Objective

In today’s information age, managers increasingly rely on quantitative models and big data to make financial decisions that have a profound impact on the performance of their organizations. Often business analysts produce the quantitative models that top management use to support their decision making, but top management must also understand the strengths and weaknesses of the models if they are to use them effectively to support their decisions. The objective of this course is to equip you with the frameworks, tools, and methodologies necessary to build and/or be an educated user of quantitative models for financial decision making. The course is suitable for students seeking a career in finance, but also for students with broader interests who wish to strengthen their general modelling skills, and it does not require any quantitative background other than what is covered in the MBA core courses.

We will help you master modelling frameworks such as regression analysis, Monte-Carlo simulation, optimization, and binomial trees; and, we will show you how to apply these frameworks in financial contexts such as portfolio management, term-structure estimation, capital budgeting, risk measurement, risk analysis in discounted cash flow models, and pricing of European, American, exotic, and real options. The modelling tools will be illustrated by applying them to a variety of real-world cases. For instance, we will use real options to carry out the valuation of a 10-year lease on a gold mine (taking into account the uncertainty in gold prices and the flexibility to choose when and how much gold to extract); we will show you how to use Monte-Carlo simulation to understand the impact of the different assumptions underlying the discounted cash-flow analysis for a new venture in the airline industry; and, we will show you how to value abandonment, expansion, contraction, and pioneer options on real-world assets.

Course description

A famous Chinese proverb reads “I hear, I forget. I see, I remember. I do, I learn”. The structure of the course “Financial Modelling with Spreadsheets” tries to capture the wisdom of this proverb. A typical session consist of three
steps. First, the instructor lectures about academic concepts from the fields of Management Science and Finance (I hear). Second, the instructor applies these concepts to a particular business situation (I see). Third, the students themselves apply the concepts to a real-world business case with the help of the instructor (I do). Students who have taken this course emphasize as a strength that the course structure (lecture + example + workshop) facilitates the learning of otherwise complex quantitative models.

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. We will discuss spreadsheet modelling best practices, and review useful spreadsheet features such as data tables, database operations, pivot tables and charts, the data analysis tool pack, and other statistical built-in functions. In addition, the use of macros to automate spreadsheet tasks will be illustrated. The table below provides a summary of the financial contexts, modelling frameworks, and spreadsheet features covered.

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<th>Financial contexts</th>
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<td>• Bond portfolio management</td>
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Prerequisites, Preparation, and Assessment

The prerequisites for this course are the MBA core courses “Data, Models, and Decisions” (or the executive MBA equivalent "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 two workshop assignments will account for 80% of the grade.
The course pack containing the lecture presentations, teaching notes, workshop exercises, and other readings will be available from our secretary Suzanne Shapiro (e-mail sshapiro@london.edu) in room A208 (ext. 8844) two weeks before the first session. Additional materials, including template and worked-out Excel files will be distributed via the portal. The course Excel files are also accessible from the LBS Network and can be found in the directory Q\Students\FMS. 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 "Data, Models, and Decisions" and covers the basics of modelling as well as the basics of the prerequisite tools Solver and @Risk. Students who have not taken "Data, Models, and Decisions" or equivalent, should read Chapters 3 and 9 of this book before Sessions 3 and 5, respectively.

- "Principles of Corporate Finance", by Brealey, Myers, and Allen, 10th ed., 2010. This is the textbook for the prerequisite core course "Corporate Finance" and covers the basic financial frameworks that are required in 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 "Derivatives" and "Financial Engineering and Risk Management". The book is particularly useful to understand the theoretical concepts related to option valuation.


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:

Schedule

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 essentials
  - Lookup and reference functions
  - NPV and IRR functions
  - Data tables
  - Database manipulation

Session 2 — Measuring Risk

Frameworks and concepts covered

- Estimating betas with regression analysis
- Using daily, weekly, and monthly data
- Testing market efficiency
  - With regression analysis
  - With pivot tables
- Recording and editing macros

Preparation

- Read in the course folder “Modern Risk Measurement”.
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
  - Matrix operations in Excel
  - Using Solver for optimization
  - 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.

Session 5 — Advanced risk analysis

Frameworks and concepts covered
- Monte-Carlo simulation
- Risk analysis of discounted cash flow models
- Case: London European Airways
- Spreadsheet features
  - 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.
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.

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

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
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

Session 10 — 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 to work on real-option valuation with Monte-Carlos Simulation.

Frameworks and concepts covered

- Real Option Valuation with Monte-Carlo Simulation