Lectures and Seminars in Insurance Mathematics and Related Fields
at ETH Zurich

Spring Semester 2020

Quantitative Risk Management, by Prof. Dr. Patrick Cheridito, #401-3629-00L

This course introduces methods from probability theory and statistics that can be used to model financial risks. Topics addressed include loss distributions, risk measures, extreme value theory, multivariate models, copulas and dependence structures and operational risk.

Topics:
1. Introduction
2. Basic Concepts in Risk Management
3. Empirical Properties of Financial Data
4. Financial Time Series
5. Extreme Value Theory
6. Multivariate Models
7. Copulas and Dependence
8. Operational Risk

Literature:

Place: ETH Zurich, Auditorium ML H44
Time: Thursday, 10.15 to 12.00 h, Lecture
      Thursday, 12.15 to 13.00 h, Exercise session
Start Date: 20. February 2020

Market-Consistent Actuarial Valuation, by Prof. Dr. Mario Wüthrich and Dr. Hansjörg Furrer, #401-4920-00L

In this lecture we give a full balance sheet approach to the task of actuarial valuation of an insurance company. Therefore, we introduce a multidimensional valuation portfolio (VaPo) on the liability side of the balance sheet. The basis of this multidimensional VaPo is a set of financial instruments. This approach makes the liability side of the balance sheet directly comparable to its asset side.

The lecture is based on four sections:
1. Stochastic discounting
2. Construction of a multidimensional Valuation Portfolio for life insurance products (with guarantees)
3. Construction of a multidimensional Valuation Portfolio for a run-off portfolio of a non-life insurance company
4. Measuring financial risks in a full balance sheet approach (ALM risks)
**Stochastic Loss Reserving Methods, by Dr. René Dahms, #401-3917-00L**

Loss Reserving is one of the central topics in non-life insurance. Mathematicians and actuaries need to estimate adequate reserves for liabilities caused by claims. These claims reserves have an influence on all financial statements, future premiums and solvency margins. We present the stochastics behind various methods that are used in practice to calculate those loss reserves.

We will present the following stochastic claims reserving methods/models:
- Stochastic Chain-Ladder Method
- Bayesian Methods, Bornhuetter-Ferguson Method, Credibility Methods
- Distributional Models
- Linear Stochastic Reserving Models, with and without inflation
- Bootstrap Methods
- Claims Development Result (solvency view)
- Coupling of portfolios

**Literature:**

*Place:* Main Building of ETH Zurich, Auditorium HG D3.2

*Time:* Wednesday, 16.15 to 18.00 h

*Start Date:* 19. February 2020

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**Data Analytics for Non-Life Insurance Pricing, by Dr. Christoph Buser and Prof. Dr. Mario Wüthrich, #401-3936-00L**

We study statistical methods in supervised learning for non-life insurance pricing such as generalized linear models, generalized additive models, Bayesian models, neural networks, classification and regression trees, random forests and gradient boosting machines.

We present the following chapters:
- generalized linear models (GLMs)
- generalized additive models (GAMs)
- neural networks
- credibility theory
- classification and regression trees (CARTs)
- bagging, random forests and boosting
**Selected Topics in Life Insurance Mathematics, by Prof. Dr. Michael Koller, #401-3923-00L**

Stochastic Models for Life Insurance

1. Markov chains
2. Stochastic processes for demography and interest rates
3. Cash flow streams and reserves
4. Mathematical reserves and Thiele’s differential equation
5. Theorem of Hattendorff
6. Unit linked policies

**Place:** Main Building of ETH Zurich, Auditorium HG F5

**Time:** Tuesday, 16.15 to 18.00 h

**Start Date:** 18. February 2020

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**Risk and Insurance Economics, by Dr. Irina Gemmo, #363-1017-00L**

The course covers economics of risk and insurance. Topics covered are fundamentals of risk, individual decision making under risk, fundamentals of insurance, information asymmetries in insurance markets, and the macroeconomic role of insurers.

**Topics:**
- fundamentals of risk
- individual decision making under risk
- fundamentals of insurance
- information asymmetries in insurance markets
- the macroeconomic role of insurers

**Main literature:**

**Further readings:**

**Place:** ETH Zurich, Auditorium CAB G59

**Time:** Tuesday, 10.15 to 12.00 h

**Start Date:** 18. February 2020
**Computational Statistics, by Prof. Dr. Marloes Maathuis, #401-3632-00L**

We discuss modern statistical methods for data analysis, including methods for data exploration, prediction and inference. We pay attention to algorithmic aspects, theoretical properties and practical considerations. The class is hands-on and methods are applied using the statistical programming language R.

*Place:* ETH Zurich  
*Time:* Thursday, 13.15 to 15.00 h, Lecture at Auditorium HG F1  
Friday, 09.15 to 10.00 h, Lecture at Auditorium NO C60  
Friday, 10.15 to 11.00 h, Exercise session at Auditorium HG G5  
*Start Date:* 20. February 2020

**Advanced Statistical Modelling: Mixed Models, by Dr. Martin Mächler, #401-4626-00L**

Mixed Models = (*| generalized| non-) linear Mixed-effects Models, extend traditional regression models by adding "random effect" terms.

