PROVISIONAL COURSE GUIDES

Pre-sessional Course (compulsory)
MA400: September Introductory Course (Financial Mathematics) – Half Unit
Teachers responsible: Dr Tugkan Batu and Dr Christoph Czichowsky
Course content: The purpose of this course is to review some key concepts of finance and probability and to discuss a range of mathematical definitions and techniques that set the agenda for the Financial Mathematics MSc as a whole. Also, this course will incorporate an introduction to programming with C++. This course is composed of two components: The first component is concerned with the common mathematical background that is assumed by the MSc Financial Mathematics and addresses some aspects of the mathematical theory that is central to the foundations of the programme: a review of sets and set operations, functions and inverse functions is first developed; probability spaces, random variables, distributions, expectations and moment generating functions are then discussed; special emphasis is placed on the binomial, the normal and the log-normal distributions; the concepts of conditional probability and conditional expectation as random variables are introduced using intuitive arguments and simple examples; stochastic processes, martingales, the standard Brownian motion and the Poisson process are introduced; Itô's formula and Girsanov's theorem are discussed on a formal basis. The second component is an introduction to programming with languages such as C++.
Teaching: 40 lectures and classes over two weeks during September, prior to the start of the academic year, and 3 support lectures in MT. There will be an informal examination (this is for the maths component only).
Reading List: Lecture notes will be provided for the mathematics component of this module. For the programming elements of the pre-sessional, we will use Derek Capper, Introducing C++ for Scientists, Engineers and Mathematicians, Springer 2001. For those with prior programming experience, a standard reference book on the C++ programming language is Bjarne Stroustrup, The C++ Programming Language, Addison Wesley, 1997.
Assessment: This course does not form part of the degree award.

Compulsory Courses

MA415 The Mathematics of the Black and Scholes Theory – Half Unit
Teachers responsible: Dr Christoph Czichowsky and Dr Arne Lokka,
Pre-requisites: Students must have completed September Introductory Course (Financial Mathematics) (MA400).
Course content: This course is concerned with a mathematical development of the risk-neutral valuation theory. In the context of the binomial tree model for a risky asset, the course introduces the concepts of replication and martingale probability measures. The mathematics of the Black & Scholes methodology follow; in particular, the expression of European contingent claims as expectations with respect to the risk-neutral probability measure of the corresponding discounted payoffs, pricing formulae for European put and call options, and the Black & Scholes PDE are derived. A class of exotic options is then considered. In particular, pricing formulas for lookback and barrier options are derived using PDE techniques as well as the reflection property of the standard Brownian motion. The course also introduces a model for foreign exchange markets and various foreign exchange options.

Teaching: 20 hours of lectures and 10 hours of seminars in the MT.
Reading List: N H Bingham and R Kiesel, Risk-Neutral Valuation, Springer; T Björk, Arbitrage Theory in Continuous Time, Oxford; P J Hunt and J Kennedy, Financial Derivatives in Theory and Practice, Wiley; D Lamberton and J Kennedy, Introduction to Stochastic Calculus Applied to Finance, Chapman & Hall; D. Lamberton and B. Lapeyre, Introduction to Stochastic Calculus Applied to Finance, Chapman & Hall/Crc Financial Mathematics Series, 2nd edition, 2007; S E Shreve, Stochastic Calculus for Finance: Continuous-time Models: vol. 2, Springer
Assessment: Exam (100%, duration: 2 hours) in the main exam period.

MA416 The Foundations of Interest Rate and Credit Risk Theory – Half Unit
Teacher responsible: Professor Michail Zervos
Pre-requisites: Students must have completed The Mathematics of the Black and Scholes Theory (MA415).
Course content: This course is concerned with the mathematical foundations of interest rate and credit risk theory. The course starts with a development of the multi-dimensional Black & Scholes theory with stochastic market data. This is then used to show how discount bond dynamics modelling can be approached by (a) the modelling of the short-rate process and the market price of risk, which underlies the family of short-rate models, or (b) the modelling of the market price of risk and the discount bond volatility structure, which gives rise to the Heath-Jarrow-Morton (HJM) framework. The course then expands on the theory of interest rate market models and credit risk.
Teaching: 20 hours of lectures and 10 hours of seminars in the LT.
Reading List: T R Bielecki and M Rutkowski, Credit Risk Modeling, Valuation and Hedging, Springer; J James and N Webber, Interest Rate Modelling, Wiley; A J McNeil, R Frey, and P Embrechts, Quantitative Risk Management: Concepts, Techniques, and Tools, Princeton University Press; M Musiela and M Rutkowski, Martingale Methods in Financial Engineering, Springer; R Rebonato, Modern Pricing of Interest-rate Derivatives: The LIBOR Market Model and Beyond, Princeton.
Assessment: Exam (100%, duration: 2 hours) in the main exam period.

