Quants Hub

Online Course Prospectus

Quants Hub - Contents

Welcome to The Quants Hub

The Quants Hub is a comprehensive online platform for Quantitative Analysts, Risk Managers, Structuring and Trading Desks, Model Validation, Programmers & Developers, Financial Engineers & Treasury Desks. This empowers you and your institution to create an individualised bespoke educational library. Use the Quants Hub as a learning resource for your team, University or as part of your companies learning & development strategy. Our large online workshop training resource can keep you updated on the latest developments on core business as well as other asset classes. You can also keep up-to-date on fringe trends such as Bitcoin, Algorithmic Differentiation, QuantLib etc.

Endorsements

"I have followed many online workshops from Quantshub.com and will continue doing in future. This is very convenient for someone who can't attend lectures in person. Workshops are very well organized, instructors are very well regarded in their chosen fields and customer service is A+."

Best,
Hardik Shukla

"Really enjoyed the course (F# and Functional Programming in Finance by Tomas Petricek)*, now I need to apply what I learned before I start forgetting things! Tomas was great, really hope he decides to put together a follow up class."*

Gene Chiaramonte

Available from June 2015:

Recruitment Testing Service

From June 2015 The Quants Hub will offer a **FREE** recruitment testing service to all banks & financial institutions on the following job specifications: Quantitative Research, Algo/FXTrading, Developers, Programmers, Risk Management, Treasury, Liquidity Risk, ALM....

So how does it work?

The testing/vetting will be in a multi-choice format from our vast test bank which boasts over 1000 questions. Each job description can be fully tailored to your financial institution, choosing from a wide variety of financial disciplines to suit your needs from our comprehensive test bank. Financial institutions can take each test before they use the facility and all jobs will subsequently be posted on the site for free. Candidates will be charged £199.00 to take each individual test, enhancing their CVs and boosting their chances in the competitive jobs market. A full report will be generated from each test to help financial institutions recruit the best possible candidates.

Quants Hub Subscription Service

Full Annual Subscription Service

The Quants Hub offers a full annual subscription service giving members access all areas to over 300 hours of lectures, 10+ programming school courses, our e-learning multi-choice question bank and online exercises. This service will be offered in a Premium Member access-all-areas format:

- **30+ full workshops**
- **50+ knowledge tests & Self-Paced courses**
- **10+ programming school courses**
- **Our e-learning multi-choice question bank and online exercises**
- **Over 300 hours of lectures & free webinars**
- **Free Online Workshops (Including a 2 day live xVA Master Class by Massimo Morini, 20/21 April 2015 and FX Option Performance by Jessica James, 26/27 May)**
- **The Quants Hub Presenter Faculty Live Q&A Webinars**

The Quants Hub is constantly expanding and we will be adding 5 programming school courses, plus approximately 10+ workshops and 40 knowledge tests in 2015. So why not use this service as part of your annual training strategy.

Hint: Be smart and share your 4 annual Programming School course passes with friends and colleagues.

Monthly Subscription Service

You can also buy a 1 month, 3 month & 6 months subscription. This subscription option allows you to access all Quants Hub workshops. The 1 month service does not include any programming school courses. The 3 month service includes: 1 Programming School course or Online Workshop, and the 6 month service includes 2 of the following: Programming School courses or Online Workshops.
This option does not include self-paced programming school courses.

Programming School Only Annual Subscription Service

If you only want to access the programming school courses, we offer a Programming School Subscription Only Service. This subscription option allows you to access 4 programming school courses per annum.
This option includes all self-paced programming school courses.

Hint: Be smart and share your 4 annual Programming School course passes with friends and colleagues.

Workshop Only Annual Subscription Service

If you only want to access all Quants Hub Workshops we offer a Workshop Only Service. This subscription option allows you to access to all Quants Hub workshops.
This option does not include self-paced Programming School courses.

Workshop Only Subscribers will also get access to free live online workshops.
The first of these is an XVA Master Class by Massimo Morini: Globally Online, 20th & 21th April 2015.

Academics Discount

We offer full-time academics a 50% discount on all the subscription services.

Government Employee Discount

We offer Government employees a 40% discount on all the subscription services.

Quants Hub Workshops

Bitcoin: The Distributed Public Ledger Revolution and the Future of Money

by Ferdinando M. Ametrano: Milan Bicocca University - Department of Statistics and Quantitative Methods; QuantLib; Banca IMI - IntesaSanpaolo Group

1) Bitcoin Primer

- Origin and history
- Economy
- Opinions
- Currency and protocol
- Decentralized Database
- Addresses and Transactions
- Wallets and Mining

2) The Block Chain

- UTOX, Merkle Trees
- Hashing and Public Key Cryptography
- Transaction Scripts
- Transactions types
  - Multisignature
- The Byzantine' General's Problem
- Alternative uses of the blockchain
- Alt-coins

3) About Money

- Medium of exchange
- Store of value
- Unit of account
- Gold
- Hayek denationalization of money
- Money supply and Price Stability
- Inflation, deflation
- Hayek Money
- Fisher Money
- Seigniorage Shares

4) Business Ecosystem

- Money transfer
- Exchanges
- Payment processors
- Wallets
- Multisignature escrow services
- Mining
- ATMs
- Cryptocurrency and Financial Institutions
- Regulatory and tax treatment

Theory and Practice for the FVA

by Alexander Antonov: Senior Vice President, Quantitative Research, Numerix

xVA general framework: from replications to adjustments

- Literature
- Introduction

xVA general framework: from replications to adjustments

- Classical replication/hedging (before the crisis)
- Modern replication/hedging (after the crisis)

xVA general framework: from replications to adjustments

- Pricing equations
- Case studies
- Replication
- Pricing PDE

xVA general framework: from replications to adjustments

- Adjustments
- Comparison
- How to avoid double counting and other traps?

Collateral in Different Currencies

- Foreign currency collateral: pricing PDE via modified replication procedure
- Efficient discount factor for the currency choice option

Collateral in Different Currencies

- Analytical methods for the efficient discount factor calculation (two currency case)
- Numerical experiments

Approximation for General Instruments (including arbitrary callable instruments)

- Main idea
- Theoretical and Numerical Issues
- Numerical experiments for a Bermudan option: comparison of the exact FVA with its different approximations

Quants Hub Workshops

A Look at QuantLib Usage and Development

by Luigi Ballabio: Senior Quantitative Developer, StatPro Italia srl

- Financial Instruments and Pricing Engines
- Session 2. The Care and Feeding of Term Structures
- Session 3. Cash Flows and Coupons (Part One)
- Session 4. Cash Flows and Coupons (Part Two)

QuantLib was the first open-source library for quantitative finance, and remains the most popular with downloads measured by the thousands for each release.

Started as a simple library, it has quickly evolved into a framework: its core classes have built-in functionality that enables them to work together, and into which a user can inject new specific behavior.

This makes QuantLib more useful, but also more daunting to approach as a new user must learn how the pieces are supposed to fit together: just grabbing and starting to use a few classes might go against the grain of the library, so to speak, and create problems later on.

In this workshop, I will first give a bird-eye look at the architecture by describing the design and rationale of its core classes (for instance, those modeling the generic concepts of financial instruments and term structures). I will show both examples of their idiomatic usage and relevant parts of their implementation, so as to be useful to both those who just want to use the library as it is and to those who want to extend it with their own instruments and models. I will also try to warn about the shortcomings of the current implementation and a few pitfalls to avoid.

In the second part of the workshop, I will describe more specific classes that can be added on top of the core classes to create more financial instruments. Again, I'll give information for users and developers alike.

One day is a short time, of course, given the sheer size of the library. However, I do hope to show you the lay of the land so that you can find your own way around it. During the presentations, I'll also point out particular C++ idioms, patterns and techniques used throughout the library, so that you'll be able to recognize them when looking at code that I won't cover directly.

Understanding Inflation and Inflation-Linked Products

by Brice Benaben: Managing Director and Head of Inflation Research, New Sky Capital

Section 1

- Introduction: forecasting inflation
- Curves and Sensitivities
- At the beginning... the linkers
- The imperfect link between "linkers" and "conventionals"
- Disconnection between "linkers" and "conventionals"

Section 2

- Recent flows: hedging swaps with bonds
- Development of the derivatives
- Change in models
- ZC swaps: lag and rebasing
- Asset swaps: the link between the cash and derivatives markets

Section 3

- Developments of Structure Notes
- LDI demand
- Latest developments
- Last word

Quants Hub Workshops

Theory and Practice for the Simulation of Credit Risk

by Norddine Bennani: Co-founder, BMA S.à r.l. Risk Management Solutions

Intensity Models

- A Simple and Classical Approach
- Review of Standard Intensity Models
- Joint Simulation of Credit Spread and Default
- Calibration and Simulation
- Intensity Models: Summary

Credit Market Models

- Notations and Model Setup
- Introducing the Survival Probability Measure
- Credit Market Model
- Model Limitations: Default Event and Portfolio Credit Risk
- Extended Credit Market Model
- Practical Implementation and Calibration

Alternative Intensity Models

- Limitations of Standard Intensity Models
- A Tractable and Practical Solution
- An Markov HJM Framework for the Default Intensity

Focus on Recovery Rate

- Modelling Recovery Rate
- Joint Simulation of Credit Spread, Default Event and Recovery Rate
- Coping with Systemic Risk
- A Spot Recovery Rate Model
- Practical Implementation and Calibration

Focus on Prepayment and Liquidity Risk

- A Brief Overview of Prepayment Risk Modelling
- Taking into account Liquidity Risk
- Numerical Applications
- A Simplified Approach to Capture Prepayment

Application to Counterparty Risk

- A Brief Introduction to CVA
- Counterparty Risk, Wrong -Way and Right -Way Risk
- Counterparty Risk and Recovery Rate

