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Derivatives Trading, Pricing and Risk Management Training

The Complete Immersion Program

This is a complete immersion course designed to give participants a complete and thorough understanding of derivative products. It is divided into two levels. Each level requires one week.

## **Week 1 Beginner:**

We cover the usage of derivatives: the derivative market and its development, what are the products, pricing and hedging “intuition”, risk management essentials, common pitfalls etc. This week will contain many “stories from the field”. Where appropriate, we will also discuss issues relating to the specific market the delegate is in.

By the end of the week, a participant will have good working knowledge of the different types of derivatives and how they are used.

This week is intended for board members, senior management, fund managers, sales people and others.

### **Monday: Overview of the Derivatives Markets: profits and pitfalls**

#### **An Overview of the Products**

- Spot
- Forwards
- Futures
- Options and other derivatives
- What is the difference between an underlying instrument (spot) and a derivative instrument (forwards)

#### **Introduction to options**

- The option premium
- Hedging - why is it important
- Hedging - how is it done
- Risk management
- Market risk vs. credit risk
- European, American and exotic options
- How are new products approved

### **Volatility**

- What is it?
- Historical vs. implied volatility

### **Where are the potential profits in derivatives**

- Case studies of successful operations
- How can we reproduce them in this region

### **What are the potential pitfalls**

- Case studies of "blowups"
- Interest rate exposure
- Parallel move in the curve
- Twists and Shifts
- Foreign exchange exposure
- How to measure, control and hedge these exposures
- Risk Buckets
- The concepts of duration and convexity
- Key-rate duration and key-rate convexity

### **Liquidity Problems**

- Structured notes as "story bonds"
- Difficulties of getting out of a structure in the secondary market
- Special liquidity problems for single market makers

## **Tuesday: Exotic options on foreign currencies and equities**

### **Motivation for using exotics**

*After all the negative publicity, why use exotics at all?*

- Customized hedging tools
- Investors talking a specific view
- Executive bonuses
- Swiss (and American) life insurance products
- As a part of a total solution (e.g. contingent premium options)
- Structured notes
- Volatility insensitive structures
- The impact of the exotic options market on the spot market (e.g. double barrier foreign exchange options)

### **How companies hedge**

### *Real life examples from the field*

- Zero or low-cost hedging strategies for corporations
- Risk management to reduce a corporation's own risk vs. an insurance program to protect against a competitive disadvantage
- Credit enhancement using derivatives
- We look at companies such as Gillette, RJR Nabisco, Abitibi-Price and more

### **Bermudan Options - pricing and hedging techniques**

#### *Between American and European options*

- Applications for Bermudan options for bonds (e.g. callable bonds)
- Cancelable swaps
- Pricing and hedging of Bermudan options - a review

### **Digital / Binary Options**

#### *All or nothing options*

- Distinction between
  - CASH or NOTHING
  - ASSET or NOTHING
- Gap options
  - adaptations of Black-Scholes
  - cash or nothing options
  - asset or nothing options
- Applications and hedging of digital / binary options
- What is the Delta of a Binary option
- How to value Digital options
- The "dog leg" forwards

### **Compound Options**

#### *Options-on-Options which allow the holder to buy or sell an "underlying" option*

- EUROPEAN on EUROPEAN, EUROPEAN on AMERICAN
- CALL on a CALL
- CALL on a PUT
- PUT on a CALL
- PUT on a PUT
- Pricing compound options - an overview
- Applications of compound options (e.g. the Banker's Trust Installment Warrants)
- Which volatility should be used
- Hedging of compound options
  - Hedging with the underlying option
  - Hedging with the underlying asset

### **Barrier Options**

#### *These options become activated/extinguished when an underlying price crosses a barrier*

- Dealing with:
  - DOWN and OUT
  - DOWN and IN

- UP and OUT
- UP and IN
- CALLS and PUTS
- Is it true that a knock-out plus a knock-in equal a European?
- "Nice" barriers vs. "nasty" barriers
- Discretely monitored barriers
- Pricing of barrier options - an overview
- Legal issues: how can an investor be sure whether a barrier was touched?
- Discretely monitored barriers
- Partial barriers
- Hedging barrier options
  - construction of equivalent portfolios
  - long a normal call and short a special put
  - when does this work and when does it fail
  - arbitrage relationships
  - risks of hedged positions
- Static hedging vs. dynamic hedging
  - a detailed example
  - when do they work and when do they fail

### **Asian Options (Average Price)**

#### *Options on the average*

- The 'Asian' style options: what are they?
- Why they make sense
- How come their price is so low - reduced volatility of the average
- Geometric vs. Arithmetic average
- Importance of the "average so far"
- Pricing of the Asian options - a review
- Continuous averaging and discrete averaging
- Hedging Asian options with normal options
- Hedging Asian options with the underlying (an example)