MA417 Computational Methods in Finance – Half Unit
Teacher responsible: Dr Luitgard Veraart and Dr Tugkan Batu
Pre-requisites: Students must have completed September Introductory Course (Financial Mathematics) (MA400).
Course content: The purpose of this course is to (a) develop the students' computational skills, and (b) introduce a range of numerical techniques of importance to financial engineering. The course starts with the implementation of binomial and trinomial trees. Random number generation, the fundamentals of Monte Carlo simulation and a number of related issues follow. Numerical solutions to stochastic differential equations and their implementation are considered. The course then addresses finite-difference schemes for the solution of partial differential equations arising in finance.
Teaching: 8 hours of lectures and 12 hours of computer workshops in the MT. 20 hours of lectures, 4 hours of seminars and 10 hours of computer workshops in the LT.
Reading List: P.Glasserman, Monte Carlo Methods in Financial Engineering, Springer; R.U. Seydel, Tools for Computational Finance, Springer; P.E.Kloeden and E.Platen, Numerical Solution of Stochastic Differential Equations, Springer; D.M. Capper, Introducing C++ for Scientists, Engineers and Mathematicians, Springer. B. Stroustrup, The C++ Programming Language, Addison Wesley; M. J. Capinski, T. Zastawniak, Numerical Methods in Finance with C++, Cambridge University Press; M. S. Joshi, C++ Design Patterns and Derivatives Pricing, Cambridge University Press;
Assessment: Exam (50%, duration: 2 hours) in the main exam period.
Project (50%) in the ST.

FM413 Fixed Income Markets – Half Unit
Teacher responsible: Dr Andrea Tamoni
Pre-requisites: Students taking this course are expected to be familiar with the theory of asset evaluation at the level of FM430 Corporate Finance and Asset Markets and the theory and practice of derivative pricing at the level of FM441 Derivatives.
Course content: This advanced course is designed for students seeking an understanding of fixed income valuation and hedging methods, and a basic familiarity with the major markets and instruments.
Provides a thorough grounding in recent developments in fixed income securities pricing, hedging and portfolio management. By the end of the course, the students will be familiar with a variety of topics, including (i) the basic concepts of fixed-income instruments, such as yield, duration, convexity; (ii) the basic techniques to analyze and hedge fixed income products, such as "curve fitting", "bootstrapping", duration-based hedging and asset-liability management; (iii) the forces, or "factors", driving the variation in the entire spectrum of interest rates at different maturities; (iv) the main evaluation tools, which can be applied to evaluate a wide range of products (trees, no arbitrage trees, calibration and some continuous time models) ; (v) the main fixed income products such as government bonds, corporate bonds (convertible, callable, puttable), and their evaluation; (vi) plain vanilla interest derivatives (caps, floors and collars, swaps, swaptions, etc.) and their evaluation; (vii) mortgage backed securities and credit risk transfers; (viii) the analysis of the "destabilizing" effects related to the use of certain derivatives written on fixed income instruments.
Teaching: 20 hours of lectures and 10 hours of seminars in the LT.
Reading List: The primary source for this course is a comprehensive set of Lecture Notes, tutorials and case studies, and a reading pack containing chapters from the following books: Sundaresan, S. (2001), Fixed Income Markets and Their Derivatives, South Western College Publishing. Duffie, D and Singleton, K (2003), Credit Risk: Pricing, Management, and Measurement, Princeton: Princeton University Press (Princeton Series in Finance). Tuckman B. and A. Serrat (2011), Fixed Income Securities: Tools for Today's Markets, 3rd Edition, John Wiley & Sons. Veronesi, P. (2010), Fixed Income Securities: Valuation, Risk, and Risk Management, John Wiley & Sons.
Assessment: Exam (100%, duration: 2 hours) in the main exam period.