A Review of the Framework

- Blending Everything Together
- Simulation: A Critical Risk Management Tool

Quants Hub Workshops

Modern Interest Rates with Collateral, Funding and Credit Risk (Part 1)

by Marco Bianchetti: Head of Financial Modelling & Validation, Market Risk Management, Derivatives Pricing, Intesa Sanpaolo

The Interest Rate Market after the Credit Crunch

- Back to basics: Libor/Euribor/Eonia/Repo interest rates
- How the market changed: stylized facts and overview of market data
- Symmetry breaking and market segmentation after the credit crunch
- Counterparty risk and collateral
- From Libor to OIS discounting, how the market has changed

Modern Interest Rate Modelling

Basic assumptions and notation

- Dimensions and units
- Interest rate definitions and conventions
- Financial contract description

Theoretical framework

- Short rate, bank account and risk neutral measure
- Feynman-Kac theorem
- Zero Coupon Bond and forward measure
- Change of measure, Girsanov theorem
- Replication

Funding and funding value adjustment (FVA)

- Black-Scholes-Merton, modern perspective
- Multiple funding sources
- Collateral: discrete margination
- Perfect collateral
- Perfect collateral for derivative and hedge
- Perfect collateral, dividends, repo
- Partial collateral
- Perfect collateral, stochastic rates
- Multiple currency

Modern Pricing of Interest Rate Derivatives

- Interest rate derivatives: modeling approaches
- A simple credit model
- Deposit
- Forward rates
- Forward Rate Agreement
- Futures
- Instantaneous forward rate
- Swap
- Forward swap measure
- Overnight Indexed Swap
- Bond
- Basis Swap
- Cap/Floor
- Swaption
- Constant Maturity Swap
- CMS Cap/Floor
- CMS Spread Option
- Beyond the Black's model
- SABR revisited

The Modern Multiple Curve Framework

- Modern multiple curve market practice
- Multiple curves construction
  - Bootstrapping instruments
  - Market data
  - Bootstrapping formulas
  - Interpolation
  - Negative rates
  - Exogenous bootstrapping
  - Turn of year effect
  - Multiple curves, multiple deltas, multiple hedging
  - Performance
  - Sanity checks
- Multiple volatility cubes

Quants Hub Workshops

Modern Interest Rate Modelling with Collateral, Funding and Credit (Part 2)

by Massimo Morini: Head of Interest Rate & Credit Models,Coordinator of Model Research, Banca IMI

This course is aimed at:

Calibrating a plurality of term structures - Pricing interest rate derivatives with multicurves - Understand the reasons for the current multicurve market - Complete the missing market information about multicurve dynamics - Modelling the dynamics of the current plurality of term structures - Hedging in a multicurve world

Fixed Income Modeling with Multicurves

- Interest rate modeling: from basics to advanced
- Advanced Multicurve Modeling, the three approaches:
  - Hull&White
  - HJM framework
  - BGM Libor Market Model
- The market standard model for CSA discounting and tenor basis pricing
- The advanced solutions with stochastic basis
- Adapting volatility to tenor and correlating tenor curves
- Implementation, derivatives pricing, hedging (mis- and super-hedging)

Rates with Credit and Funding

- Counterparty and Wrong way Risk for Rates derivatives
- The credit spread hidden in today rates
- Current relation between spot and forward
- Credit, liquidity, funding to explain the basis
- A credit model that replicates the tenor basis

Cutting Hedge in Fixed Income

- Negative rates
- Cost of clearing, initial margin and Fra-Futures basis
- Cross currency and collateral
- Constructing curves when curves are missing
- Rates in Regulatory risk models
- Pricing Bermudans and Model Risk

References:

- Interest Rate Modelling after the Financial Crisis. M. Bianchetti and M. Morini, Risk Editions
- Counterparty Credit Risk, Collateral and Funding: With Pricing Cases For All Asset Classes. D. Brigo, M. Morini and A. Pallavicini, Wiley
- Understanding and Managing Model Risk: A Practical Guide for Quants, Traders and Validators. M. Morini, Wiley Finance

Quants Hub Workshops

Advanced Equity Derivatives (Part 1)

by Oliver Brockhaus, MathFinance AG

Equity basics

- Dynamics: empirical evidence
- Dividends: model survey, affine dividends, adjusted volatility
- Implied volatility: parameterizations, arbitrage conditions

Volatility models

- Local volatility
- Stochastic volatility: survey, calibration, simulation techniques
- Local stochastic volatility: parametric local volatility, Markovian projection
- Jump diffusion
- Case study: barrier option

Equity dynamics and hedging

- Hedging and incomplete markets
- Marking to market with smile models

Implied distribution

- Quantile maps
- Arbitrage removal
- Copula models

Pricing and risk managing equity derivatives products

- Certificates: Vanilla, basket, Asian, barrier, Autocallable
- Strategies: CPPI, Volatility Target, Autopilot, Timer
- Dividend swaps and options
- Volatility products: volatility swaps, variance options, Vix futures and options, correlation swaps

Advanced Equity Derivatives (Part 2)

by Oliver Brockhaus, MathFinance AG

Volatility dynamics

- Forward versus spot volatility
- Understanding vol of vol
- A forward skew propagation model
- Case study: pricing and risk management of a cliquet product: Napoleon

Equity / credit hybrid models

- Defaultable equity versus counterparty credit risk
- Structural credit models
- Local and stochastic hazard rate
- Funding, collateral and derivatives pricing
- Case study: CVA for equity derivatives with wrong way risk

Equity / rates hybrid models

- Local volatility and stochastic interest rates
- Stochastic volatility and stochastic interest rates
- Case study: autocallable
- Case study: variance swap

Multi asset models

- Correlation: implied, local and stochastic correlation
- FX: quanto and composite options with smile

Quants Hub Workshops

Liquidity Risk Management (Part 1)

by Francesco Fede, Head of Treasury, Banca IMI and Antonio Castagna, Partner, IASON

- The origin of the new financial environment
- A Journey into Liquidity: Liquidity interrelations between banks and G-SIFI RegulationLiquidity interrelations between banks and G-SIFI Regulation:
  - Different types of liquidity
  - Vicious and virtuous effects
  - The role of central banks
- Liquidity interrelations between banks and G-SIFI Regulation
- New Regulation on Liquidity Risk

Monitoring Liquidity Risk

- A Taxonomy of Cash-Flows
- Liquidity Options
- Quantitative Liquidity Risk Measures
- The Term Structure of Expected Liquidity
- Cash-flows-at-Risk

Liquidity Buffer and Term Structure of Funding

- Liquidity Buffer and Counterbalancing Capacity 183
- Causes of the Liquidity Buffer: Maturity Mismatch, Derivative Collateral, Off-Balance Sheet Commitments
- Basel III Regulation and Liquidity Buffer

Liquidity Risk Management (Part 2)

by Antonio Castagna, Partner, IASON

Models for Market Risk Factors

- Stock Prices and FX Rates
- Interest Rate Models
- Default Probabilities and Credit Spreads
- Expected and Minimum Liquidity Generation Capacity of Available Bonds
- Fair Haircut for Repo Transactions and Collateralised Loans
- Adjustments to the Value of Illiquid Bonds

Behavioural Models

- Prepayment Modelling
- Sight Deposit and Non-Maturing Liability Modelling
- Credit Lines Modelling

The Links between Credit Risk and Funding Cost

- Cash-flows Fair Values and Discounting
- Critique of the Debit Value Adjustment
- The DVA for Derivative Contracts
- Dynamic Replication of the DVA
- Accounting Standard and DVA
- The Distinction between Price and Value

Cost of the Liquidity and Fund Transfer Pricing 535

- Principles of Transfer Pricing
- The Funding and the Banking Activity
- Building the Funding Curve
- Including the Funding Cost into the Loan Pricing
- Monitoring of the Funding Costs and Risk Control of the Refunding Risk
- Funding Costs and Asset/Liability Management
- Internal Fund Transfer Pricing System
- Best Practices and Regulation

Liquidity Risk and the Cost of Funding in Derivatives Contracts

Quants Hub Workshops

Bank ALCO Governance and Process Best-Practice

by Professor Moorad Choudhry, Department of Mathematical Sciences, Brunel University

The "Dear CEO" letter issued by the UK FSA in January 2011 demonstrated the importance of a bank's asset-liability committee (ALCO) process in bank risk management and the regard in which it is held by the regulatory authorities. The ALCO is an essential part of effective bank governance infrastructure and capability.

This one-day course and workshop has been designed to raise awareness and understanding of recommended best-practice principles for ALCO governance and procedure. Aimed at senior managers, executives and non-executive directors in all types of banking institutions, as well as all staff involved in the ALCO process, the course presents essential tools and techniques of value in inculcating the right governance culture, as well as a range of templates that can be applied at any bank.

At the end of the course delegates will have an understanding of ALCO terms of reference formulation, a clearer understanding of how to formulate and drive the governance process in the most effective way and possession of a tool-kit of best-practice ALCO templates.

