Calculation Principles
- Tariffication
- Generalized Linear Models and Neural Networks
- Bayesian Models and Credibility Theory
- Claims Reserving
- Solvency Considerations

Script:
M. V. Wüthrich, Non-Life Insurance: Mathematics & Statistics
http://ssrn.com/abstract=2319328

Place:	Main building of the ETH Zurich
Time:	Monday, 16.15 to 18.00 h, Lecture at Auditorium **HG D7.1**
	Tuesday, 13.15 to 15.00 h, Lecture at Auditorium **HG D7.1**
	Tuesday, 15.15 to 16.00 h, Exercise session at Auditorium **HG D7.1**
Start Date:	Tuesday, 17. September 2019

Life Insurance Mathematics, by Prof. Dr. Michael Koller, #401-3922-00L

The classical life insurance model is presented together with the important insurance types (insurance on one and two lives, term and endowment insurance and disability). Besides that, the most important terms such as mathematical reserves are introduced and calculated. The profit and loss account and the balance sheet of a life insurance company is explained and illustrated.

Place:	Main building of the ETH Zurich, Auditorium **HG E1.1**
Time:	Friday, 16.15 to 18.00 h
Start Date:	20. September 2019

Financial Risk Management in Social and Pension Insurance, by Dr. Peter Blum, #401-3929-00L

For pension insurance and other forms of social insurance, investment returns are an important source of funding. In order to earn these returns, substantial financial risks must be taken, and these risks represent an important threat to financial stability, in the long term and in the short term.

Risk and return of financial assets cannot be separated from one another and, hence, asset management and risk management cannot be separated either. Managing financial risk in social and pension insurance is, therefore, the task of reconciling the contradictory dimensions of

1. Required return for a sustainable funding of the institution,
2. Risk-taking capability of the institution,
3. Returns available from financial assets in the market,
4. Risks incurred by investing in these assets.

This task must be accomplished under a number of constraints. Financial risk management in social insurance also means reconciling the long time horizon of the promised insurance benefits with the short time horizon of financial markets and financial risk.

It is not the goal of this lecture to provide the students with any cookbook recipes that can readily be applied without further reflection. The goal is rather to enable the students to develop their own understanding of the problems and possible solutions associated with the management of financial risks in social and pension insurance.

To this end, a rigorous intellectual framework will be developed and a powerful set of mathematical tools from the fields of actuarial mathematics and quantitative risk management will be applied. When analyzing the properties of financial assets, an empirical viewpoint will be taken using statistical tools and considering real-world data.

Place: Main building of the ETH Zurich, Auditorium **HG D7.2**
Time: Wednesday, 16:15 to 18:00 h
Start Date: 18. September 2019

Reinsurance Analytics, by Dr. Peter Antal and Dr. Philipp Arbenz, #401-3928-00L

This course provides an introduction to reinsurance from an actuarial perspective. The objective is to understand the fundamentals of risk transfer through reinsurance and models for extreme events such as natural or man-made catastrophes. The lecture covers reinsurance contracts, Experience and Exposure pricing, natural catastrophe modelling, solvency regulation, and insurance linked securities.

Topics covered include:
- Reinsurance Contracts and Markets: Different forms of reinsurance, their mathematical representation, history of reinsurance, and lines of business.
- Experience Pricing: Modelling of low frequency high severity losses based on historical data, and analytical tools to describe and understand these models.
- Exposure Pricing: Loss modelling based on exposure or risk profile information, for both property and casualty risks.
- Natural Catastrophe Modelling: History, relevance, structure, and analytical tools used to model natural catastrophes in an insurance context.
- Solvency Regulation: Regulatory capital requirements in relation to risks, effects of reinsurance thereon, and differences between the Swiss Solvency Test and Solvency 2.
- Insurance linked securities: Alternative Risk Transfer techniques such as catastrophe bonds.