### **Average strike options**

#### *The strike of the option is determined by the average price*

- Applications of average strike options
- Pricing and hedging of average strike options
- Comparison of average price and average strike options

## **Wednesday: Bonds and options on bonds**

### **The Term Structure of Interest Rates**

*We discuss many types of interest rates and how they are derived from each other*

- Par bond yield curve
  - Construction with benchmark bonds and linear interpolation
  - Construction with a universe and exponential cubic splines

- The zero coupon curve
- Corporate curves and spreads
- What does the spread really measure?
- Forward curve
- The Libor interest rate curve
- Does volatility affect the curve?
- Commercial paper rates
- Derivation of one curve from another
  - Bond stripping and reconstitution
  - Gap and Multigap analysis

### **Fixed and Floating Rate Instruments**

*Fixed and floating rate instruments are discussed and compared in this section*

- Some popular indices
  - Libor
  - Constant maturity treasuries (CMT)
  - Fed Funds
  - Other indices
- Inverse floating rate notes
- How fixed coupon bonds are related to interest rates
- How are floating rate notes related to interest rates

### **Duration and Convexity**

*Duration and convexity analysis for structured notes*

- Duration
- Convexity
- Key rate duration
- Duration with respect to the discounting rate
- Duration with respect to the index
- Determination of the relevant index

### **Callable bonds - pricing and hedging techniques**

*Between American and European options*

- Applications for Bermudan options for bonds (e.g. callable bonds)
- Cancelable swaps
- Pricing and hedging of Bermudan options an overview

## **Thursday: Convertible bonds and other hybrid products**

### **Hybrid Instruments**

*Introduction to convertible bonds and other hybrid instruments*

- Introduction to hybrid instruments
- The market and its size
- Convertibles, Preferred Shares, Elks, Decs, Percs etc.
- The issuers: who issues them and why
- The investors: advantages / disadvantages to the investor
- The brokerage house: a study of the underwriting process
- The secondary market
- Convertible bonds in the US

- Hybrid instruments in emerging markets
- Overnight financing or bought deals
- The Japanese “reset convertibles”
- Reverse convertibles in Germany
- Exchangeable bonds in Canada
- Dual currency convertibles
- Convertible bonds with sinking funds
- Other embedded features
- A catalog of hybrid instruments: the precise definitions of all the different acronyms

### **Convertible Bonds in Detail**

*We look under the hood of a convertible bond*

- Why use them
- The different regions of a convertible: equity equivalent, hybrid, bond equivalent and the bankruptcy region
- The different types of convertibles
- Convertible = a bond + a warrant ???
- What are their special features and how do they effect the convertible
- Zero coupon bonds ( Lyons )
- Call and put options
- The credit spread
- The special risks of convertible bonds
- Dilution
- The “waterfall” effect
- Hedging

### **The Convertible Bond Investor and Speculator**

*Several groups invest in convertibles bonds, each looking for different qualities*

- Investment managers
  - Risk averse equity managers
  - Income oriented equity managers
  - Risk averse equity managers
  - Income oriented equity managers
  - Convertible specialists
  - Bond managers seeking equity “kickers
- Hedge funds
  - What do they do
  - How to Delta hedge
  - Special concerns for illiquid bonds
  - Are hedge funds useful to the market or are they detrimental
- What is important to investors in different regions of the world?
  - The US
  - The UK

- Euro convertible bonds
  - Hong Kong
  - and other regions
- How to design and market convertibles to each type of investor
- What happens in case of issuer default

## **The Issuer**

*What type of issuer issues convertibles*

- Examining the convertible bond market by type of issuer
- What is the size of a typical convertible issue?
- What kind of credit ratings does a typical convertible carry?
- How to arrange for an attractive deal without giving too much
- What other embedded features can we put in a convertible?
- Is it eligible for 144(A) or not?
- Who issues the other types of hybrid securities and why?
- What types of convertibles tend to be issued in different economies?

## **Relative value**

*What are the measures of value for convertibles*

- Conversion value
- Conversion premium
- The concept of payback and cash payback
- YTM – yield to maturity
- YTC – yield to call
- YTW – yield to worst
- Premium
- Investment premium
- What is the expected maturity, how to compute it and how to use it

## **Building a portfolio of convertibles**

*Basic risk management techniques for convertibles*

- Duration
- Understanding the intuition behind duration
- Macaulay duration
- Modified Duration
- What are they used for?
- Convexity
- Key rate duration and convexity
- How to use duration and convexity
  - For investment management purposes
  - For risk management
- Delta and Gamma
- How are Delta and Gamma used?