Key Features:

The Role of the Asset-Liability Committee in Bank Governance and Risk Management

- Bank risk management operating framework
- Board and ExCo interaction

ALCO Organisation and Operating Framework

- Membership, responsibilities
- The ALCO Terms of Reference: best-practice framework
- Reporting line and Board-delegated authority
- Confirming the timetable and "standing items" diary
- Sub-committee organisation and reporting
- Balance sheet management committee
- Products pricing committee

ALM Policy Framework

- Policy approval process
- Appropriate policy-setting procedure: fitting policy in line with the bank operating model
- Hedging policy
- Risk appetite framework

Working as Part of the Balance Sheet Risk Triumvirate

- Effective interaction with CRO and CFO offices and committees
- Managing and driving balance sheet risk culture

Effective Governance of the ILAA and ICAAP Process

- What to ensure is in place during ILAA / ICAAP preparation and submission
- What to look for in the ILAA / ICAAP summary to ensure regulator sign-off

The ALCO MI Pack

- Guidelines for constructing a fit-for-purpose MI deck
- Recommended ALCO MI pack template structure

Working with the Board

- ALCO pack and the Board paper summary / briefing note
- Deciphering the ALCO pack
  - What to look for
  - Does it answer the Board's questions?
  - Is there anything missing?
- Reviewing ALCO, Exco and Board interaction and effectiveness

WORKSHOP EXERCISE:

Drafting the ALCO Agenda and MI Pack

- Balance sheet review: assessing items for the ALCO agenda
- Datasets for inclusion in MI pack
- Most effective way to communicate risk exposure data and MI
- Forward planning: the year's schedule, agenda of standing items + schedule

Quants Hub Workshops

Bank Internal Funds Transfer Pricing and Asset-Liability Management

by Professor Moorad Choudhry, Department of Mathematical Sciences, Brunel University

Key Features:

- An effective internal funding framework
- Objectives of internal funding policies
- Integrating FTP into overall liquidity policy
- The cost of funds: applying the true bank funding cost to the business
- Funding policies: banking book, securities trading book, derivatives book
- Setting the correct market-implied FTP curve
- Treasury operating model, FTP and balance sheet management
- Assets and Liabilities Behaviouralisation
- FTP and liability strategy
- Template FTP policy for a commercial bank: example illustration

The Concept of Internal Funds Pricing

- An effective internal funding framework

Objectives of Internal Funding Policy

- Consistent liquidity pricing behaviour amongst business lines
- Removing interest-rate risk from the business lines
- Including the bank's cost of liquidity in product pricing
- Driving balance sheet shape and direction for assets and liabilities
- The correct internal pricing regime for the bank

The Cost of Funds

- Constructing the bank's internal funding curve
- Different reference funding curves (Libor, OIS, etc)
- Marginal unsecured curve
- Secured funding curve
- Weighted average cost of funds (WACF) curve

Setting the Correct Market-Implied Term Funds Transfer Pricing (FTP) Curve

- Business best-practice approach to constructing the risky yield curve
- Proxies for the internal funding curve input

FTP and Liquidity Management

- Pricing liquidity via the FTP process
- Costs of raising liquidity correctly

Pricing Liquidity

- The concept of the term liquidity premium (TLP)

Treasury Op Model, FTP and Balance Sheet Management

- Integrating FTP into balance sheet management
- FTP centre as cost centre or profit centre
- FTP across different business lines: alternative approaches

FTP and Liability Strategy

- Integrating FTP strategy into ALM and liability strategy
- Driving liabilities-raising behaviour through the FTP mechanism
- A dynamic FTP regime for changing yield curve environments

Funding Policies

- Banking book
- Trading book
- Derivatives

Quants Hub Workshops

Bank Liquidity Risk Management

by Professor Moorad Choudhry, Department of Mathematical Sciences, Brunel University

This one-day course provides business best-practice tools and techniques for bank liquidity risk management. Aimed at senior or experienced Treasury and Finance practitioners, it is an advanced-level workshop that covers the complete spectrum from governance and policy to risk measurement and stress testing. Delegates should leave with a complete understanding of leading edge banking liquidity risk practice, delivered within the overall context of asset-liability management (ALM) and balance sheet risk management.

Learning Outcomes:

1. Ability to work with complex material including bank management information (MI).
2. Ability to present MI and policy to a group of peers and executives.
3. Ability to formulate policy and develop a coherent strategic plan for a bank's liquidity risk management and liabilities mix.
4. Recognise the limitations of modelling approaches commonly used in quantitative finance whenapplied to estimating asset-liability gap exposure, and formulate a comprehensive suite of liquidity risk metrics, both qualitative and quantitative, that can be applied at any banking institution as part of its risk management process and procedure.
5. Recognise the major characteristics of liquidity and funding risk exposure at a bank or non-bank financial, and construct appropriate risk mitigation strategy and policy approaches.
6. Design and implement suitable liquidity risk management policy and integrate within the overall financial risk management policy framework.
7. Understand the role of the bank's asset-liability committee (ALCO) in risk management and apply best-practice ALCO governance and policy approach as priority segment of the overall liquidity risk management infrastructure in the bank.

Lecture 1

Introduction

Treasury Operating Model – ALCO Practice

Lecture 2

Board Risk Appetite Statement - Liquidity Risk template

Liquidity Policy Statement

Encumbrance Policy

Liquidity Metrics MI

Basel III LCR

LCR Impact Analysis Example

Lecture 3

Stress ILAA Deposits Strategy

Deposit Raising

Intra Day Liquidity Risk

Lecture 4

Internal Funds Transfer Pricing (FTP)

Lecture 5

Funding policies by asset and liability product line:-

Banking book, Trading Book, Derivatives

Lecture 6

Constructing the internal funding curve

Lecture 7

Liquid Asset Buffer (LAB) policy

Lecture 8

Final Word

Quants Hub Workshops

Bank Strategic Asset-Liability Management

by Professor Moorad Choudhry, Department of Mathematical Sciences, Brunel University

A high-level principles seminar for senior executives who work directly or indirectly with the ALM function and apply ALM principles at the CEO and ALCO level when determining bank strategy and risk management appetite.

Asset-liability management and liquidity management are the cornerstones of bank risk management. The premier executive challenge of the Basel III era is integrating these into bank strategy, such that they form an integrated part of every bank's overall business model and drive customer engagement.

This advanced-level seminar is aimed at senior and experienced bankers and is of relevance to every member of a bank's ALCO. It seeks to review key aspects of ALM and present the vital questions of how ALM, liquidity risk and ALCO governance should be set up and implemented at a bank. Delegates will be encouraged to critique different bank operating models and risk governance, with a view to determine collectively what represents business best-practice.

Workshop Content:

Strategy and capital
- Treatment of capital and reserves
- Concept of no free funding and no "capital income" for business lines
- Capital structure considerations
- ROC and RAROC
- Strategy setting within Basel III regime

Strategy setting
- Pre- and post-crash models
- Resource inputs
- Treasury input to strategy setting

Treasury operating model
- Business best-practice governance and org structure

Managing NIM
- Understanding net interest margin
- Issues in preserving NIM: holistic balance sheet view

Liquidity risk management
- The funding model: strategic principles
- Liquidity policy statement and statement of liquidity risk appetite

Funds transfer pricing and asset-liability origination
- Principles of internal funding
- Funding policies for each business line
- Correct FTP to ensure no disincentives in asset-liability raising
- Interaction with NIM

Liabilities strategy formulation
- The right funding model
- Optimum funding strategy
- Liabilities pricing and FTP

The yield curve
- Understanding inputs and outputs
- Interpolation model: not straight line!

Loan origination pricing: correct input parameters
- Reviewing elements of loan pricing

The liquid asset buffer
- Cash-securities mix
- Funding principles
- Portfolio selection for liquidity preservation not return

Managing interest rate risk in the Banking book
- Business best-practice approach to hedging IRR
- Hedging – not speculation!

Credit rating agency principles
- Factors in determining the credit rating
- Action when targeting a desired rating

Quants Hub Workshops

Counterparty Risk and Funding: A Tale of Two Puzzles

by Stéphane Crépey: Professor, Department of Mathematics, University of Evry and
Tomasz R. Bielecki: Professor, Department of Applied Mathematics, Illinois Institute of Technology

Based on:
S. Crépey and T. Bielecki (with an introduction by D. Brigo): Counterparty Risk and Funding: A Tale of Two Puzzles. Taylor & Francis, Forthcoming.

See also the counterparty risk material on screpey.free.fr and the references therein.

Abstract:
The credit crisis and the ongoing European sovereign debt crisis have highlighted the native form of credit risk, namely counterparty risk. This is the risk of non-payment of promised cash-flows due to the default of a party in an OTC derivatives transaction. By extension this is also the volatility of the pricing of this risk, the so-called Credit Valuation Adjustment (CVA).

A key related issue, especially with credit derivatives, is the so-called wrong-way risk, i.e. risk of positive dependence between the size of the counterparty risk exposure and the default riskiness of the counterparty. Moreover, as banks themselves have become risky, counterparty risk must be understood in a bilateral perspective (CVA and Debt Valuation Adjustment DVA), where the counterparty risk of the two parties are jointly accounted for in the modeling. In this context the classical assumption of a locally risk-free asset which is used for financing purposes (lending and borrowing as needed) is not sustainable anymore, which raises the companion issue of a proper accounting of the funding costs of a position (Funding Valuation Adjustment FVA). Finally since August 2007 one also saw the emergence of a systemic counterparty risk, referring to various significant spreads between quantities that were very similar before, like between OIS swap rates and LIBOR swap rates of different tenors. Through its relation with the concept of discounting, this systemic component of counterparty risk has impacted on all derivatives markets.

All the above adjustments, which are interdependent and must be computed jointly, are today one of the main P&L centers of investment banks. They touch on many areas: modeling, computation, pricing, risk management, regulation, economics, legal, lobbying, politics, often in conflicting perspectives. The current trend of the regulation is to push participants to negotiate centrally (as opposed to bilaterally above) via clearing houses. But such a move poses a very serious liquidity constraint on the market for margin calls abound. The aim of the course is to introduce different aspects of these controversial issues: CVA, DVA, FVA, Wrong-Way Risk, ratings valuation adjustment (RVA).

Introduction
- Motivating example
- CVA as an option

Model-free Mathematics
- Pure counterparty risk
- Pure funding
- Putting things together

Reduced-Form Modeling
- Reduced-Form BSDE approach
- CVA, DVA, LVA and RC: the four wings of the TVA

Markov Copulas and Credit Migrations
- Ratings Valuation Adjustment

Replication under Funding Costs and Collateralization
- Piterbarg's model

Quants Hub Workshops

Counterparty Risk and Funding (Part 1)

by Stéphane Crépey: Professor, Department of Mathematics, University of Evry

Based on:
T. Bielecki and S. Crépey (with an introduction by D. Brigo): Counterparty Risk and Funding: A Journey with BSDEs and Dynamic Copulas. Taylor & Francis, Forthcoming.