ST409 Stochastic Processes – Half Unit
Teacher responsible: Dr Umut Cetin **Pre-requisites**: Students must have completed Further Mathematical Methods (MA212).
Good undergraduate knowledge of distribution theory
Course content: A broad introduction to stochastic processes for postgraduates with an emphasis on financial and actuarial applications. The course examines Martingales, Poisson Processes, Brownian motion, stochastic differential equations and diffusion processes. Applications in Finance. Actuarial applications.
Teaching: 20 hours of lectures, 10 hours of seminars and 10 hours of workshops in the MT. Week 6 will be used as a reading week.
Reading List: T Bjork, Arbitrage Theory in Continuous Time; T Mikosch, Elementary Stochastic Calculus; S I Resnick, Adventures in Stochastic Processes; B K Oksendal, Stochastic Differential Equations: An Introduction with Applications, D Williams, Probability with Martingales.
Assessment: Exam (100%, duration: 2 hours).

Courses provided by the Department of Mathematics
These courses are listed under Paper 6 of the MSc Financial Mathematics Programme Regulations and all students on the degree must take at least one of the following:

MA402 Game Theory I - Half Unit
Teacher responsible: Dr Paul Dütting **Pre-requisites**: Students must know basics of linear algebra (matrix multiplication, geometric interpretation of vectors) and probability theory (expected value, conditional probability, independence of random events).
Course content: The course studies the theory of games and its applications in economics: Game trees with perfect information, NIM, combinatorial games. Backward induction. Extensive and strategic (normal) form of a game. Nash equilibrium. Commitment. Zero sum games, mixed strategies. Maxmin strategies. Nash equilibria in mixed strategies. Finding mixed-strategy equilibria for two-person games. Extensive games with information sets, behaviour strategies, perfect recall. If time permits: The Nash bargaining solution. Multistage bargaining.
Teaching: 22 hours of lectures and 10 hours of seminars in the MT.
Reading List: Lecture notes will be provided. Supplementary reading: K Binmore, Playing for Real: Game Theory CUP, 2007; E Mendelson, Introducing Game Theory and Its Applications, CRC 2004
Assessment: Exam (100%, duration: 2 hours) in the main exam period.

MA411 Probability and Measure – Half Unit
Teacher responsible: Dr Pavel Gapeev
Pre-requisites: Some background in real analysis is essential.
Course content: The purposes of this course are (a) to explain the formal basis of abstract probability theory, and the justification for basic results in the theory, and (b) to explore those aspects of the theory most used in advanced analytical models in economics and finance. The approach taken will be formal. Probability spaces and probability measures. Random variables. Expectation and integration. Convergence of random variables. Conditional expectation. The Radon-Nikodym Theorem. Martingales. Stochastic processes. Brownian motion. The Itô integral.
Teaching: 20 hours of lectures and 10 hours of seminars in the MT. 1 hour of seminars in the LT.
Reading List: Full lecture notes will be provided. The following may prove useful: J S Rosenthal, A First Look at Rigorous Probability Theory; G R Grimmett & D R Stirzaker, Probability and Random Processes; D Williams, Probability with Martingales; M Caplinski & E Kopp, Measure, Integral and Probability; J Jacod & P Protter, Probability Essentials.
Assessment: Exam (100%, duration: 2 hours) in the main exam period.

MA414 Stochastic Analysis – Half Unit
Teacher responsible: Dr Arne Lokka
Pre-requisites: ST409 or MA411.
Course content: This course is concerned with a rigorous introduction to the area of stochastic analysis with emphasis on Itô calculus. The course begins necessary preliminaries, followed by a construction of the standard Brownian motion and a study of its properties. Subsequently, Lévy's characterisation of Brownian motion, martingale

representation theorems and Girsanov's theorem are established. The course then expands on a study of stochastic differential equations.
Teaching: 20 hours of lectures and 10 hours of seminars in the LT.
Reading List: Full lecture notes will be provided. The following may prove useful: I Karatzas and S E Shreve, Brownian Motion and Stochastic Calculus, Springer; B Øksendal, Stochastic Differential Equations: An Introduction with Applications, Springer; D Revuz and M Yor, Continuous Martingales and Brownian Motion, Springer; L C G Rogers and D Williams, Diffusions, Markov Processes, and Martingales, Cambridge.
Assessment: Exam (100%, duration: 2 hours) in the main exam period.