In applications, such models are called "hierarchical models", "repeated measures" or "split plot designs". Mixed models are widely used and appropriate in an area of complex data measured from living creatures from biology to human sciences.

The lecture will build on various examples, use R and notably the 'lme4' package, to illustrate concepts. The relevant R scripts are made available online.

Inference (significance of factors, confidence intervals) will focus on the more realistic *un*balanced situation where classical (ANOVA, sum of squares etc) methods are known to be deficient. Hence, Maximum Likelihood (ML) methods and its variant, "REML", will be used for estimation and inference.

Lecture notes and all R scripts are made available from [https://github.com/mmaechler/MEMo](https://github.com/mmaechler/MEMo)

*Place:* Main Building of ETH Zurich, Auditorium HG F26.5  
*Time:* Tuesday, 08.15 to 10.00 h  
*Start Date:* 18. February 2020

**Causality, by Dr. Christina Heinze-Deml, #401-4632-15L**

In statistics, we are used to search for the best predictors of some random variable. In many situations, however, we are interested in predicting a system's behavior under manipulations. For such an analysis, we require knowledge about the underlying causal structure of the system. In this course, we study concepts and theory behind causal inference.

*Place:* Main Building of ETH Zurich, Auditorium HG E1.1  
*Time:* Wednesday, 10.15 to 12.00 h  
*Start Date:* 19. February 2020

**Statistical Learning Theory, by Prof. Dr. Joachim Buhmann, #252-0526-00L**

The course covers advanced methods of statistical learning:

- Variational methods and optimization. We consider optimization approaches for problems where the optimizer is a probability distribution. We will discuss concepts like maximum entropy, information bottleneck, and deterministic annealing.
- Clustering. This is the problem of sorting data into groups without using training samples. We discuss alternative notions of "similarity" between data points and adequate optimization procedures.

- Model selection and validation. This refers to the question of how complex the chosen model should be. In particular, we present an information theoretic approach for model validation.

- Statistical physics models. We discuss approaches for approximately optimizing large systems, which originate in statistical physics (free energy minimization applied to spin glasses and other models). We also study sampling methods based on these models.

**Literature:**


**Place:** Main building of the ETH Zurich

**Time:** Monday, 14.15 to 16.00 h, Lecture at Auditorium HG G3

**Start Date:** 17. February 2020

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

Research Seminar in Financial and Insurance Mathematics

For the program see [https://www.math.ethz.ch/imsf/courses/talks-in-imsf.html](https://www.math.ethz.ch/imsf/courses/talks-in-imsf.html)

**Place:** Main Building of ETH Zurich, Auditorium HG G43

**Time:** Thursday, 17.15 to 18.00 h

**Start Date:** 20. February 2020
Additional Lectures at the University of Zurich:

**Microeconomics of Insurance II, by Prof. Dr. Pablo Koch Medina, #2385**
This is a continuation of the lecture Microeconomics in Insurance held in the winter semester. We explore additional selected topics.

*Place:* University of Zurich  
*Time:* Monday, 08:00 to 09:45 h  
*Start Date:* 24. February 2020

**Capital Adequacy and Risk Measures, by Prof. Dr. Cosimo Munari, #0558**
The aim of this lecture is to provide a comprehensive introduction to the theory of risk measures in a capital adequacy setting. We cover both theoretical and practical aspects. Special emphasis is given to the estimation and backtesting of Value at Risk and Expected Shortfall, the key risk measures in solvency regulation.

*Place:* University of Zurich  
*Time:* Thursday, 08:00 to 09:45 h  
*Start Date:* 20. February 2020

**Topics of Applied Risk Management, by Dr. Gerold Studer, #3481**
This course provides insights into financial risk management tools and techniques broadly used in the world of banking, providing theoretical foundations and discussing typical applications in practice. The lectures are complemented by case studies, allowing students to apply the techniques in real world set-ups.

The following topics are treated:
- Introduction: banking activities & their characteristics; is risk management a value creating activity?
- Managing interest rate risk: value vs. income effect, duration & convexity; replication - portfolios; interest rate swaps - valuation and risk sensitivities
- Market risk: options and their sensitivities; dynamic hedging and replication; VaR - methodologies / backtesting / stresstesting
- Credit risk: default probabilities; rating agencies; internal rating models; recovery rates; exposure modelling; credit portfolio models; credit derivatives / CDOs / CLNs
- Operational risk: nature of operational risk; managing operational risk; quantification of operational risk
- Capital: role of capital for financial institutions; capital regulations for banks (Basel III)

*Place:* University of Zurich  
*Time:* Friday, 16.15 to 18.00 h  
*Start Date:* 28. February 2020
## Affiliation of the lecturers

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<tr>
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