See also the counterparty risk material on screpey.free.fr and the references therein.

Abstract:
The credit crisis and the ongoing European sovereign debt crisis have highlighted the native form of credit risk, namely counterparty risk. This is the risk of non-payment of promised cash-flows due to the default of a party in an OTC derivatives transaction. By extension this is also the volatility of the pricing of this risk, the so-called Credit Valuation Adjustment (CVA). A key related issue, especially with credit derivatives, is the so-called wrong-way risk, i.e. risk of positive dependence between the size of the counterparty risk exposure and the default riskiness of the counterparty. Moreover, as banks themselves have become risky, counterparty risk must be understood in a bilateral perspective (CVA and Debt Valuation Adjustment DVA), where the counterparty risk of the two parties are jointly accounted for in the modeling. In this context the classical assumption of a locally risk-free asset which is used for financing purposes (lending and borrowing as needed) is not sustainable anymore, which raises the companion issue of a proper accounting of the funding costs of a position (Funding Valuation Adjustment FVA). Finally since August 2007 one also saw the emergence of a systemic counterparty risk, referring to various significant spreads between quantities that were very similar before, like between OIS swap rates and LIBOR swap rates of different tenors. Through its relation with the concept of discounting, this systemic component of counterparty risk has impacted on all derivatives markets. All the above adjustments, which are interdependent and must be computed jointly, are today one of the main P&L centers of investment banks. They touch on many areas: modeling, computation, pricing, risk management, regulation, economics, legal, lobbying, politics, often in conflicting perspectives. The current trend of the regulation is to push participants to negotiate centrally (as opposed to bilaterally above) via clearing houses, and to guarantee their failure through collateralization. But such a move poses a very serious liquidity constraint on the market for margin calls abound. The aim of the course is to introduce different aspects of these controversial issues: CVA, DVA, FVA, Wrong-Way Risk, systemic counterparty risk.

- Introduction
  - Motivating example
  - CVA as a giant hybrid option
- Model-free mathematics
  - Pure counterparty risk
  - Pure funding
  - Putting things together
- Reduced-Form Modeling
  - Reduced-Form BSDE approach
  - CVA, DVA, LVA and RC: the four wings of the TVA

Counterparty Risk and Funding (Part 2)

by Stéphane Crépey: Professor, Department of Mathematics, University of Evry

- Standard Reduced-Form BSDE TVA approach
- Beyond immersion?
  - Dynamized Gaussian copula model
  - Dynamized Marshall-Olkin copula model
  - Wrong way and gap risks: a marked default time perspective
- Multiple curves
  - The whys of the LOIS
  - A Lévy HJM multiple-curve model with application to CVA computation

Quants Hub Workshops

Advanced Interest Rate Modelling (Part 1)

by Pat Hagan: Consultant & Mathematics Institute, Oxford University

Basic Fixed Income Instruments

- Basics: discount factors, FRAs, swaps, and other delta products
- Basic curve stripping, bucket deltas, and managing IR risks
- Martingales & the fundamental theorem
- Vanilla options (caps, floors, and swaptions) & Black's model
- Vol matrices, bucket vegas, and managing vol risks
- Smiles, local volatility models, and equivalent volatilities
- Mishedging, and the development of the stochastic vol model
- Using the SABR model to manage volatility smiles, hedging stability
- Lévy based models for managing volatility surfaces

Current Market Practice

- Money vs. scrip
- Holiday calendars, business day rules, and schedule generation
- Day count fractions

Advanced delta

- Reference rates & basis spreads
- Stripping reference rates to obtain basis spreads
- OIS discounting and dual-curve stripping
- Cross-currency basis curve; collateralizing legs in alternate ccy
- Leverage, cost of funds, and the credit crisis
- Moving to scenario-based risks and hedging

Setting the Correct Market-Implied Term Funds

Arbitrage Free SABR

- Arbitrage in the SABR model
- Reduction to the effective forward equation
- Arbitrage free boundary conditions
- Exactly conservative numerical methods
- Comparison with historical data
- Hedging under SABR model
- Closed-form solutions; boundary layer analysis

Advanced Interest Rate Modelling (Part 2)

by Pat Hagan: Consultant & Mathematics Institute, Oxford University

Managing Exotics

- Three elements to modern pricing: model, calibration, and evaluation
- Choosing a model and the five main interest rate risks
- HJM models - strengths, weaknesses, usage
- BGM/LMM models - strengths, weaknesses, usage
- Short rate models - strengths, weaknesses, usage
- Markovian models - strengths, weaknesses, usage

Practical Pricing of Exotics

- LGM model
- Closed form zero coupon bond and swaption prices under the LGM model
- Callable swaps (Bermudans)
- Calibration strategies and the selection of calibration instruments
- Forward volatility risk
- How the risks, hedges, and values of the exotic depend on the calibration instruments

Adjustors and risk migration

- Classic mis-hedging problem
- Risk migration and the adjusted price
- The adjusted price
- Examples

Pricing callable range notes (accrual options)

- Standard range note
- Using replication to price the non-callable range notes. Convexity adjustments
- Pricing requirements
- Libor market model vs. external adjustors vs. internal adjustors
- Using internal adjustors with the LGM modle
- Pricing, risk analysis, and hedging the embedded and external options
- General procedure for callables with embedded options

Quants Hub Workshops

ADI Schemes for Pricing Options under the Heston model

by Karel in't Hout: Professor of Applied Mathematics and Numerical Analysis, University of Antwerp

This training course includes the Matlab source code for computing vanilla and barrier option prices, together with their Greeks, under the Heston model. The numerical solution technique is based on a suitable finite difference discretization on nonuniform spatial grids followed by a state-of-the-art ADI time discretization scheme.

- Heston PDE for vanilla and barrier option prices
- Initial and boundary conditions
- Specific issues: mixed derivative, Feller condition
- Domain truncation
- Nonuniform spatial grids
- Spatial discretization: finite difference (FD) schemes
- Temporal discretization: four state-of-the-art ADI schemes
- Linear systems: LU factorization
- Stability and convergence analysis
- Specific issues: damping procedure, cell averaging
- Step-by-step discussion of the HestonADI code (Matlab)
- Numerical experiments
- Approximation of the Greeks

Quants Hub Workshops

Monte Carlo Simulation in Finance (Part 1)

by Jörg Kienitz: Director, Financial Risk Solutions, FSI Assurance, Deloitte & Touche GmbH

This seminar discusses the application of Monte Carlo simulation to financial problems. Problems include scenario generation, risk measures, derivatives pricing or CVA calculation. The bullet points are:

- Probability Theory and Stochastic Processes
- One and multifactor models
- General purpose and special sampling schemes for e.g. Heston or SABR models
- Static and dynamic Monte Carlo Methods
- Risk Measures via scenario generation
- Derivatives pricing and hedging strategies
- Interest rate simulation and CVA
- Calculating sensitivities ('Greeks') and early exercise rights
- Implementing Monte Carlo methods

Methods:

• Presentation (slides)

• Illustration using computer examples. Each single topic is illustrated using Matlab code.

Prerequisites:

To participate in this course, you need to have a basic background in stochastic modelling but all the concepts and models are introduced and discussed in detail.

Topics:

Mathematical Basics

- Foundations of Probability
- How does Monte Carlo Work?
- Distributions
  - Basic Distributions in Finance
- Stochastic Processes
  - Diffusion Processes
  - Jump-Diffusion Processes
  - Jump Processes

Applications of the Monte Carlo Method

- Option Pricing
- Evaluating Hedge Strategies
- Scenario Generation and Risk Measures

Static Monte Carlo Simulation

- Sampling from the Uniform Distribution
  - Random Number Generators
  - Good ones and bad ones
- Sampling Techniques
  - Inverse Method
  - Ratio of Uniforms
- Sampling from the Normal and other Distributions

Dynamic Monte Carlo Simulation

- Path Generation Methods
  - (Log) Euler-Scheme
  - Predictor Corrector
  - Bridge Sampling
  - Exact Sampling
- Sampling from Jump Diffusion Processes
  - SGS Sampling
  - FGS Sampling
- Sampling from Pure Jump Processes
  - Variance Gamma, NIG
  - Stochastic Volatility Lévy Models

Implementation Issues (from Algorithms to Code I)

- Ingredients for a successful implementation of Monte Carlo algorithms
- Object Oriented Design I

Quants Hub Workshops

Monte Carlo Simulation in Finance (Part 2)

by Jörg Kienitz: Director, Financial Risk Solutions, FSI Assurance, Deloitte & Touche GmbH

This seminar discusses the application of Monte Carlo simulation to financial problems. Problems include scenario generation, risk measures, derivatives pricing or CVA calculation. The bullet points are:

- Probability Theory and Stochastic Processes
- One and multifactor models
- General purpose and special sampling schemes for e.g. Heston or SABR models
- Static and dynamic Monte Carlo Methods
- Risk Measures via scenario generation
- Derivatives pricing and hedging strategies
- Interest rate simulation and CVA
- Calculating sensitivities ('Greeks') and early exercise rights
- Implementing Monte Carlo methods

Methods:

• Presentation (slides)

• Illustration using computer examples. Each single topic is illustrated using Matlab code.

Prerequisites:

To participate in this course, you need to have a basic background in stochastic modelling but all the concepts and models are introduced and discussed in detail.