MA420 Quantifying Risk and Modelling Alternative Markets – Half Unit
Teacher responsible: Professor Michail Zervos
Pre-requisites: Students must have completed Stochastic Processes (ST409).
Course content: This course is concerned with various issues arising in the context of investment risk specification as well as with the mathematical theory of so-called alternative markets, such as commodity and energy markets. In particular, the course considers the structural credit risk models and the quantification of risk by means of copulas and risk measures. Also, the course expands on the modeling of alternative markets and addresses the problem of valuation of investments in real assets.
Teaching: 20 hours of lectures and 10 hours of seminars in the LT. 2 hours of lectures in the ST.
Reading List: F.Benth, J.Benth, S.Koekebakker, Stochastic Modelling of Energy and Related Markets, World Scientific 2008.
H.Föllmer and A.Schied, Stochastic Finance, 3rd edition, De Gruyter, 2011.
A.McNeil, R.Frey and P.Embrechts, Quantitative Risk Management, Princeton University Press, 2005.
A.K.Dixit and R.S.Pindyck, Investment under Uncertainty, Princeton University Press, 1994.
Assessment: Exam (100%, duration: 2 hours) in the main exam period.

Additional non-assessed course:

MA422 Research Topics in Financial Mathematics
Teacher responsible: Dr Luitgard Veraart
Course content: The seminar ranges over many areas of financial mathematics, stochastic analysis and stochastic control theory.
Teaching: 15 hours of seminars in the MT. 15 hours of seminars in the LT. 9 hours of seminars in the ST.
5 x 3 hour talks by researchers in the MT and LT. 3 x 3 hour talks by researchers in the ST.
Additional seminars will be scheduled throughout the year. Please see the Timetables website for further information.
Assessment: This is a non-assessed course.

Courses in other Departments

FM402 Financial Risk Analysis – Half Unit
Teacher responsible: Dr Yves Nosbusch
Pre-requisites: The course assumes a basic knowledge of finance theory, statistics and mathematics (calculus, linear algebra).
Course content: This course aims to provide an overview of the main theoretical concepts underlying the analysis of financial risk and to show how these concepts can be implemented in practice in a variety of contexts. This course shares some topics with

FM442 Quantitative Methods in Finance and Risk Analysis. The course will include a selection of: Conceptual foundations: diversification, hedging and their limits; Fixed income securities; Options and dynamic replication; Value at Risk; Endogenous risk; Ideas from Behavioural Finance; Credit risk (ratings based models, structural models, reduced form models); Credit derivatives
Teaching:20 hours of lectures and 8 hours of classes in the MT. 2 hours of classes in the LT.
Reading List: Course readings will vary from year to year depending upon the topics covered. Useful references are M Crouhy, D Galai and R Mark, Risk Management, McGraw-Hill, 2001; P Jorion, Value at Risk, McGraw-Hill, 2007; J Hull, Risk Management and Financial Institutions, Prentice-Hall, 2015; J Hull, Options, Futures and Other Derivatives, Prentice-Hall, 2014 and D Duffie and K Singleton, Credit Risk, Princeton University Press, 2003.
Assessment: Exam (100%, duration: 2 hours) in the main exam period.

FM404 Forecasting Financial time Series – Half Unit
Teacher responsible: To be confirmed
Pre-requisites: Students must have completed Quantitative Methods in Finance and Risk Analysis (FM442).
The first half of FM437 Financial Econometrics, or alternatively FM442 Quantitative Methods for Finance and Risk Analysis, is a required prerequisite. Students who can demonstrate comparable background may be granted an exemption from this requirement.
Course content: This course will examine the techniques involved with forecasting key variables in finance, and how to incorporate model uncertainty into financial forecasts. Students will learn both the theory and the practice of forecasting in finance.
The following topics will be covered: introduction to time series analysis; Maximum Likelihood Estimation (MLE) with time series data, and MLE based model selection; Bayesian inference, posterior probabilities, and Bayesian Model Averaging; Markov Chain Monte Carlo methods; present value regressions, vector autoregressios, causality, and cointegration; asset pricing and the Generalized Method of Moments (GMM); frequentist and Bayesian information theoretic alternatives to GMM.
Additional information can be found on Christian Julliard's teaching page and on On Moodle (for current students)
Teaching: 20 hours of lectures, 10 hours of classes and 10 hours of computer workshops in the LT.
Reading List: Lecture notes will be provided, and some journal articles may also be used.
Assessment: Exam (100%, duration: 3 hours and 15 minutes) in the main exam period.

