

# Financial Modelling with Spreadsheets

## Spring 2012

### Lecturer

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## Objective

This course covers the frameworks and tools necessary to build advanced spreadsheet models for financial decision making. The course is suitable for students seeking a career in finance, and also for students with broader interests who wish to strengthen their spreadsheet modelling skills. Financial models covered include portfolio management and estimation, term structure estimation, capital budgeting, risk measurement, risk analysis in discounted cash flow models, and pricing of European, American, exotic, and real options. Basic financial concepts necessary to understand these models will be reviewed. Useful spreadsheet features such as data tables, scenario manager, database operations, pivot tables and charts, data analysis add-in, and other statistical built-in functions will be reviewed. In addition, we will learn how to record and edit macros to automate spreadsheet tasks.

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## Course Description

This is a hands-on course in which approximately half of the time will be spent working through workshops in the computer lab. Each session will typically start at the lecture theatre with a short lecture reviewing the conceptual frameworks necessary to build the financial models of interest. The class will then move to the computer lab where the students will complete the workshops with the assistance of the lecturer. The software used in the course is Microsoft Excel, with the add-ins Solver for optimization and @Risk for simulation, which can be downloaded from the portal.

| Financial models covered  | Spreadsheet features covered  |
|---|---|
| <ul style="list-style-type: none"> <li>• Mean-variance portfolio selection and estimation</li> <li>• Bond portfolio management</li> <li>• Term structure estimation</li> <li>• Capital budgeting</li> <li>• Risk measurement</li> <li>• Discounted cash-flow risk analysis</li> <li>• European and American option valuation</li> <li>• Exotic option valuation</li> <li>• Real option valuation</li> </ul> | <ul style="list-style-type: none"> <li>• Sensitivity analysis with scenario manager and data tables</li> <li>• Creating tornado diagrams</li> <li>• Database operations</li> <li>• Pivot tables and charts</li> <li>• Matrix operations</li> <li>• Regression analysis</li> <li>• Recording and editing macros</li> <li>• Using macros to automate the use of the @Risk and Solver add-ins</li> </ul> |

## Prerequisites, Preparation, and Assessment

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The **prerequisites** for this course are the MBA core courses "**Decision and Risk Analysis**" and "Corporate Finance" or similar courses in other institutions. Familiarity with the following add-ins for Excel is required: "**Solver**" and either "**@Risk**" or "Crystal Ball" for Monte-Carlo simulation. Students who do not meet these prerequisites are welcome to take the class provided they are prepared to do some additional reading to catch up. Class participation will account for 20% of the course grade and the student reports for three workshop assignments will account for 80% of the grade.

## Course Materials

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The course pack (exercises, teaching notes, and other readings) will be available from our secretary Suzanne Shapiro (e-mail [sshapiro@london.edu](mailto:sshapiro@london.edu)) in room A208 (ext. 8844) three weeks before the first session. Additional materials, including the lecture presentations and the course datafiles, will be distributed in class and via the portal. The course datafiles are also accessible from the LBS Network and can be found in the directory Q\Students\CBFM. The course makes extensive use of the portal, providing web access to the course outline and schedule, cases, workshop assignments, teaching notes, and lecture presentations. Please check these on-line resources regularly. The Excel add-in @Risk can be downloaded from the portal.

The materials in the course pack and portal should be sufficient to take the course and hence there is no required textbook for the course. Several textbooks, however, can be used to complement the materials in the course pack and in the Portal:

- "*Spreadsheet Modeling and Applications*", by Albright and Winston, Thomson/Duxbury Press 2005. This is the textbook for the prerequisite

core course "Decision and Risk Analysis" and covers the basics of modelling as well as the basics of the prerequisite tools Solver and @Risk. Students who have not taken "Decision and Risk Analysis" or equivalent, should read Chapters 3 and 9 of this book before Sessions 3 and 5, respectively.

- "*Advanced Modelling in Finance Using Excel and VBA*", by Mary Jackson and Mike Staunton, Wiley 2001. This textbook addresses both the financial and spreadsheet modelling aspects of the course.
- "*Options, Futures and Other Derivatives*", by John C. Hull, Sixth Edition, Prentice Hall 2006. This textbook is also recommended for other complementary elective courses such as "Options and Futures" and "Financial Engineering and Risk Management". The book is particularly useful to understand the theoretical concepts related to option valuation.
- "*VBA for modelers*", by Christian Albright, Second Edition, Palisade 2006. This textbook provides a step-by-step guide to using VBA to build decision-support systems with Excel.