Topics:

CVA - Simulating Future Interest Rates

- Simulating Short Rate Processes
  - Hull-White
  - CIR
- Calculating CVA/DVA/FVA for Fixed Income Products

Speeding up and improving your Monte Carlo

- Variance Reduction Techniques
  - Antithetic Sampling
  - Control variates
  - Importance Sampling
  - Stratification
  - Multi-Level Monte Carlo
- Quasi Random Numbers
  - Halton Sequence
  - Sobol Sequence

Simulating Multi-Dimensional Models

- Introducing Dependence
  - Correlation
  - Copula
  - Scenario Generation and Risk Measures (Calculating CVaR using Simulation)
  - Multi-Dimensional Normals
  - Simulating Market Models (LMM)
  - Simulating Stochastic Volatility Models (SABR and Heston)
  - Inverse Method
  - Ratio of Uniforms
- Sampling from the Normal and other Distributions

Greeks (Adjoint, Proxies) and Early Exercise

- The Adjoint and Proxy Methods
- American Monte Carlo
  - Bermudan Options
  - Backward Script for CVA calculation
- Illustration using Libor Market Model

Implementation Issues (from Algorithms to Code II)

- Choosing the Language for Development
- Object Oriented Design II

Quants Hub Workshops

Pricing Options via Fourier Inversion & Simulation of Stochastic Volatility Models

by Roger Lord: Head of Quantitative Analytics, Cardano

Within this workshop we will explore two topics that are important to the modern day pricing of derivatives - the Monte Carlo simulation of stochastic volatility models, as well as how to price options by using Fourier inversion techniques.

The first part of the workshop will focus on techniques to efficiently simulate stochastic volatility models such as Heston, Schöbel-Zhu and SABR. Pitfalls of using too simple methods are shown, and lessons are learned from more sophisticated methods that are applicable in a wide variety of stochastic volatility models.

The second part will be focussed on the usage of Fourier inversion techniques to price options. Since the characteristic function of many, typically affine, models can be expressed in closed-form, one can price vanilla options by means of Fourier inversion. We will show how to derive the characteristic function of such models, and focus on how to compute these efficiently by means of choosing an optimal contour, or via control variates.

- An overview of stochastic volatility models (e.g. Heston, Schöbel-Zhu, SABR)
- Pitfalls using Euler or higher-order schemes
- Leaking correlation
- Moment-matching schemes
- Derivation of characteristic function in affine models
- Option pricing using Fourier inversion
- Caveats using complex logarithms
- Choosing the optimal dampening coefficient
- Usage of control variates

Derivatives Pricing in the New Framework: OIS Discounting, CVA, DVA and FVA.

by Luis Manuel García Muñoz: Head of Interest Rates, Credit and CVA Quant Teams, BBVA

We will analyze the valuation of OTC derivatives exploring the effect of collateral, funding and counterparty credit risks.

The first part of the presentation will be devoted to the valuation of collateralized derivatives. We will analyze the effect of different collateralization schemes and reformulate the fundamental theorem of asset pricing under this multiple discounting curves environment associated to different collateralization schemes.

The second part will be focussed on CVA, DVA and FVA. CVA and FVA will be deduced using hedging arguments. We will analyze the problem of DVA hedging and explore CVA hedging under incomplete markets.

- OIS discounting.
- Effect of collateral different from cash denominated in the deals currency.
- Interest rate modeling in a multiple discounting curves frameworks.
- CVA and FVA as hedgeable risks.
- The problem of DVA hedging.
- CVA hedging under incomplete markets.

Quants Hub Workshops

Algorithmic Differentiation (AD) for Computational Finance

by Uwe Naumann: The Numerical Algorithms Group Ltd. (NAG)

Prerequisites

- You are interested in accurate and cheap greeks
- You are unhappy with the accuracy and/or the computational cost of bumping

Outline

Motivation. Tangent and Adjoint AD

- motivation: accurate and cheap greeks
  - hello world of finance: race
- first- and higher-order tangent and adjoint AD
  - tangents (directional derivatives) and adjoints
  - associativity of chain rule of differential calculus
  - drivers
  - second-order tangents and adjoints
  - recursion for higher order
- exercise

Tangent and Adjoint Code by AD (Part I)

- tangent code
  - tangent code generation rules
  - example (live)
  - tangent code by overloading
  - second- and higher-order tangent code
- adjoint straight-line code
  - adjoint code generation rules
  - example (live)
- exercise

Tangent and Adjoint Code by AD (Part II)

- intraprocedural adjoint code
  - control flow reversal
  - example (live)
- interprocedural adjoint code
  - split call reversal
  - example (live)
- adjoint code by overloading
- second- and higher-order adjoint code
- exercise

Advanced Topics in AD. Outlook

- checkpointing adjoint code
- (symbolic) tangents and adjoints of numerical methods
- coupling with bumping
- "mind the gap"
- software tool support
- conclusion and outlook

Reading

U. Naumann: The Art of Differentiating Computer Programs. Number 24 in Software, Environments, and Tools, SIAM, 2012.
http://bookstore.siam.org/se24/

Quants Hub Workshops

Valuation Adjustments: Pricing and Risk Management

by Andrea Prampolini: Head of Counterparty Risk Management, Banca IMI

Adjusting the value of derivatives

- The rise of a hybrid asset class
- Operational evolution
- Perspectives on value

Credit Value Adjustment

- Counterparty risk and financial stability
- Computing conditional expectations
- Global calibration
- Sensitivities
- Transfer pricing
- Mitigation and management

Debt Value Adjustment

- Fair value and the law of one price
- Hedging DVA
- Allocation of DVA cost

Funding Value Adjustment

- Funding cost and funding benefit
- Evidence from the novation market
- Managing FVA
- Financing initial margin

Capital charge

- Forward RWA
- Managing the cost of capital
- Contingent capital structure

Collateral Optimization in Light of Credit Risk Regulation and Clearing

by Dmitry Pugachevsky: Director of Research, Quantifi

"Recent Basel III and Dodd-Frank regulations significantly increased collateral requirements, either for cleared or OTC trades. This course will look at different capital costs arising from counterparty risk and from clearing and will compare different approaches and models".

Introduction: cost of collateral, impact of recent regulations

Counterparty credit risk and collateral

- Bilateral CVA - accounting, trading and risk management aspects
- CSA and OIS
- Funding and FVA
- Profitability and marginal cost of a trade

Basel capital charges related to CCR

- Basel II and default capital charges, IMM and NIMM methods
- Basel III and CVA capital charges, Standardized and Advanced methods
- Basel III treatment of wrong-way risk
- Comparison of different methods
- Capital reducing portfolio optimization

Cost of clearing

- Recent regulations
- Cost of collateral - Initial and Variation Margins
- To clear or not to clear

Conclusions

Quants Hub Workshops

Contingent Capital Explained (Part 1)

by Wim Schoutens: Research Professor, Financial Engineering, Catholic University of Leuven, Belgium

About the course:

The course takes a very pragmatic and practical approach and employs a lot of numerical examples. The financial landscape went since 2010 through one of the biggest regulatory overhauls ever: Basel III, the Swiss-finish, CRD4 and the ICB-Vickers report all have made statements about the concept of contingent capital. The course covers and describes the construction of CoCos (Contingent Convertibles) in the light of these latest reforms. Furthermore, the course goes extensively into the price setting question of CoCos and the related dynamics. We provide insight in rule of thumbs pricing and elaborate on more advanced methods. The pricing theory is applied and illustrated with the Lloyds and Credit Suisse CoCos. Practical examples and market data is used throughout the course. Furthermore, the delegates will be guided through a hands-on explanation with numerical examples of the dynamics of CoCos. Potential effects of the death-spiral are discussed. The course is a must for all financial professionals and sheds a light on the intricacies of contingent capital from the structuring, pricing, hedging and regulatory point of view.

What are CoCos?

- Basic intro to the concept of contingent capital
- History and key events
- The life of a CoCo
- Bail-in
- Pro's and Cons of CoCos

CoCo Triggers

- Accounting, regulatory and market based triggers
- Write-down/write-up CoCos
- CoCos Analogies

Regulatory Aspects

- Changes in the regulatory landscape
- CoCos as new capital instruments
- CoCos in the light of Basel III, CRD4 and other regulatory proposals
- CoCo Bonuses

The CoCos Market

- Examples of recent issues
- CoCo performance
- CoCo investors

Quantitative Aspects of CoCos

- Rule of Thumb pricing; the CoCo triangle
- Case Study: Rule of Thumb pricing of the Lloyds, CS, UBS and Barclays CoCos
- Equity derivative based methods
- Case Study: Equity Derivative pricing of the Lloyds, CS, UBS and Barclays, KBC, CoCos
- Advanced models
- Case Study: Determining the coupon of a new coco issue.

Contingent Capital Explained (Part 2)

by Jan De Spiegeleer: Head of Risk Management , Jabre Capital Partners

Bail-In Capital

- Definition
- Examples
- Case study :Bail-In mechanisms in Europe
  - Denmark
  - Lehman Brothers

CoCo Dynamics

- Comparison with Convertible Bonds
- Factor Analysis
- Sensitivity Analysis
- Vega Profile

CoCos with upside potential

- CoCoCo bond
- Case Study

Death Spiral

- Example of Reset convertibles
- Case study

Quantitative Aspects of CoCos

- Pricing CoCos in Jump-Diffusion
- Introducing CEV
- Multi-Factor Pricing

Quants Hub Workshops

Long Term Portfolio Simulation for CVA, Funding, Limits, and Capital

by Alexander Sokol: CEO and Head of Quant Research, CompatibL

The workshop will focus on the specifics of constructing and calibrating models for CVA/PFE which must simulate the evolution of a large number of risk factors for long time horizons and with incomplete calibration data. Both risk neutral and real world measure models will be covered with specific focus on avoiding extreme or unrealistic values of risk factors for long time horizons and dealing with incomplete or short dated calibration data.