FM441 Derivatives – Half Unit
Teacher responsible: Dr Rohit Rahi
Pre-requisites: This is an advanced course. Students will be expected to show some familiarity with statistics, calculus and random processes.
Course content: The course provides a thorough grounding in the theory of derivatives pricing and hedging. Particular emphasis is placed on pricing within a multi-period, mostly continuous-time, framework. A special feature of the course is its coverage of the modern theory of no-arbitrage pricing using PDE and martingale methods. These methods are applied to the pricing of vanilla and exotic options, forwards, futures and interest rate derivatives. The uses of derivatives in hedging and risk-management are discussed as well.
Teaching: 20 hours of lectures and 10 hours of seminars in the LT.

Reading List: Teaching notes will be distributed. No one book covers the entire course, but the following is an excellent reference: John C Hull, Options, Futures and Other Derivatives.
Assessment: Exam (100%, duration: 2 hours) in the main exam period.

FM442 Quantitative Methods in Finance and Risk Analysis – Half Unit
Teacher responsible: Dr Philippe Mueller
Pre-requisites: A background in statistics and mathematics is required. No prior programming experience is necessary but students without programming experience are highly encouraged to concurrently take FM457 Computational Tools in Finance.
Course content: This is a graduate level course on the quantitative and statistical tools that are important in applied finance. It studies financial markets and market risk from a quantitative point of view, focusing on understanding the relationship between risk and return and on models for managing financial risks. The course brings together three essential fields: finance, statistics and computer programming. Students will be exposed to the application of these tools and the key properties of financial data through a set of computer-based classes and exercises. The following key topics will be covered; review of statistics and introduction to time series econometrics; modeling of financial returns; introduction to the analysis of financial data using MATLAB; volatility models including GARCH type models and the concept of implied volatility; risk measures and coherence; Value-at-Risk and Expected Shortfall; introduction to simulation-based methods and application to option pricing and risk management.
Implementing the models and tools in MATLAB is an essential part of the course and, consequently, all classes are computer-based. With regards to empirical work the students will learn how to deal with very practical problems such as locating financial data and processing the data to be able to analyze it in the first place. Through the computer-based exercises the students explore the data bases available at the LSE and they will become comfortable working with real data. Throughout the term the students will build their own toolbox of routines that can also be used outside the course.
Teaching: 20 hours of lectures and 10 hours of seminars in the MT.
Reading Lists: The core text for this course is:
Jon Danielsson, Financial Risk Forecasting, John Wiley & Sons, 2011.
Extra readings will be assigned for selected topics.
Assessment: Exam (75%, duration: 1 hour and 30 minutes) in the main exam period.
Project (20%, 2000 words) and presentation (5%) in the MT.

FM445 Portfolio Management – Half Unit
Teacher responsible: Prof Kathy Yuan
Course content: This course aims to cover the main topics in equity portfolio management. Some of the topics covered in the course include: Portfolio optimization techniques; Multi-factor models and their applications; Trading strategies; International portfolio management and currency hedging; Trading costs; Portfolio performance measurement and attribution; Style analysis; Mutual funds; Hedge funds. The course is based on a number of empirical applications and case studies, so that students can gain a better understanding of implementation issues related to managing an equity portfolio.
Teaching: 20 hours of lectures and 10 hours of seminars in the LT.
Reading List: A study pack will include lecture notes and case studies. All relevant articles will be made available during the course. Useful references are Modern portfolio theory and investment analysis, by E. J. Elton, M. J.Gruber, S. J. Brown, and W. N. Goetzmann, Wiley Press; Modern investment management, by Bob Litterman and the Quantitative Resource Group, GSAM, Wiley Press; Investments, by Z. Bodie, A. Kane, and A. Marcus, McGraw-Hill Irwin.

Assessment: Exam (80%, duration: 2 hours) in the main exam period.
Coursework (20%). The 20% coursework comprises five homework assignments and one project.

