June 2017

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

Autumn Semester 2017

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 and Generalized Linear Models
- 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, Auditorium **HG D7.1**
	Tuesday, 13.15 to 15.00 h, Auditorium **HG D7.1**
Start Date:	Tuesday, 19. September 2017

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:	Friday, 22. September 2017

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: Wednesday, 21. September 2017

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

The aim of this course is understanding the following aspects:

History of reinsurance. Role of reinsurance in society and history of catastrophic events. Forms of reinsurance (proportional and nonproportional). Covered types of business (property, casualty, specialties, life, health). Modelling of reinsurance losses through frequency severity models (typical distributions and parameters). Rating/Pricing of reinsurance contracts (experience and exposure). Modelling of natural catastrophes (methodological approaches and techniques). Natural catastrophes in Switzerland (importance, insurance, reinsurance). Reinsurance markets and companies. Risk profile implications of reinsurance (Catastrophe risk, reserving risk, Credit risk, basis risk, etc). Solvency implications of reinsurance (primary insurance and reinsurance side). Solvency 2 modelling (standard models, internal models, FINMA StandRe). Alternatives to reinsurance (insurance linked securities, subordinate debt). Trigger types of cat bonds (indemnity, modeled loss, industry loss, parametric).

Place: Main Building of the ETH Zurich, Auditorium **HG E1.1**
Time: Tuesday, 16.15 to 18.00 h
Start Date: Tuesday, 19. September 2017

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

The course's objective is to present various mathematical models that are used in life insurance for valuation or risk management purposes.

Following main topics are covered:

1. Guarantees & options in life insurance
2. Financial modeling

3. Valuation of life insurance contracts: Unit linked and participating contracts
4. Mortality modeling

Place: Main Building of the ETH Zurich, Auditorium **HG E1.1**
Time: Thursday, 16.15 to 18.00 h
Start Date: Thursday, 21. September, 2017

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

This course gives a first introduction to the main modelling ideas and mathematical tools from mathematical finance. It aims at a double audience: mathematicians who want to learn the modelling ideas and concepts for finance, and non-mathematicians who need an introduction to the main tools from stochastics used in mathematical finance. 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: Monday, 13.15 to 14.00 h, Auditorium **HG E1.2**
Thursday, 08.15 to 10.00 h, Auditorium **HG E1.2**
Start Date: Thursday, 21. September 2017

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? What significance do international economic relations have for Switzerland?

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? What is the best way to protect the environment? How does the government budget deficit affect the economy? These and similar questions are always on the minds of policy makers.

The course webpage (to be found at
https://moodle-app2.let.ethz.ch/auth/shibboleth/login.php)
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, 4th Edition, Cengage Learning EMEA.

We advise you to also buy access to Aplia. This internet platform will support you in learning for this course. To save money, you should buy the book together with Aplia. This is sold as a bundle Mankiw/Taylor, Economics 4e + PAC Aplia 24 Months (ISBN 9781473762008).

Place: Main Building of the ETH Zurich, Auditorium **HG E5**
Time: Tuesday, 15:15 to 17:00 h
Start Date: Tuesday, 19. September 2017

Capita Selecta in Extreme Value Theory, by Prof. Dr. Paul Embrechts, #401-4621-67L

In this course topics beyond one-dimensional Extreme Value Theory (EVT) will be discussed. Capita Selecta included are: multivariate extremes, EVT for stationary processes, point process methodology and max-stable processes.

Topics treated will include:
- A brief overview of one-dimensional EVT
- More-dimensional EVT
- The point process approach
- An introduction to max-stable processes
- Some applications

Literature:
[1] P. Embrechts, C. Klueppelberg and T. Mikosch (1997): Modelling Extremal Events for Insurance and Finance. Springer, Berlin.
[2] S. I. Resnick (2007): Extreme Values, Regular Variation, and Point Processes, Springer, New York. Springer, New York.
[3] S. I. Resnick (2007): Heavy-Tail Phenomena. Probabilistic and Statistical Modeling. Springer, New York.
[4] Recent research papers.

Place: Main Building of the ETH Zurich, Auditorium **HG D7.1**
Time: Wednesday, 13.15 to 15.00 h
Start Date: Wednesday, 20. September 2017

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, Auditorium **HG E1.2**
Time: Monday, 08:15 to 10:00 h
Start Date: Monday, 25. September 2017

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

Introduction to the Bayesian approach to statistics: Decision theory, prior distributions, hierarchical Bayes models, Bayesian tests and model selection, empirical Bayes, computational methods, Laplace approximation, Monte Carlo and Markov chain Monte Carlo methods.