- Methodology Fundamentals
  - Introduction and Objectives
  - Real World or Risk Neutral?
  - Dealing with Long Simulation Horizons
  - Dealing with Heavily Multifactor Simulation
  - Margin Period of Risk (MPR)
  - General Wrong Way Risk (WWR)
  - Systemic Wrong Way Risk
  - Generic Rate and Asset Factors
- Model Construction Techniques
  - Incremental Correlation
  - Bridge Correlation
  - Historical Correlation
  - Model Extension
- Fast Valuation Techniques
  - Linear Trades
  - American Monte Carlo
- Models
  - Popular Interest Rate Models
  - Popular Default Intensity Models
  - Popular FX and Asset Price Models
  - Risk Neutral Portfolio Model
  - Real World Portfolio Model
  - General Wrong Way Risk Model
  - Margin Period of Risk Model
  - Systemic Wrong Way Risk Model
  - Minimum Transfer Amount Model

Counterparty Risk, CVA and Basel III

by Harvey Stein: Head, Regulation and Credit Modeling, Bloomberg

Abstract

Despite recent market upheavals, the OTC derivatives markets continue to comprise one of the largest components of the financial markets. Prompted by the desire to weather or even reduce market turmoil, approaches for analyzing and mitigating counterparty risk have garnered renewed interest. Regulators have been advocating greater usage of clearing houses. Accounting boards have been refining and codifying fair market valuation, placing additional emphasis on careful consideration of counterparty risk. And investors and traders have been trying to better factor some notion of counterparty risk into their trading and risk management practices. Here we will investigate the notion of counterparty risk and the associated credit valuation adjustment (CVA) in the fixed income markets. We will:

- Outline the CVA calculation, contrasting the counterparty risk for a bond with that of an interest rate swap,
- Detail the underlying model assumptions,
- Give examples of the calculation,
- Discuss the impact the CVA has in the value of these instruments,
- Discuss risk mitigation techniques,
- Review Basel III CVA capital requirements, and
- Investigate the theory and computation of the FVA

Quants Hub Live Workshop - 20th & 21st April 2015

XVA Master Class

by Massimo Morini, Head of Interest Rate and Credit Models, IMI Bank of Intesa San Paolo

Workshop Content:

Day 1:

- How recent changes affect the banks business:
  - Reorganizing for XVAs and the profitability of the Derivatives Business
  - Accounting and Regulatory (Capital and Prudent Valuation) perspective
- The base CSA Price
  - The value of collateral and OIS discounting
  - Negative rates and Multicurve in an XVA framework
- Credit Value Adjustment (CVA)
  - CVA hedging
  - Wrong-way risk and Correlated Counterparties
  - Models and Model Risk
  - The mathematics and the implementation
- Debt Value Adjustment (DVA)
  - The Closeout puzzle and effects
  - Hedging DVA or Transfer to the treasury
- Funding Value Adjustment (FVA)
  - Net Stable Funding Ratio and cost of funding
  - Competitive FVA charge and XVA consensus
  - The FVA debate and Practical Solutions
  - The mathematics and the implementation
- Capital Value Adjustment (KVA)
  - Correct prediction of future capital costs
  - Simulating real world exposures
  - Regulatory Capital Requirements

Day 2:

- Interactions between XVAs and an aggregation without double counting
  - Double counting DVA and Funding Benefit: explanation and avoidance
  - The alternative between CVA hedging with CDS and Capital Charging
  - A double counting of cost of debt in FVA and cost of equity in KVA?
- Collateral Options
  - Cross-curency swaps
  - The value of switching collatal currency
  - The value of the bond vs cash collateral
- Initial Value Adjustment
  - CCPs, ISDA OTC bilateral Margins, and SIMM
  - Compute the Initial Margin prospective funding cost
  - An efficient implementation and the effect on pricing
- Other mitigations of risk:
  - Break-up Clauses
  - Netting and Set-off agreements
  - Tranching CVA
- Gaining Computational Efficiency
  - XVA Simulation with analytic exposures vs American Montecarlo for XVA
  - Efficient sensitivities through Adjoint Differentiation
  - Adjoints for XVAs: interaction with default, calibration and wrong way risk

All attendees either online or at the live event in London will receive the recorded video workshop.
This workshop will be hosted via the WebEx platform.

Quants Hub Live Workshop - 26th & 27th May 2015

FX Option Performance: Long Term Anomalies, Opportunities and Hedging Strategies

by Jessica James, Head of the FX Quantitative Solutions Team at Commerzbank

Another course on FX options? But surely there are plenty of courses and books which tell you how to price and hedge these products? Indeed there are – but that's not what this is for. On this course you will learn about the value, not the price, of FX options.

The course will be a fascinating introduction for students entering the field, a source of exciting ideas for investors looking for opportunities, and an essential guide for corporations wondering how to hedge their FX exposures.

Workshop Content:

Day 1: 'The FX Option Market:
How it works, what's right, and what's wrong'

(1) Introduction to the FX option market

- History of theory and trading
- Market Participants
- What they are, why buy or sell them
- How to price them
  - Black-Scholes-Merton
  - Limitations of this classical model
- The underlyings (FX rates, depos, forwards, vols) and how they behave. (correlation of underlyings, implied vs realised quantities)
- How they affect the price of options – lots of market examples, EURCHF will be fun
- The 'greeks'
- How options are traded
  - By a hedger
  - By a hedge fund
  - By a trading desk

(2) What's wrong with the market: Puts vs Calls

- What's the 'fair price' for an option?
- Backtesting FX option returns – theory, data, difficulties
- How might mispricings arise?
- Broad brush results: straddles
- Puts vs calls: first sign that something is wrong
- Individual ccy results – clues to what is happening with AUD, JPY
- Explanation and theory of the carry problem
- Implications for hedgers
- Trading strategies

Day 2: 'The FX Option Market:
Long term anomalies and how to use them for trading and hedging'

(1) What's wrong with the market: ATMF vs OTM options, G10 vs EM

- Theory of OTM options – volatility smile
- Data available (risk reversals and butterflies) and what does it mean
- Illustration that OTM options are poor value
- Detailed discussion as to how/why
- Differences with G10 and EM
  - ATMF
  - OTM
  - With tenor
- Theory of differences
- Currency-by-currency discussion
- Trading strategies

(2) The FX Carry Trade

- History
- Theory
- Improvements/enhancements. How to reduce risk and improve returns
- Can we do it with options?
- Trading strategies

All attendees either online or at the live event in London will receive the recorded video workshop.
This workshop will be hosted via the WebEx platform.

Quants Hub Programming School

Programming School

The Programming School courses are run in two formats.

The first features a breakdown of the lectures on a weekly basis and is run online over a 10-14 week period. In this format each week is structured around one particular lecture and is supported by a forum and additional learning material in the form of an exercise or multiple-choice quiz. There will also be two dedicated webinars scheduled during the course that offers you live direct interaction with your course presenter.

Format two is referred to as the 'Self-Paced' Course. With this option you have access to all of the material as soon as you are enrolled on the course. It is then down to you to decide how quickly or slowly you watch the lectures and partake in the Tests.
*****Please note there are no webinars featured within the Self-Paced courses*****

The conclusion of both formats is a Final Project. You will be instructed to put the material you have consumed throughout the course into practice by creating a piece of work on the strength of what you have learned. The course presenter will then grade these and feedback will be provided along with a pass or fail mark. Should your first project attempt be unsuccessful, one retake will be permitted.

Certificates from both **PRMIA** and **CPD** will be awarded once a pass mark has been achieved.

Programming School Certification

PRMIA Certification

The Professional Risk Managers' International Association (PRMIA) is a non-profit professional association, governed by a Board of Directors directly elected by its global membership, of nearly 90,000 members worldwide. PRMIA is represented globally by over 65 chapters in major cities around the world, led by Regional Directors appointed by PRMIA's Board.
www.prmia.org

CPD Certification

The CPD Certification Service was established in 1996 as the independent CPD accreditation institution operating across industry sectors to complement the CPD policies of professional and academic bodies. The CPD Certification Service provides recognised independent CPD accreditation compatible with global CPD principles.
www.cpduk.co.uk

Quants Hub Programming School

F# and Functional Programming in Finance

by Tomas Petricek, Founder DualNotion Ltd

The course requires no prior functional programming knowledge and is designed for both software developers and quants or actuaries. You will learn:

- How to approach problems from the functional perspective and capture your ideas using idiomatic F#.
- Model a problem domain, such as stock options, using functional types and develop domain specific languages (DSLs) for processing such domains.
- Use type providers to access data, perform interactive data and time-series analysis on financial data using the Deedle library and create charts to visualize the results.
- How to use F# within a larger context, including interoperability with R and best practices for the encapsulation of F# components for .NET.

Course Content:

Lecture 1. Introducing F# and Functional Programming
We quickly look at the main reasons for adopting F#. Why is it becoming popular in the finance industry and what are some successful case studies? Then we introduce the fundamental F# language features such as immutability, tuples and pattern matching.

Lecture 2. Working with Collections and Data Structures
This lecture introduces the most important functional pattern – processing of immutable data structures using higher-order functions. We finish the processing of historical stock prices from Yahoo! Finance, calculating statistics and visualizes the result with simple charts.

Lecture 3. Implementing Mathematical Calculations
F# makes it easy to turn mathematical equations to code. In this lecture we look at examples such as Monte-Carlo simulations, Black-Scholes equation and calculating historical volatility. You'll learn how to avoid mistakes with units of measure, how to write efficient numerical code and how to use the rich Math.NET library.

Lecture 4. Domain Specific Languages for Finance
Domain specific languages (DSLs) are an effective way of solving recurring problems. In this lecture, we build a DSL for pricing financial options and for detecting patterns in changing prices. You'll learn how to model problem domain using functional data structures and how to build an easy to use library on top of the model.

Lecture 5. Explorative Data and Time-Series Analysis
In this lecture we look at F# type providers and Deedle. Type providers make it easy to access data from sources including CSV and XML files, Excel, SQL databases and Web and REST services. Using Deedle we can then align multiple time-series and perform interactive analysis – such as comparing different industry sectors or calculating daily returns.

