London Graduate School in
Mathematical Finance

The London Graduate School in Mathematical Finance is a consortium of the mathematical finance groups of Birkbeck College, Brunel, Imperial College, King's College, LSE and UCL. Its main purpose is to provide a programme of advanced courses in mathematical financial, primarily but not exclusively for first year PhD students in the various groups.

A mixture of long and short courses is offered. The duration of long courses is 20-30 hours across 10 weeks. The duration of short courses is 8-15 hours across five weeks (not necessarily consecutive).

2011-12 course programme

Welcome reception and opening lecture

Time: 18:30 (start time of welcome reception)
Date: Wednesday 5 October 2011
Location: Mathematical Common Room, room 549, level 5, Huxley Building, Imperial College London, 180 Queen's Gate. SW7 2RH
Nearest underground stations: South Kensington and Gloucester Road

The reception will be preceded by a lecture by Professor Mark Davis on 'Model-free bounds for the value of variance swaps' in room 139, Huxley Building, starting at 17:30.

Please enter the Huxley Building by the street entrance, 180 Queen's Gate, SW7, opposite Queen's Gate Terrace. The entry level is Level 2. For the lecture, take the stairs past the lifts down to Level 1. For the reception, take the lift to Level 5, turn right and then left.

Imperial College, South Kensington campus map: http://www3.imperial.ac.uk/campusinfo/southkensington

2011-12 course schedule

MF1 Information and finance: from market filtration to derivatives pricing (long course)

Lecturer: Professor Dorje C Brody, Brunel
http://www.brunel.ac.uk/siscm/mathematical-sciences/people-in-maths/academic-staff/professor-dorje-brody

Time: 18:00 – 21:00
First meeting: Monday 10 October 2011
Duration of course: 8 x 3 hours October – December 2011
Location: Room 139, level 1, Huxley Building, Imperial College

Imperial College, South Kensington campus map: http://www3.imperial.ac.uk/campusinfo/southkensington

Course summary:

1. Introduction and overview
1.1 Introduction 1.2 The modelling framework 1.3 Modelling the cash flows 1.4 Modelling the information flow 1.5 Overview of the course

2. Application to credit risk modelling
2.1 Why information-based approach for credit-risk modelling? 2.2 Simple model for defaultable discount bonds 2.3 Defaultable discount bond price processes 2.4 Defaultable discount bond dynamics 2.5 Bond volatility—information and variance swap 2.6 Perspective from the filtering theory 2.7 Digital bonds and binary bonds with partial recovery 2.8 Dynamic consistency and model calibration 2.9 Simulation of bond price processes

3. Pricing and hedging credit derivatives
3.1 Options on credit-risky bonds 3.2 Measure change technique 3.3 Option Greeks 3.4 Bond option price processes 3.5 Arrow-Debreu method and information derivatives

4. Time-change method and barrier options
4.1 Time-change and Brownian bridge 4.2 Time-changed market information 4.3 Discount function under time change 4.4 Pricing credit-risky bond in time-changed setup 4.5 Asset price dynamics 4.6 Bond option valuation in time-changed setup 4.7 Reflection of Brownian paths 4.8 Barrier option pricing

5. Complex credit-linked structures
5.1 Coupon bonds: the X-factor approach 5.2 Credit default swaps 5.3 Baskets of credit-risky bonds 5.4 Homogeneous baskets

6. Single cash flow to market factors: origin of stochastic volatility
6.1 Asset price dynamics in the case of a single cash flow 6.2 European-style call options 6.3 Examples of specific dividend structures 6.4 Market factors and multiple cash flows 6.5 Geometric Brownian motion model 6.6 Dividend growth 6.7 Assets with common factors 6.8 Origin of unhedgeable stochastic volatility

7. Non-Markovian information flow
7.1 Time-dependent information flow 7.2 Changes of measure for Brownian bridges 7.3 Derivation of the conditional density 7.4 Consistency relations 7.5 Expected dividend 7.6 Asset prices and derivative prices 7.7 Existence of the information process 7.8 Multi-factor models with a time-dependent information flow rate