FM472 International Finance – Half Unit
Teacher responsible: To be confirmed
Course content: This course examines key issues in international finance, focusing on recent developments and incorporating theoretical, empirical, policy and institutional dimensions. The course uses exchange rates as a unifying theme and considers them from four perspectives: theory, policy, global risk and international investors. The course examines models of exchange rate determination and related empirical evidence. It analyses the choice and coordination of exchange rate regimes, including the European Monetary Union. It examines exchange rates as one of the sources of global financial instability. It considers the risk exposure for investors arising from exchange rate volatility and its hedging with currency instruments. The course also explores the links, in each area, to current developments such as the internationalisation of the Chinese Renminbi, the EMU sovereign debt crisis, the recent financial crisis and global imbalances, forex carry trades and the high volatility of short term exchange rates.
Teaching: 20 hours of lectures and 10 hours of seminars in the LT.
Reading List: A selection of journal articles; background reading from a textbook such as Keith Pilbeam International Finance (Palgrave, 2013, 4th edition)
Assessment: Exam (100%, duration: 2 hours) in the main exam period.

FM492 Principles of Finance
Teacher responsible: Prof Richard Payne **Pre-requisites**: Students must have completed: one Economics course, one Maths course and one Statistics course at an undergraduate level.
Course content: This course examines the theory of financial decision-making by firms and examines the behaviour of the capital markets in which these decisions are taken. The topics covered are the theory of capital budgeting under certainty in perfect and imperfect capital markets, portfolio theory, equity and bond markets, the capital asset pricing model, efficient markets, sources of funds, basic theory of capital structure and the cost of capital, company dividend decisions and financial markets and institutions.
Teaching: 20 hours of lectures and 20 hours of seminars in the MT. 20 hours of lectures and 20 hours of seminars in the LT. 2 hours of lectures and 6 hours of seminars in the ST.
Reading List: Detailed course programmes and reading lists are distributed at the start of the course. Illustrative texts include: Principles of Corporate Finance by Richard Brealey, Stewart Myers, and Franklin Allen, McGraw-Hill Inc.
Assessment: Exam (100%, duration: 3 hours) in the main exam period.

ST422 Time Series – Half Unit
Teacher responsible: Dr Wai-Fung Lam
Pre-requisites: Good undergraduate knowledge of statistics and probability.
Course content: A broad introduction to statistical time series analysis for postgraduates: what time series analysis can be useful for; autocorrelation; stationarity; causality; basic time series models: AR, MA, ARMA; ARCH and GARCH models for financial time series; trend removal and seasonal adjustment; invertibility; spectral analysis; estimation; forecasting. We will also discuss nonstationarity and multivariate time series.
Teaching: 20 hours of lectures and 10 hours of seminars in the MT.
Exercises will be given out to do at home during Week 6.

Reading List: Brockwell & Davis, Time Series: Theory and Methods; Brockwell & Davis, Introduction to Time Series and Forecasting; Box & Jenkins, Time Series Analysis, Forecasting and Control; Shumway & Stoffer, Time Series Analysis and Its Applications.
Assessment: Exam (100%, duration: 2 hours).

ST426 Applied Stochastic Processes – Half Unit
Teacher responsible: Dr Erik Baurdoux
Course content: This course builds on material discussed in ST409 (Stochastic Processes). In particular, elements of the general theory of semi-martingales will be covered and emphasis will be given on presenting a variety of models involving processes with general dynamics, including jumps. The theory will be applied to a range of topics in mathematical finance and insurance, as well as financial economics.
Teaching: 20 hours of lectures and 10 hours of seminars in the LT. 2 hours of lectures in the ST. Week 6 will be used as a reading week; exercises will be given out to students to do at home.
Reading List: Brownian Motion and Stochastic Calculus. Ioannis Karatzas and Steve Shreve Numerical Solution of Stochastic Differential Equations with Jumps in Finance. Eckhard Platten, Nicola Bruti-Liberati. Essentials of Stochastic Finance: Facts, Models, Theory. Albert Shiryaev. Stochastic Integration and Differential Equations. Phillip Protter. Levy Processes in Finance: Pricing Financial Derivatives. Wim Schoutens
Selected papers from scientific journals.
Assessment: Exam (100%, duration: 2 hours) in the main exam period.