Lecture 6. F# in the Larger Context
We wrap up by looking at the ways for integrating F# in the broader context. This lecture explores how to call advanced statistical libraries using the R provider, how to use object-oriented programming to integrate with .NET and how to use F# tools and libraries for unit testing, building and documenting code.

Final Project Submission

Certification

This Programming School Course is fully certified by **PRMIA**.

You will receive **27 CPD points (9 hours of structured CPD and 18 hours of self-directed CPD)** for completing this course.

Quants Hub Programming School

Python for Finance

by Yves J. Hilpisch, Founder and Managing Director, The Python Quants GmbH

The requires no prior knowledge of Python but knowledge of a similar programming language as well as of standard financial models. You will learn:

- How to best start using Python, related tool and libraries for Quant Finance
- How to model and store data efficiently with Python
- How to implement compact and performant financial algorithms
- How to visualize financial data with Python
- How to manage and analyze financial time series data
- How to implement performant I/O operations
- How to increase the performance of financial Python code

Course Content:

Lecture 1. Python and Tools
The first lecture shows how to efficiently set-up a Python and develeopment environment for Quant Finance. It also introduces into IPython, and in particular into the Notebook version which allows interactive, browser-based financial analytics with Python.

Lecture 2. Introductory Financial Use Cases
This lecture immediately dives into three canonical use cases: calculating and plotting implied volatilities, implementing performant Monte Carlo simulations, backtesting a trend based trading strategy. These use cases illustrate the benefits of the major Python libraries (NumPy, pandas), explained in detail in later lectures.

Lecture 3. Data Types/Structures and Visualization
This lecture is all about data modeling and storage with Python and the visualization of data. It introduces the basic data types and structures in Python, shows how to make use of NumPy's array capabilities and how to write vectorized numerical code with Python/ NumPy.

Lecture 4. Financial Time Series
This lecture is about the use of the pandas library for the management and analysis of financial time series. It shows examples implementing simple and advanced analytics as well as time series visualization. It also shows how to work with High Frequency data.

Lecture 5. Input-Output Operations
Financial analytics and financial application development mainly rests on the efficient and performant management and movement of (large, big) data. This lecture illustrates how to make sure that data reading and writing (to HDDs, SSDs) takes place at the maximum speed that any given hardware component allows. Examples also illustrate how to make use of compression techniques in such a context.

Lecture 6. Performance Libraries
The Python ecosystem has to offer a number of powerful performance libraries. For example, using the Numba dynamic compling library allows to compile Python byte code at call-time to machine code by using the LLVM infrastructure. The resulting compiled functions are directly callable from Python. Similarly, using the Multiprocessing module of Python makes parallelization of Python function executions a simple and efficient task.

Final Project Submission

Certification

This Programming School Course is fully certified by **PRMIA**.

You will receive **27 CPD points (9 hours of structured CPD and 18 hours of self-directed CPD)** for completing this course.

Quants Hub Programming School

R in Finance

by Joris Meys, Biostatistics Department Statistical Consultant, University of Ghent

In this workshop, you're introduced to the statistical programming language R. The workshop focuses on the aspects of the R language useful for financial analyses, with emphasis on techniques for automation and visualisation. We introduce R and the working environment RStudio using a practical approach with hands-on examples, and introduce a number of the most used add-on packages for financial analysis. The code of the examples will be available.

This workshop does not require any prior knowledge of R, but some experience with programming is assumed.

Course Content:

Lecture 1.
Basics, Objects and Operations - Part 1

- Introduction to R
- Introduction to Scripting
- Basics of R

Lecture 2.
Basics, Objects and Operations - Part 2

- Mathematics in R
- Working with vectors
- Working with text
- Adding dimensions

Lecture 3.
Dates and Times in R

- Working with Dates and Times
- Working with time series

Lecture 4.
Plotting Data

- The base plotting system
- The grammar of graphics: ggplot2

Lecture 5.
Logical Flow and Functions

- Functions and Methods
- Logical Flow
- Testing your code

Lecture 6.
Data Manipulation

- Data in and out
- Data Manipulation
- Reshaping data

Lecture 7.
Statistics and Statistical objects

- Quick summarizing
- Statistical Objects

Final Project Submission

Certification

This Programming School Course is fully certified by **PRMIA**.

You will receive **51 CPD points (11 hours of structured CPD and 40 hours of self-directed CPD)** for completing this course.

Quants Hub Programming School

Advanced C++ Design and Implementation in Quantitative Finance

by Nick Webber, Finance Lecturer, De Montfort University

The course uses concepts of application design to structure the presentation of C++ and numerical material. As new ideas are introduced their realizations in C++ are presented in the context of applications of simulation and lattice methods to models of option pricing. The simulation method is developed from a naive monolithic single procedure main to a powerful fully polymorphic application. The final application, employing a variety of important design patterns including a polymorphic factory, uses most of the syntactical elements of C++ in standard design paradigms. During this development a lattice method is implemented, enabling further features to be introduced.

A basic knowledge of C++ is assumed. A knowledge of classes is not assumed, nor a knowledge of object oriented programming styles. Implementations are in DevCpp, a freeware IDE wrapping the C++ 03 standard compliant GCC 3.4.2 compiler. C++ 11 extensions to C++ 03 are not required.

Course Content:

Lecture 1.
A simple procedural Monte Carlo
This module takes as its starting point the construction a simple monolithic procedural implementation of a basic time-stepping Monte Carlo method of option valuation.

Lecture 2.
Introducing objects: basic syntax and design
The procedural application of module 1 is converted into an application with functionality split between objects. Constructs option, process and accumulator objects.

Lecture 3.
Developing the basic structure
The basic objects in the module 2 are refined and developed by introducing I/O objects, a stopwatch, an application wrapper object, and a valuation object. A path, coded as a std::vector, is introduced.

Lecture 4.
Introducing polymorphism: basic syntax
In the application developed in module 2 it is awkward to value different options. Module 3 introduces and implements polymorphism. It constructs polymorphic option, process and application objects. The concept of a pseudo-factory, encapsulating object creation, is introduced and implemented.

Lecture 5.
A lattice application
A basic procedural lattice method is constructed. The objects that support it are identified and integrated into the application developed in module 4. The module 5 application can value American and Bermudan style options, with the lattice, and European style options, with simulation.

Lecture 6.
Advanced topics in class design
Motivated by the inconvenience of zero-based arrays and vectors in the lattice application this module develops a vector class that illustrates a number of advanced features of C++ object design. In the module 6 application std::vector is replaced by the new vector class.

Lecture 7.
Polymorphic I/O
So far I/O has been comparatively crude. Module 7 now addresses polymorphic I/O including I/O to and from file. Objects request input using parameter classes. A singleton IO object is introduced. An environment object is created to manage I/O choice.

Lecture 8.
Generic programming and templates
This module provides background material required for the template factory described in module 10. Template inputter functions are added to the model 7 application.

Lecture 9.
Design patterns with objects
This module develops a non-template polymorphic application factory, a precursor to the template factory developed in module 10.

Lecture 10.
A template factory
The non-template application factory of module 9 is converted in a full template factory. Separate IO and environment factories are added. The progress made since module 1 is assessed.

Final Project Submission

Certification

This Programming School Course is fully certified by **PRMIA**.

You will receive **90 CPD points (30 hours of structured CPD and 60 hours of self-directed CPD)** for completing this course.

Quants Hub Programming School

Mathematica / UnRisk

by Michael Aichinger, Senior Researcher and Consultant, Industrial Mathematics Competence Center

In each lecture the presented examples are out of the quant finance field. For example in the lecture Dynamic Interactivity and MMA the audience will be guided to develop a Viewer for diffferent copula functions with different marginal distributions.

Course Content:

Lecture 1.
Introduction to Mathematica and Basic Programming in Mathematica

- MMA Syntax
- MMA Programming paradigms
- Modules, Functions
- Example:Trees

Lecture 2.
Data Import and Export, Visualization

- Importing data
- Statistics in MMA
- Visualization in MMA
- Exporting data
- Example: Bootstrapping

Lecture 3.
Writing your own packages

- IDE for Developing -> Wolfram Workbench
- Developing your own packages
- Coding/Encoding packages
- Installing packages
- Example: Bonds

Lecture 4.
Speeding up your MMA Code

- Compiled Functions and their limits
- Generating CCode
- Apply these techniques to the previous examples

Lecture 5.
Dynamic Interactivity and MMA

- The Manipulate Command
- The Dynamic Command
- Advanced Manipulate (Speeding up, Combining Manipulate with Dynamic)
- Example: Default Probabilities

Lecture 6.
Linking Technologies and MMA

- LibraryLink -> C++
- JLink -> Java
- RLINK -> R
- Database LINK -> Databases
- Example: Link code to MMA

Lecture 7.
Building Up a MC Simulation with MMA

- Random Number Generators
- Setting up Paths
- Valuation
- Variance Reduction Techniques
- Quasi Monte Carlo with MMA

Lecture 8.
PDE based solutions in Mathematica

- Finite Differences and Upwinding
- Solving Systems of Linear equations
- Example: Solution of a 1D Finance PDE in MMA (HW1F)

Lecture 9.
UnRisk - Q

- Introduction to UnRisk-Q
- Models, Methods (Equities)
- Instruments

Lecture 10.
VaR Calculations with UnRisk-Q

- Parametric, Historical and MC VaR
- Marginal VaR
- Contribution VaR

Final Project Submission

Certification

This Programming School Course is fully certified by **PRMIA**.

You will receive **20 CPD points (20 hours of structured CPD and 20 hours of self-directed CPD)** for completing this course.

Quants Hub Programming School

Creating PDE/FDM Software Frameworks and Applications in C++11

by Daniel Duffy, Founder, Datasim Financial

The goal of this hands-on course is to introduce the new language features in C++ 11 and apply them to the design and implementation of frameworks to approximate the solution of partial differential equations (PDE) using the finite difference method (FDM). We design the frameworks with reusability and extendibility in mind so that you add your own solvers to the framework or apply design techniques to other kinds of applications in computational finance. In particular, we combine the object-oriented and functional programming models that C+11 supports and we encapsulate the algorithms in a next-generation design patterns object network.