Topics that we will discuss are:

Difference between the frequentist and Bayesian approach (decision theory, principles), priors (conjugate priors, Jeffreys priors), tests and model selection (Bayes factors, hyper-g priors in 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 **D3.2**
Time: Tuesday, 15:15 to 17:00 h
Start Date: Tuesday, 19. September 2017

Machine Learning, by Prof. Dr. Joachim M. Buhmann, #252-0535-00L

Machine learning algorithms provide analytical methods to search data sets for characteristic patterns. Typical tasks include the classification of data, function fitting and clustering, with applications in image and speech analysis, bioinformatics and exploratory data analysis. This course is accompanied by practical machine learning projects.

The theory of fundamental machine learning concepts is presented in the lecture, and illustrated with relevant applications. Students can deepen their understanding by solving both pen-and-paper and programming exercises, where they implement and apply famous algorithms to real-world data.

Topics covered in the lecture include:
- Bayesian theory of optimal decisions
- Maximum likelihood and Bayesian parameter inference
- Classification with discriminant functions: Perceptrons, Fisher's LDA and support vector machines (SVM)
- Ensemble methods: Bagging and Boosting
- Regression: least squares, ridge and LASSO penalization, non-linear regression and the biasvariance trade-off
- Non parametric density estimation: Parzen windows, nearest neighbour
- Dimension reduction: principal component analysis (PCA) and beyond

Literature:

[1] C. Bishop. Pattern Recognition and Machine Learning. Springer 2007.
[2] R. Duda, P. Hart, and D. Stork. Pattern Classification. John Wiley & Sons, second edition, 2001.
[3] T. Hastie, R. Tibshirani, and J. Friedman. The Elements of Statistical Learning: Data Mining, Inference and Prediction. Springer, 2001.
[4] L. Wasserman. All of Statistics: A Concise Course in Statistical Inference. Springer, 2004.

Place: Main Building of the ETH Zurich
Time: Thursday, 14:15 to 15.00 h, Auditorium **ML D28 / E12**
Friday, 08:15 to 10.00 h, Auditorium **HG F1 / F3**
Start Date: Thursday, 21. September 2017

Deep Learning, by Prof. Dr. Thomas Hofmann, #263-3210-00L

In recent years, deep learning and deep networks have significantly improved the state-of-the-art in many application domains such as computer vision, speech recognition, and natural language processing. This class will cover the mathematical foundations of deep learning and provide insights into model design, training, and validation. The main objective is profound understanding of why these methods work and how. There will also be a rich set of hands-on tasks and practical projects to familiarize students with this emerging technology.

Place: Main Building of the ETH Zurich, Auditorium **HG D7.1**
Time: Monday, 10:15 to 12.00 h
Start Date: Monday, 25. September 2017

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

Research Seminar in Financial and Insurance 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: Thursday, 21. September 2017

Additional Lectures at the University of Zurich:

Microeconomics of Insurance, by Prof. Dr. Pablo Koch Medina and Prof. Dr. Cosimo Munari, #2876

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: Tuesday, 19. September 2017

The Economy of Risk in Insurance, by Dr. Michel Dacorogna, #3782

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 thought 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: Monday, 18. September 2017

Introduction to Mathematical Finance, by Dr. Candia Riga, #2262

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 derivatives (e.g. options). This course focuses on discrete-time models, where trading is only allowed at times in a discrete set fixed a priori. These models have the advantage that one can study them without dealing too much with technicalities. The two main problems that will be addressed are the pricing and hedging of financial derivatives. We will show how to compute the "fair" price of a derivative and prove that it is in accordance with the underlying economic theory. The problem of hedging, that is how to construct a trading strategy that covers the risks involved in the sale of a derivative, will turn out to be closely related to that of pricing. At the end of the course, we will show how the binomial model, the simplest discrete model studied in the course, converges to the most classical continuous model, i.e. the Black-Scholes model, when the number of trading dates within a finite time horizon converges to infinity.

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

Place: University of Zurich, Irchel Campus, Institut für Mathematik
Time: Thursday, 15:00 to 16:45 h
Start Date: Thursday, 21. September 2017

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