Place: Main building of the ETH Zurich, Auditorium **HG E1.1**
Time: Tuesday, 16.15 to 18.00 h
Start Date: 17. September 2019

Mathematical Modelling in Life Insurance, by Dr. Tobias Peter, #401-3927-00L

In life insurance, it is essential to have adequate mortality tables, be it for reserving or pricing purposes. The course provides the actuarial tools necessary to create mortality tables from scratch.

Additionally, various guarantees embedded in life insurance products are discussed. Students will learn to price them with the help of stochastic models. Aside of the mere application of specific models, students should develop an intuition for the various drivers of the value of these options.

Topics to be covered include:

1. Guarantees and options embedded in life insurance products:
   - Stochastic valuation of participating contracts
   - Stochastic valuation of Unit Linked contracts

2. Mortality Tables:
   - Determining raw mortality rates
   - Smoothing techniques: Whittaker-Henderson, smoothing splines,...
   - Trends in mortality rates
   - Stochastic mortality model due to Lee and Carter
   - Neural Network extension of the Lee-Carter model
   - Integration of safety margins

Place: Main building of the ETH Zurich, Auditorium **HG E1.1**
Time: Thursday, 16.15 to 18.00 h
Start Date: 19. September 2019

Mathematical Foundations for Finance, by Prof. Dr. Walter Farkas, #401-3913-01L

This course gives a first introduction to the main modelling ideas and mathematical tools from mathematical finance. It mainly aims at non-mathematicians who need an introduction to the main tools from stochastics used in mathematical finance. However, mathematicians who want to learn some basic modelling ideas and concepts for quantitative finance (before continuing with a more advanced course) may also find this of interest. The main emphasis will be on ideas, but important results will be given with (sometimes partial) proofs.

Topics to be covered include:
- financial market models in finite discrete
- absence of arbitrage and martingale measures
- valuation and hedging in complete markets
- basics about Brownian motion
- stochastic integration
- stochastic calculus: Itô's formula, Girsanov transformation, Itô's representation theorem
- Black-Scholes formula

Place: Main building of the ETH Zurich
Time: Tuesday, 12.15 to 13.00 h, Lecture at Auditorium **HG D1.1**
Wednesday, 10.15 to 12.00 h, Lecture at Auditorium **HG D1.1**
Friday, 08.15 to 10.00 h, Exercise session at Auditorium **HG D7.1**
Start Date: 17. September 2019

Principles of Macroeconomics, by Prof. Dr. Jan-Egbert Sturm, #363-0565-00L

This course examines the behaviour of macroeconomic variables, such as gross domestic product, unemployment and inflation rates. It tries to answer questions like: How can we explain fluctuations of national economic activity? What can economic policy do against unemployment and inflation?

This course helps you understand the world in which you live. There are many questions about the macroeconomy that might spark your curiosity. Why are living standards so

meagre in many African countries? Why do some countries have high rates of inflation while others have stable prices? Why have some European countries adopted a common currency? These are just a few of the questions that this course will help you answer.

Furthermore, this course will give you a better understanding of the potential and limits of economic policy. As a voter, you help choose the policies that guide the allocation of society's resources. When deciding which policies to support, you may find yourself asking various questions about economics. What are the burdens associated with alternative forms of taxation? What are the effects of free trade with other countries? How does the government budget deficit affect the economy? These and similar questions are always on the minds of policy makers.
The course webpage https://moodle-app2.let.ethz.ch/course/view.php?id=11092 contains announcements, course information and lecture slides.

Literature:
The set-up of the course will closely follow the book of
N. Gregory Mankiw and Mark P. Taylor (2017), Economics, Cengage Learning, 4th Edition.

Place: Main building of the ETH Zurich, Auditorium **HG E5**
Time: Tuesday, 15:15 to 17:00 h
Start Date: 17. September 2019

Bayesian Statistics, by Dr. Fabio Sigrist, #401-3628-14L

Introduction to the Bayesian approach to statistics.