ST427 Insurance Mathematics – Half Unit
Teacher responsible: Dr Hao Xing
Course content : A self-contained comprehensive introduction to life and non-life insurance mathematics. For the life insurance, mortality laws are analysed from probabilistic and statistical point of view. Actuarial analysis of basic insurance products: pure endowment, life insurance/assurance, and annuity. Prospective/retrospective reserves of these products. Extension to general multi-states policy is studied via Markov chains Pricing embedded interest and mortality guarantees is introduced. For the non-life insurance, axiomatic approach to ordering of risks is presented, optimal forms of insurance from the insured's and from the insurer's point of view are analysed, and Pareto-optimal risk exchanges are introduced. Standard schemes of reinsurance are introduced and analysed. Ruin probability of an insurance company and capital requirement are studied. Heavy tail distributions and the extreme value theory are introduced. Case studies on current developments in life and non-life insurance industry are also presented.
Teaching: 20 hours of lectures and 10 hours of seminars in the MT.
An informal 'open book' mid-term practice examination will take place in Week 6.
Reading List: R Norberg, Risk and Stochastics in Life Insurance (Lecture notes)
R Norberg, Non-life Insurance Mathematics (Lecture notes)
T Mikosch, Non-Life Insurance Mathematics.
Assessment: Exam (100%, duration: 2 hours).

ST429 Probabilistic Methods in Risk Management and Insurance - Half Unit
Teacher responsible: Dr Hao Xing
Course content: A self-contained introduction to probabilistic and statistical methods in risk management. This course starts with risk factors models and loss distributions, which are illustrated via examples in stocks, derivatives, and bonds portfolios. Axioms of coherent risk measures are introduced. Value at risk and other risk measures are introduced and their relation with coherent risk measures is discussed. Multivariate factor models are introduced and analysed: covariance and correlation estimations,

multivariate normal distributions and their testing, normal mixture distributions and their fitting to data. The theory of copulas is introduced: meta distributions, tail dependence, fitting copulas to data. Some limitations of copulas are also discussed. The extreme value theory is introduced: generalized extreme value distribution, threshold exceedances and generalized Pareto distribution, modelling and measures of tail risk. Applications to insurance with large loss are also discussed. Students will be exposed to financial data via sets of computer-based classes and exercises.
Teaching: 20 hours of lectures and 10 hours of seminars in the LT.
An informal 'open book' mid-term practice examination will take place in Week 6.
Reading Lists: A.McNeil, R.Frey, P.Embrechts, Quantitative Risk Management: Concepts, Techniques, Tools; Princeton Series in Finance
Assessment: Exam (75%, duration: 2 hours) in the main exam period.
Project (25%, 2000 words).

ST439 Stochastics for Derivatives Modelling – Half Unit
Teacher responsible: Dr Beatrice Acciaio
Pre-requisites: Students must have completed Stochastic Processes (ST409).
Course content: Valuation and hedging of derivative securities: general principles of mathematical finance; asset price models; static vs dynamic option pricing; connection with PDEs; exotic options; volatility derivatives; mean-variance hedging.
Teaching: 20 hours of lectures and 10 hours of seminars in the LT.
During week 6 students will carry out group work, solving problems that will have been set in an earlier class.
Reading Lists: Steven Shreve, Stochastic Calculus for Finance II: Continuous-Time Models, Springer.
Selected papers from scientific journals.
Thorsten Rheinlander and Jenny Sexton, Hedging Derivatives, World Scientific.
Assessment: Exam (100%, duration: 2 hours) in the main exam period.

ST440 Recent Developments in Finance and Insurance - Half Unit
Teacher responsible: Dr Beatrice Acciaio
Pre-requisites: Students must have completed Stochastic Processes (ST409).
Course content: Recent developments in the theory of stochastic processes and applications in finance and insurance and their interface. A variety of topics will be chosen, from robust evaluation; optimal hedging; evaluation via utility criteria; optimal risk sharing; minimal capital requirement according to the Basel Accords and the Solvency Directives.
Teaching: 20 hours of lectures and 10 hours of seminars in the LT.
During week 6, students will be required to give group presentations using material which will have been provided in week 1 or 2. They will also discuss in groups solutions to problems that will have been set in class.
Reading List: H. Foellmer and A. Schied: Stochastic finance. An introduction in discrete time. (3rd ed.), de Gruyter.
Selected papers from scientific journals.
Assessment: Exam (100%, duration: 2 hours) in the main exam period.

Further information about these courses can be found on the School course guides page at the following link:
http://www.lse.ac.uk/resources/calendar/courseGuides/graduate.htm (Please note the course guides for 2016/7 will be updated in August).