8. Application to reinsurance contracts
8.1 Introduction: reinsurance claims 8.2 Gamma processes and associated martingales 8.3 Gamma bridge processes 8.4 Further properties of gamma bridges 8.5 Valuation of aggregate claims 8.6 Valuation of general reinsurance contracts 8.7 Discrete cash flows 8.8 Option price process 8.9 Example: gamma-distributed cash flow

MF2 Computational finance (short course)

Lecturer: Professor William T Shaw, UCL
http://www.ucl.ac.uk/math/staff/WShaw.html

Time: 2pm to 4pm, October, November and December 2011
First meeting: Wednesday 12 October 2011
Duration of course: 8 x 2 hours (tbc: may be increased to 10 x 2)
Location: Room 106, Roberts Building, UCL

UCL, Bloomsbury campus map (Map No.2): http://www.ucl.ac.uk/locations/ucl-maps

Course summary: In modern mathematical finance, the use of computers goes far beyond their traditional use for purely numerical work, and it is now wholly out of date to think of computers entirely for number crunching, or indeed to just use computer languages that are only capable of numerical calculations. Mathematical finance involves the calculations of expectations by some form of integration, the calculation of many quantities of interest requires differentiation, and practical calculations often involve the solution of partial differential equations. Many calculations involve large amounts of manipulation. Modern work is therefore best done in environments where it is possible to do symbolic manipulations alongside efficient numerical work. This must of course be balanced against the needs of industry, where one frequently finds more traditional tools in use. Then, especially for risk management purposes, it is appropriate to make detailed comparisons between analytical solutions and their numerical analogues.

The emphasis therefore will be on useful modern computational methods, including **numeric, symbolic and parallel (grid or GPU) methods**. Numerical methods will be approached from the point of view of their accuracy and mathematical integrity, and links to numerical analysis. This course will not be looking at code-structuring or IT integration issues (which tend to be very institution-specific) nor will be looking at anything related to particular operating systems or hardware platforms. It will be given in based on C++, Mathematica and CUDA.

The course will recognize that the use of computers for modelling in the financial industry can take various forms. Intensive numerical methods in pricing and hedging tools in daily use in institution-wide systems will often be implemented in C++. Advanced mathematical techniques may require a combination of exotic special functions, complex variable methods and computer algebra and calculus. Risk management and rapid prototyping teams may require flexible on-desk tools for implementing models quickly on a one-off basis.

Further Details

Platform: The ideal situation is for students to bring their own laptop pre-configured with eduroam internet access, in order to download material brought up in lectures.

First lectures:
1. Introduction + Simulation via quantiles
2. Quick introduction to C++

Ideally you will have available a C++ compiler on your laptop or computer elsewhere. If you have programmed before, e.g. in MS Visual studio, you are welcome to use that, but if you are new to this type of coding I encourage you to try the Dev-cpp tool (see below) which is very friendly to beginners.

C++ Programming Material
I am using the C++ development environment Dev-cpp from www.bloodshed.net, running under Windows.
Mark Joshi's web page that goes with his book Design Patterns and Derivatives Pricing is here. It has a link where you can download his code as a zip file. You might also like to take a look at his tools for linking C++ models to Excel. He supports the Dev-cpp environment with pre-made project files. See the section on Software downloads on this page.

MF3 Topics in mathematical finance (short course)

Lecturer: Professor Dr Hélyette Geman, Birkbeck College
http://www.ems.bbk.ac.uk/faculty/geman/
http://www.helyettegeman.com/

Time: to be announced (evenings)
First meeting: to be announced
Duration of course: 5 x 3 hours, May 2012
Location: Birkbeck

Course summary: to be announced

MF4 Portfolio optimisation (long course)

Lecturer: Dr Albina Danilova, LSE
http://www2.lse.ac.uk/researchAndExpertise/Experts/profile.aspx?KeyValue=a.danilova@lse.ac.uk

Time: 18:00 – 21:00
First meeting: Monday 9 January 2012
Duration of course: 30 hours, plus take home exam
Location: LSE (further details to be announced)

Course summary: Merton's optimal investment problem; utility maximisation by duality methods; incomplete markets and indifference pricing; techniques – dynamic programming, convex duality, viscosity solutions.