Topics that we will discuss are:

Difference between the frequentist and Bayesian approach (decision theory, principles), priors (conjugate priors, noninformative priors, Jeffreys prior), tests and model selection (Bayes factors, hyper-g priors for regression), hierarchical models and empirical Bayes methods, computational methods (Laplace approximation, Monte Carlo and Markov chain Monte Carlo methods).

Literature:
[1] Christian Robert, The Bayesian Choice, 2nd edition, Springer 2007.
[2] A. Gelman et al., Bayesian Data Analysis, 3rd edition, Chapman & Hall (2013).

Place: Main building of the ETH Zurich, Auditorium **G3**
Time: Tuesday, 15:15 to 17:00 h
Start Date: 17. September 2019

Mathematics Tools in Machine Learning pplied Analysis of Variance and Experimental Design, by Dr. Fadoua Balabdaoui, #401-3619-69L

The aim of this course is to review some of the most important mathematical results used in machine learning (and also in statistics). Most of the results will be motivated by actual applications. The theoretical proofs of these results will be re-done and explained in detail.

Place: Main building of the ETH Zurich, Auditorium **E5**
Time: Thursday, 10:15 to 12:00 h
Start Date: 19. September 2019

Applied Analysis of Variance and Experimental Design, by Dr. Lukas Meier, #401-0625-01L

Principles of experimental design, one-way analysis of variance, contrasts and multiple comparisons, multi-factor designs and analysis of variance, complete block designs, Latin

square designs, random effects and mixed effects models, split-plot designs, incomplete block designs, two-series factorials and fractional designs, power.

The exercises, but also the classes will be based on procedures from the freely available, open-source statistical software package R, for which an introduction will be held.

Literature:
G. Oehlert: A First Course in Design and Analysis of Experiments, W.H. Freeman and Company, New York, 2000.

Place: Main building of the ETH Zurich
Time: Monday, 13:15 to 15:00 h, Lecture at Auditorium **HG G5**
Monday, 15:15 to 17:00 h, Exercise session at Auditorium **HG E1.1**
Start Date: 23. September 2019

Applied Statistical Regression, by Dr. Marcel Dettling, #401-0649-00L

This course offers a practically oriented introduction into regression modeling methods. The basic concepts and some mathematical background are included, with the emphasis lying in learning "good practice" that can be applied in every student's own projects and daily work life. A special focus will be laid in the use of the statistical software package R for regression analysis.

The course starts with the basics of linear modeling, and then proceeds to parameter estimation, tests, confidence intervals, residual analysis, model choice, and prediction. More rarely touched but practically relevant topics that will be covered include variable transformations, multicollinearity problems and model interpretation, as well as general modeling strategies. The last third of the course is dedicated to an introduction to generalized linear models: this includes the generalized additive model, logistic regression for binary response variables, binomial regression for grouped data and poisson regression for count data.

The exercises, but also the classes will be based on procedures from the freely available, open-source statistical software package R, for which an introduction will be held.

Literature:
[1] Faraway (2005): Linear Models with R.
[2] Faraway (2006): Extending the Linear Model with R.
[3] Draper & Smith (1998): Applied Regression Analysis.
[4] Fox (2008): Applied Regression Analysis and GLMs.
[5] Montgomery et al. (2006): Introduction to Linear Regression Analysis.

Place: Main building of the ETH Zurich
Time: Monday, 08:15 to 10:00 h, Lecture at Auditorium **HG E1.2**
Monday, 10:15 to 12:00 h, Exercise session at Auditorium **HG E1.2**
Start Date: 23. September 2019

Talks in Financial and Insurance Mathematics, by Proff. P. Cheridito, J. Teichmann, M. V. Wüthrich, #401-5910-00L

Research colloquium on various topics in mathematical finance and actuarial mathematics.

For the program see http://www.math.ethz.ch/Finance/CoursesTalks/Talks

Place: Main building of the ETH Zurich, Auditorium **HG G43**
Time: Thursday, 17.15 to 18.00 h
Start Date: 19. September 2019

Additional Lectures at the University of Zurich:

Microeconomics of Insurance, by Prof. Dr. Pablo Koch Medina, #2585

This lecture focuses on understanding insurance markets from a microeconomic perspective. Some of the topics covered are: the demand for insurance, the supply of insurance, adverse selection and moral hazard.