- How are equity movements hedged?
- Volatility exposure
- Correlation worries

### **Hedging**

*Long a convertible bond and short shares*

- How to construct a delta hedge
- Bullish, bearish and neutral hedges
- The “carry” trade and how it works
- Being long a convertible bond while being short the shares or vice versa
- What is the “haircut”
- The hate / love relationship between issuers and hedge funds
- Computation of the return on capital
- What can go wrong
- The Long Term Capital Management (LTCM) example

### **Friday: Credit Derivatives**

#### **Evaluating the Credit Derivatives Market and the Rationale for its Development**

- Current and future potential of credit derivatives market
- Assessing the size of the market in terms of capacity and liquidity
- The size of the market and the distribution among product lines and underlying instruments
- Difficulties in developing a true “two way” market
- Evaluating the potential for a secondary market in credit derivatives
- How the Euro has impacted on the credit derivatives market
- Credit derivatives: the US experience
- The recent credit crunch and its implications on the market

#### **Different Structures and Assessing their Risks to Ensure Successful Implementation**

- Default Swaps & Options
- Total return swaps
- Credit linked notes
- Put credit spreads on asset swaps
- Credit spread notes
- Demystifying the risks: cross, equity, term structure, settlement, legal and basis risk
- Collateralized Debt Obligations CDO's: Collateralized Bond Obligations (CBOs) and collateralized loan obligations (CLOs)
- Downgrade options and their uses

### **Examples of sample terms sheets**

- Examining specific terms sheets
- What is the use of each structure
- Why is someone purchasing the structure
- How is it created
- What are the benefits to the issuer

### **Convertibility products**

- Suitable for hedging cross border risks
- The currency repatriation hedge
- Is this a credit derivative or is it a foreign exchange structure?

### **New products**

- News from the field
- What are some of the most recent deals being done
- The role of the exchanges: the CME experience with the QBI index
- Credit enhanced convertible bonds

### **The credit spread**

- Comparison: credit spread vs. corporate spread
- The credit spread curve and its meaning
- Connecting the credit spread, the recovery value and the probability of default
- What is the "current spread" as opposed to the "forward spread"
- The credit rating agencies and their role
- The credit transition matrix and its implications

### **Connecting Between Credit Derivatives and the Repo Markets**

- Is it a credit derivative or is it a repo trade?
- Similarities and differences
- When to use each instrument

### **Where should the CD desk be placed within the bank**

- We examine several possibilities
- Possible solutions arrived by different banks
- Advantages and disadvantages of the various approaches

## **Week 2 Intermediate/Advanced:**

During this week, we learn how to structure and price the products. We will develop spreadsheet models that the delegate can take to their office and use. This week will require a more mathematical approach and will include many workshops.

By the end of the week, each delegate will amass a collection of spreadsheets to take with them. A reasonable knowledge of Excel is assumed.

This week is intended for people in charge of pricing and structuring.

## **Monday: Forwards and Options**

### **Warm-up session on pricing and valuing derivatives**

- The price of any instrument is the present value of the expected value of its cash flows
- The risk neutrality assumption
- Normal and log normal distributions
- The stochastic model for the underlying instrument
- Special cases: commodities, interest rates, weather and catastrophe derivatives
- The time value of money
- Net present value of cash flows
- Converting between yield curves:
  - the par bond curve
  - the zero coupon curve
  - the forward curve
  - discount factors
- When should each curve be used?

**Workshop:** building a spreadsheet to convert from the par bond yield curve to the spot curve and vice versa using boot strapping and other methods.

### **Mastering the theory and practice behind option pricing models**

- Discovering where you can find the underlying data for your calculations
- Reuters, Bloomberg, and other data feeds
- Learning how to price European options using:
  - closed form formulas
  - tree building
  - numerical quadrature
  - Monte Carlo techniques
  - finite difference methods
- A comparison between different types of trees:
  - equal probability trees and other trees
  - when should each one be used?
- Explaining what the assumptions behind the different models are
- Fully understanding the differences that arise between the various models

- Sanity check: "is it the price reasonable?"

**Workshop:** building a spreadsheet to price European options using the methods described above.

## Historical Volatility

*An in-depth review of historical volatility estimation techniques*

- Which historical period should you use?
- What data frequency should you look at?
- Using various estimators: Close Close, Open High Low Close etc.
- When should each estimator be used?
- What type of data is suitable for which estimator?
- Parkinson rules
- Exponential smoothing techniques
- A short introduction to Arch and Garch

**Workshop:** calculate historical volatility

## Implied Volatility

*Estimation and application of implied volatility*

- How to gauge implied volatility?
- Real life difficulties: the synchronization problem
- The volatility skew and smile
- Is implied volatility a good predictor of future volatility?