Course Content:

Lecture 1.
New Fundamental Language Features in C++11
In this lecture we discuss the new syntax that makes C++11 a 'better C++' in terms of understandability and reliability of code. Topics include: auto, decltype, noexcept, constexpr, nullptr, uniform initialization and initializer lists, template typedef, default template parameters, new fundamental data types.

Lecture 2.
Advanced Language Features in C++11
In this lecture we discuss features that improve the efficiency and robustness of C++ code. Topics include: variadic templates, move semantics A-Z and smart pointers. We shall use these features when developing PDE models in C++.

Lecture 3.
Introduction to Functional Programming in C++11
C+11 is a multiparadigm programming language. In this lecture we give a short overview of the functional programming (FP) model and how C++11 supports it.

Lecture 4.
Data Structures
In this lecture we introduce a number of new data types. Topics include: tuple, union, fixed-size arrays and unordered containers. We show some examples of use, including how to use them in design patterns code.

Lecture 5.
Applied Functional Programming in C++11
In this lecture we apply C++ to the creation of next-generation design patterns and classes that model a number of essential entities in the PDE software framework. The focus is on creating code that is portable and that can be extended to suit a wide range of PDE models. It is the combination of the object-oriented and functional programming models that provides the foundation for flexible software.

Lecture 6.
Creating Software Frameworks
In this lecture we introduce a framework that can accommodate one-factor (and later two-factor) option pricing problems. The framework is based on experience with several software projects that have proved to be successful. The focus is on applying and integrating the topics from the first five lectures to produce customisable applications. Of particular importance is applying system patterns such as Layers and Builder.

Lecture 7.
One-Factor Option Pricers
In this lecture we implement several popular finite difference schemes and we add them to the framework. Included are Crank-Nicolson, implicit Euler and Richardson extrapolation.

Lecture 8.
Advanced Option Pricers
We elaborate on the topics in lecture 7 by discussing nonlinear PDEs in computational finance, for example uncertain volatility models (UVM), anchoring (Asian-style problem) and early exercise features. We use both the Method of Lines (MOL) in Boost and Alternating Direction Explicit (ADE) to produce high-order accurate and efficient schemes.

Lecture 9.
Two-Factor Option Pricing Models
In this lecture we give an overview of the main finite difference methods to price two-factor option problems.

Lecture 10.
Project Discussion
The main focus of the projects is to take a focused and well-defined problem, solve it with one or more finite difference schemes and implement the schemes using C++11

Final Project Submission

Certification

This Programming School Course is fully certified by **PRMIA**.

You will receive **CPD** points for completing this course.

Quants Hub Programming School

Advanced C# 5.0

by Daniel Duffy, Founder, Datasim Financial

The goal of this hands-on course is to introduce the language features in C# and apply them to computational finance. We discuss advanced topics to help the quant developer to create flexible code, frameworks and applications. The course style and contents have the same level of detail as in Daniel J. Duffy's courses on www.datasimfinancial.com and www.datasim.nl. We assume that the student has a good working knowledge of C#. If you have queries on this course please do not hesitate to contact me dduffy@datasim.nl.
This course is suitable for quant developers and model validators.

Course Content:

Lecture 1.
Quick Review of C#
The goal of this lecture is to review some essential C# syntax that we assume to be known and that will be used in later lectures. Key topics are: value and reference types, boxing and unboxing, structs versus classes, properties, object initializers, and .NET arrays.

Lecture 2.
Interfaces, Delegates and Software Contracts
This lecture discusses advanced issues that promote the interoperability of C# applications and that are used as the building blocks for design patterns. We introduce the interface concept, how to use it and how it differs from abstract classes.

Lecture 3.
C# Generics A-Z
Generics tend to receive little attention and the goal of this lecture is to show how to use generics to produce reusable and reliable code. In general, we create a generic class or function once and then use it many times by specialising the underlying generic type.

Lecture 4.
Disposal and Garbage Collection
We discuss both explicit resource management and automatic memory management (garbage collection) in this lecture. In particular, we show how to release resources such as open files, unmanaged objects, locks and operating system handles by implementing the IDispose interface.

Lecture 5.
Diagnostics and Code Contracts
In this lecture we discuss how to improve the robustness and reliability of C# applications. On the one hand we wish to diagnose problems that arise during development while on the other hand we wish to gather and record diagnostic information once an application has shipped.

Lecture 6.
Reflection and Assemblies
In this lecture we introduce two related topics.
First, we discuss the Reflection API that has functionality that allows us to dynamically query metadata in the Common Language Runtime (CLR).
Second, we introduce assemblies as a mechanism for encapsulating components in secondary storage.

Lecture 7.
LINQ (Language Integrated Query) Fundamentals
LINQ allows developers to query any collection that implements IEnumerable , including arrays, lists, XML DOM as well as remote data sources, for example SQL Server tables. LINQ offers both compile-time checking and dynamic query composition.

Lecture 8.
Advanced LINQ
We describe LINQ query operators in this lecture.
They allow us to create complex queries and reports.
In particular, we discuss standard query operators, filtering, joins and projections. We also introduce set and aggregation methods.

Lecture 9.
Native C++ and C# Interoperability
In this lecture we give an introduction to C++/CLI (a .NET language) that allows us to integrate C# and ISO C++. This can be a useful feature when we wish to integrate legacy C++ code into .NET-based applications or when we wish to call C# code from ISO C++ code. Topics discussed are: how C++/CLI syntax is close to C# syntax, generics and templates, interoperability scenarios.

Lecture 10.
Project Discussion
The main focus of the projects is to take a well-defined problem and implement the schemes using C# language features and related design patterns.

Final Project Submission

Certification

This Programming School Course is fully certified by **PRMIA**.

You will receive **CPD** points for completing this course.

Quants Hub Programming School

Matlab – An Introduction for Financial Applications

by Jörg Kienitz, Director, Financial Risk Solutions, FSI Assurance, Deloitte & Touche GmbH

The course gives an overview of the Matlab system with a view towards financial engineering. Since this is a beginners course we start by giving an introduction to the basic functionality like plotting, handling of matrices, using m-files and running scripts. All examples are based on financial problems. Thus, we aim to implement the Black-Scholes pricing formula, calculate Greeks. Furthermore, we consider writing programs. To this end we develop basic programming skills and show how to transform algorithms to working Matlab code and how to arrange the code. We wish to use the Binomial model as an example. Finally, we cover useful functionality for everyday life such as interpolation, integration or special functions. The last topic is on Monte Carlo simulation. We wish to outline the development of a Monte Carlo simulation application for option pricing. To this end we cover random number generation, calculating the Monte Carlo estimator as well as the Standard error and presenting the outcome as a convergence table or a convergence plot.

After the course you know the basic functionality of the Matlab system and you have a solid background for tackling financial problems with Matlab. Furthermore, you are able to explore further techniques such as object oriented programming and larger projects with the skills you acquired during this course.

Course Content:

Lecture 1.
Introduction to Matlab

1. The Matlab Workspace
2. Working with Matlab (Importing Data, Vectors, Matrices, ...)
3. The Help Functionality
4. Matlab for Financial Engineering – A Perspective

Lecture 2.
Basic Functionality

1. Plotting and Visualizing
2. 2D Plots and Subplots
3. Interpolation
4. 3D Plots
5. Further Issues with Plotting

Lecture 3.
Programming in Matlab

1. m-files
2. Script m-files
3. Introduction to Programming
   - Standard techniques
   - Special Matlab topics
   - Summary of Basic Programming tasks
4. Example: Black Scholes Merton Formula, Greeks, Binomial Trees

Lecture 4.
Data Types

1. Logic Arrays, n-dim Arrays, Sparse Arrays, CellArrays, ...
2. Function Handles
3. Example: Optimization

Lecture 5.
Useful Functionality

1. Special Functions
2. Integration and Transforms
3. Example: Implementing Option Pricing Methods

Lecture 6.
Monte Carlo

- Random Number Generation
- Path Generation
- Example: MC Application (Path-Dependent Options)

Final Project Submission

Certification

This Programming School Course is fully certified by **PRMIA**.

You will receive **27 CPD points (9 hours of structured CPD and 18 hours of self-directed CPD)** for completing this course.

Fee Structure

Monthly Subscription Service

1 Month Service: **£899**
(Workshops only, no programming school courses)

3 Months Service: **£1499**
(Workshop access all areas & 1 Programming School course or Online Workshop)

6 Months Service: **£1999**
(Workshop access all areas & includes 2 of the following: Programming School courses or Online Workshops)

Programming School Only Annual Subscription Service

This subscription option allows you to access **4 Programming School** start date courses per annum, plus all self-paced courses: **£2499**

Workshop Only Annual Subscription Service

If you only want to access only the Quants Hub Workshops we offer a Workshop Only Service. This subscription option allows you to access to all Quants Hub workshops.
This option includes all self-paced programming school courses.

Full Annual Subscription Service

Full Annual Subscription includes 4 Programming School courses, Live & Online Workshops or WBS Training 2 day Conference attendance per login.

1 Full Annual Subscription/Login account: **£3799** per annum for access to all areas

2 Full Annual Subscription/Login accounts: **£4799** per annum for access to all areas

3 Full Annual Subscription/Login accounts: **£5799** per annum for access to all areas

Quants Hub Workshops

Quants Hub Online Video Workshop: **£99**

Quants Hub Programming School Courses

Full Programming School Course: **£699**

Self-Paced Programming School Course: **£399**

Academics Discount
We offer full-time academics a 50% discount on all the subscription services.

Government Employee Discount
We offer Government employees a 40% discount on all the subscription services.