Place: University of Zurich
Time: Tuesday, 08:00 to 09:45 h
Start Date: 17. September 2019

The Economy of Risk in Insurance, by Dr. Michel Dacorogna, #3606

The purpose of the course is to familiarize the student with the modern concepts of insurance in view of their application to pricing, capital management and solvency regulation. Most of those concepts are in line with the financial theory and apply to both P&C and life insurance.

The course is taught in five modules:
1. In a first part, we present the concept of risk and risk measure and the pricing of risk in insurance.
2. Aggregation of risk and dependencies
3. Concept of capital and management of capital
4. Adding time diversification to risk diversification
5. Entreprise risk management towards a holistic approach to risk management.

Place: University of Zurich
Time: Monday, 08:00 to 09:45 h
Start Date: 16. September 2019

Introduction to Mathematical Finance, by Prof. Dr. Ashkan Nikeghbali, #1861

These lectures give an introduction to the most simple mathematical models which are used to describe the evolution of financial markets. These kinds of descriptions have many practical applications. In particular, they are involved in a fundamental way when one needs to give a fair price to options or derivatives. The main part of this course is focused on discrete models, under which the prices of the different assets are supposed to change only at a finite number of times. These models have the advantage that one can study them without dealing too much with technicalities. In the last part of the course, we give an introduction to the most classical (continuous) model, i.e. the Black-Scholes model, which involves a particular random process, called Brownian motion, that is one of the most fundamental objects in probability theory.

Literature:
[1] "Introduction to the Mathematics of Finance" by R.J. Williams
[2] "PDE and Martingale Methods in Option Pricing" by Andrea Pascucci

Place: University of Zurich, Irchel Campus, Institut für Mathematik
Time: Wednesday, 14:00 to 15:45 h
Start Date: 18. September 2019

Addresses of the Lecturers

Dr. Peter Antal
PartnerRe
peter.antal@math.ethz.ch

Dr. Philipp Arbenz
SCOR
philipp.arbenz@math.ethz.ch

Dr. Fadoua Balabdaoui
D-MATH, ETH Zurich
fadoua.balabdaoui@stat.math.ethz.ch

Dr. Peter Blum
SUVA
peter.blum@math.ethz.ch

Prof. Dr. Patrick Cheridito
D-MATH, ETH Zurich
patrick.cheridito@math.ethz.ch

Dr. Michel Dacorogna
Department of Banking and Finance UZH
michel.dacorogna@uzh.ch

Dr. Marcel Dettling
School of Engineering ZHAW
marcel.dettling@math.ethz.ch

Prof. Dr. Erich Walter Farkas
Department of Banking and Finance UZH
farkas@math.ethz.ch

Prof. Dr. Ashkan Nikeghbali
Institute of Mathematics UZH
ashkan.nikeghbali@math.uzh.ch

Prof. Dr. Pablo Koch Medina
Department of Banking and Finance UZH
pablo.koch@bf.uzh.ch

Prof. Dr. Michael Koller
Prudential plc
michael.koller@math.ethz.ch

Dr. Lukas Meier
D-MATH, ETH Zurich
lukas.meier@stat.math.ethz.ch

Dr. Tobias Peter
AXA Winterthur
tobias.peter@math.ethz.ch

Dr. Fabio Sigrist
Lucerne School of Business
fabio.sigrist@math.ethz.ch

Prof. Dr. Jan-Egbert Sturm
D-MTEC, KOF, ETH Zürich
sturm@kof.ethz.ch

Prof. Dr. Josef Teichmann
D-MATH, ETH Zürich
josef.teichmann@math.ethz.ch

Prof. Dr. Mario Wüthrich
D-MATH, ETH Zürich
mario.wuethrich@math.ethz.ch