MF5 Interest rates

Lecturer: Professor Mark Davis, Imperial
http://www3.imperial.ac.uk/people/mark.davis

Time: to be announced
First meeting: to be announced (second term of 2011-12)
Duration of course: January – March 2012, 10 x 3 hours, Wednesday 2pm-5pm (tbc)
Location: Imperial (further details to be announced)

Course summary: Description of the interest rate market and construction of the yield curve; short rate models and associated option pricing; the HJM approach; changes to numeraire and Forward Measures; The Libor Market Model; hedging interest rate contracts.

MF6 Arbitrage free credit valuation adjustment (short course)

Lecturer: Professor Damiano Brigo, KCL
http://www.kcl.ac.uk/nms/depts/mathematics/people/atoz/brigod.aspx

Time: 18:00 – 20:00
First meeting: (W1) Wednesday 30/11/2011, Room K-1.56 (lower ground floor, King's Building)
Other dates: (W2) Thursday 01/12/2011, Room S-1.04 (lower ground floor, Strand Building); (W3) Wednesday 07/12/2011, Room K-1.56; (W4) Thursday 08/12/2011, Room S-1.04); (W5) Wednesday 14/12/2011, Room K-1.56
Duration of course: 5 weeks
Location: KCL (Room K-1.15, King's Building, weeks 1, 3 and 5; Room S-1.04, Strand Building, weeks 2 and 4)

A map of the KCL Strand campus can be viewed here: http://www.kcl.ac.uk/about/campuses/strand.html

Course summary: Accurate valuation of Credit Valuation Adjustments (CVA) requires consistent arbitrage free dynamical models for several asset classes, proper modelling of dependencies across asset classes and in particular an understanding of the interaction between credit risk and market risk drivers. Subtleties concerning closeout conventions, liquidity risk, first to default risk, collateral modelling and cost of funding further complicate the proper valuation of CVA. In this course we introduce the basic definition of CVA, both unilateral and bilateral. We analyse the Debit Valuation Adjustment (DVA) that appears in the bilateral case. We give examples of valuation of CVA across asset classes and address closeout conventions, collateral modelling and first to default risk. We also spend the initial lectures to introduce credit risk models that are relevant in the CVA space, paying special attention to the often neglected role of credit volatility.

MF7 Insurance (short course)

Lecturer: Dr Andrea Macrina, KCL
http://www.kcl.ac.uk/nms/depts/mathematics/people/atoz/macrinaa.aspx

Please note that this course will not be available in 2011-12, but is scheduled to be added to the programme in 2012-13.

Registration

To participate in these courses, you should register with the local course coordinator:

Birkbeck: Professor Dr Hélyette Geman (Economics, Mathematics and Statistics)
Email: h.geman@bbk.ac.uk

Brunel and Imperial: Professor Dorje C Brody (Mathematics)
Contact: Doris Abeysekera
Email: d.abeysekera@imperial.ac.uk

KCL: Ian Marshall (Research Administrator, Department of Statistics, LSE) on behalf of Professor Damiano Brigo, KCL
Academic questions should be addressed to:
Professor Damiano Brigo (Mathematics)
Email: damiano.brigo@kcl.ac.uk

LSE Statistics and Mathematics: Ian Marshall (Research Administrator, Statistics)
Email: i.marshall@lse.ac.uk
Academic questions should be addressed to:
Department of Statistics: Dr Pauline Barrieu
Email: p.barrieu@lse.ac.uk
Department of Mathematics: Dr Albina Danilova
Email: a.danilove@lse.ac.uk

UCL: Ian Marshall (Research Administrator, Department of Statistics, LSE) on behalf of Professor William T Shaw, UCL
Email: i.marshall@lse.ac.uk

Please register by Friday 7 October 2011 at latest. The coordinators will assemble a global list of participants. An email address for each PhD student should be provided so that we can construct a mailing list for seminar and course announcements.