In addition, the following entertaining, easy-to-read, and informative New York Times bestseller gives a good overview of some of the characters and strategies in the quantitative finance industry:

- "*The Quants: How a small band of maths wizards took over Wall Street and nearly destroyed it*", by Scott Patterson, Random House Business Books 2010.

# Schedule

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## **Session 1 — Introduction to Financial Modelling and Spreadsheet Essentials**

### **Frameworks and concepts covered**

- Course mechanics
- Introduction to financial modelling
  - Strengths and weaknesses of spreadsheets
  - Six golden rules of spreadsheet design
  - Do we make the most of modelling?

### **Spreadsheet features covered**

- Lookup and reference functions
  - NPV and IRR functions
  - Data tables
  - Database manipulation
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## **Session 2 — Measuring Risk**

### **Frameworks and concepts covered**

- Estimating betas
- Log returns
- Using daily, weekly, and monthly data
- Testing market efficiency

### **Spreadsheet features covered**

- Regression analysis
  - With data analysis add-in
  - With Excel built-in functions
- Frequency histograms
- Pivot tables
- Recording and editing macros

### **Preparation**

- Read in the course folder "Modern Risk Measurement".
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## Sessions 3 and 4 — Portfolio Optimization

### Frameworks and concepts covered

- Mean-variance portfolio selection:
  - Computing mean-variance portfolios
  - Back-testing portfolio performance
  - Research on portfolio selection
- Bond portfolio selection
- Term structure estimation
- Capital budgeting

### Spreadsheet features covered

- Matrix operations in Excel
- Auditing tools
- Using solver
- Using macros to generate the efficient frontier

### Preparation

Students who are not familiar with Solver need to read the following sections of Albright and Winston before class: 3.1, 3.2, 3.3, 3.4, 3.7, 3.8, 4.1, 4.7, 6.1, 6.2, 6.3, 7.1, and 7.2.

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## Session 5 — Advanced risk analysis

### Frameworks and concepts covered

- Monte-Carlo simulation
- Risk analysis for London European Airways

### Spreadsheet features covered

- Sensitivity analysis
  - Scenario analysis with scenario manager
  - Data tables
  - Tornado diagrams
- Using @Risk for Monte-Carlo simulation
- Combining macros with @Risk

### Preparation

Students who are not familiar with @Risk should read the handout "Allowing for Risk in Spreadsheet Models--A Tutorial on Risk Analysis with @Risk", which is in the course folder, and Chapter 9 of Winston and Albright before class.

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## **Session 6 — Workshop Assignment on Portfolio Optimization**

For this session, we will meet directly at the computer laboratory. The workshop assignment will be distributed, and the students will work in pairs on the assignment with the help of the professor and tutors.

### **Frameworks and concepts covered**

The assignment will build on the concepts covered in Sessions 3 and 4. Specifically, the students will have to build a Solver model to deal with a portfolio management situation.

### **Preparation**

Students who are not familiar with Solver need to read the following sections of Albright and Winston before class: 3.1, 3.2, 3.3, 3.4, 3.7, 3.8, 4.1, 4.7, 6.1, 6.2, 6.3, 7.1, and 7.2.

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## **Session 7 — American Option Valuation**

### **Frameworks and concepts covered**

- Review of options
  - Binomial trees
  - Risk neutral valuation
  - American option valuation
  - Estimating stock return volatility
  - Matching volatility with a binomial tree
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## **Session 8 — Workshop Assignment on Real Option Valuation with Binomial Trees**

For this session, we will first have a short lecture and then we will move to the computer laboratory. The workshop assignment will be distributed, and the students will work in pairs on the assignment with the help of the professor and tutors.

### **Frameworks and concepts covered**

- Real options
  - Valuing an internet start up with real options
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## **Session 9 — Black-Scholes Formula and Exotic Option Valuation**

### **Frameworks and concepts covered**

- Black-Scholes formula
    - Pricing European options
    - Estimating implied stock return volatilities
  - Simulating stock price evolution with Monte-Carlo simulation
  - Exotic option valuation with Monte-Carlo simulation
    - Knockout options
    - Lookback options
    - Asian options
    - As-you-like-it options
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## **Session 10 — Workshop Assignment on Real Option Valuation with Monte-Carlo Simulation**

For this session, we will first have a guest speaker and then we will move to the computer laboratory for a workshop assignment.

### **Frameworks and concepts covered**

- **Real Option Valuation with Monte-Carlo Simulation—Workshop assignment**