**Workshop:** modifying your option pricing spreadsheet to compute implied volatility

## Understanding the importance of the Greeks

- The meaning of Delta, Gamma, Vega, Rho and Theta
- Examining what the implications are when their value changes
- What do traders look for?

**Workshop:** modifying your option pricing spreadsheet to compute Delta, Gamma and the other Greeks.

## Developing a Framework for Accurate Risk measurement

*Sensitivity analysis ("Greeks"), Scenario analysis and Value-at-risk*

- How to quantify the risk of an option
  - Delta: sensitivity to the asset price
  - Gamma: sensitivity of delta to the asset price
  - Vega: sensitivity to volatility
  - Theta: time premium

- Rho: sensitivity to interest rates
- Scenario analysis
  - Which scenarios should you look at
  - Visualization and graphics
- The Group of Thirty (G30) recommendations
- Value at Risk (VAR)
- Introduction
- Several methods used (e.g. RiskMetrics)
- Advantages and critiques

**Workshop:** develop a sheet for finding the VAR of a portfolio of options. Compare with the Greeks.

## **Tuesday: Exotic options on foreign currencies and equities**

### **Getting to grips with the pricing and valuing of exotic options**

- Learn how to price exotic options using:
  - a tree to handle American and Shout options
  - Monte Carlo to handle Asian options and Barrier options
  - quadrature to handle Compound options and Chooser options
  - techniques to improve and speed up the Monte Carlo algorithm

**Workshop:** creating the model to price several exotic options of your choice and find hedge ratios.

**Workshop:** design Monte Carlo algorithm, add antithetic variables. Improve using the control variate techniques.

## **Wednesday: Bonds and options on bonds**

### **Options on interest rates: applying them in practice**

- Examining how yield curves are modeled
- Applying the different interest rates models:
  - Cox Ingersoll Ross,
  - Black, Derman and Toy
  - Ho and Lee
  - Vasicek, Hull and White
  - Longstaff and Schwartz
  - Black-Karasinski
  - Brace and Musiela
- Explaining the advantages and disadvantages of each model
- How to choose the right model for your particular needs

- How to successfully overcome the problem of calibrating your model to current market conditions
- Using binomial and trinomial interest rate trees
- Incorporating volatility into your tree calculations
- Learning how to deal with the different length of time in interest rates when building your tree

**Workshop:** building a binomial tree and pricing a callable bond

## Understanding duration and convexity

- Describing the concepts of duration, convexity and option adjusted spread (OAS)
- Learning what their uses are:
- adjusted duration and MacAulay duration
- the case of the "century" bond
- using duration as a hedge ratio
- How to use OAS as a measure of relative value

**Workshop:** modifying your spreadsheet to compute duration, convexity and OAS

## Thursday: Convertible bonds and other hybrid products

### Pricing Methodologies for Convertible Bonds

*An introduction to pricing theory*

- Two ideas
- the no arbitrage condition
- the reverse engineering principle
- The interest rate tree
- how to construct a tree
- construct the forward curve
- nodes and probabilities
- the role of volatility
- why are trees so powerful
- The stock price tree: risk neutral valuation
- Why is a convertible not a bond plus a warrant
- The Goldman Sachs model
- Two factor models and beyond
- Models on the share price vs. models on the firm value
- How to model credit spreads
- Adapting the models to cope with the special features of convertibles

**Workshop:** Price a convertible as a bond + a call option on the stock.  
Note cases where the method fails.

**Workshop:** Develop a simple two factor model for convertible bonds

## Examples

*In this workshop we cover examples of hybrid instruments and see how they are analyzed*

Some of the products to be covered include:

- Decs
- Percs
- Convertible Bonds
- Mandatory Convertibles
- Preferred Shares

**Workshop:** Convert your model to deal with these instruments.

## Friday: Credit Derivatives

*Working in small teams, delegates will be presented with term sheets of various deals using different products, such as credit derivatives, CBO's etc. We will analyze each deal in terms of the following:*

- Motivation - why would a someone sell the product and why would another party purchase it?
- What is the view expressed by entering into the deal?
- Assessing the major risks and rewards associated with each deal
- Pricing - how is this structure priced
- Sensitivity - how will the structure perform under various scenarios (parallel shifts, flattening or steepening of the yield curve etc.) Credit spread changes? What about volatility swings?
- Hedging - how can the parties entering the deal hedge their exposure?
- Alternatives - what other structures are there which offer similar behavior under various possible market conditions?
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### Some of the products covered

- Put Credit Spread
- Asset Swap Put Credit Spread
- Binary Credit Linked Note
- Credit Spread Collar
- Dual Currency Credit Spread Note
- Forward Spread Note
- Coupon Enhanced Credit Linked Note
- Basket Credit Linked Note
- Total Return Swap

**Workshop:** As part of the pricing exercise above, we will develop various pricing spreadsheets.