Optimum Decision Making and Risk Analysis Applied to Finance

13—17 February 2017
UCL, London

Objectives—Scope and Purpose:

Optimisation technologies have become key tools in making intelligent business decisions and are often adopted in the Finance industry. Important problems of the Finance industry, such as

- asset allocation and portfolio construction
- asset and liability management
- risk quantification and risk control

are well-addressed by optimisation-based models. The success of optimisation enabled solutions depends on many factors such as which modelling tools are used, integration with data sets and the selection of the most efficient solution algorithms available for the problem.

Learning Outcomes:

After successful completion of the workshop, the participants will

- be able to
  - formulate and develop their own optimisation models
  - link them to data sources and solve the models using state-of-the-art commercial solvers.
- have acquired a good knowledge of how to embed optimisation models into applications.

Workshop Format:

This workshop is modular and presented in three parts (two days x 2, plus one day). This workshop is presented in an interactive format and is split into theory and practical sessions. The participants have the opportunity to familiarise themselves with relevant software and learn some practical applications. In the afternoon of each day participants spend some time discussing their modelling and solving requirements with the expert presenters. This reinforces the theory learned and provides an excellent grounding which makes the training truly valuable and practical. Participants are encouraged to engage in general discussion and further examples of applying the lessons learned.

Practical sessions

Our instructors are all acknowledge subject experts and have many years' experience in this field. They will take you through all the steps of an optimisation project using powerful optimisation tools such as the modelling language AMPL, its extension Stochastic AMPL (SAMPL), and the modelling system AMPLDev, together with the solvers CPLEX and FortMP.

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Pre-requisites: *This is an advanced course designed to allow individuals with various levels of optimisation knowledge to attend. Some previous exposure to optimisation theory and methods is helpful but not essential.*

Module Plan:

Part 1. Theory and applications of Linear and Integer Programming (Day 1 & 2)
- Basic concepts of linear and integer programming
- Formulation, solution and investigation of LP and IP models
- Embedding of models in information systems
- Prototyping business intelligence and DSS solutions

Part 2. Optimisation under uncertainty: Stochastic Programming & Robust Optimisation (Day 3 & 4)
- Implications of time and uncertainty in optimisation
- Representing uncertainty with discrete scenarios
- Formulation and solution of Stochastic Programming (SP) and Robust Optimisation (RO) models
- Solution of SP and RO models

Part 3. Risk and return analysis for Asset Allocation (Day 5)
- Markowitz mean-variance quadratic programming models, with real world descriptions such as buying thresholds and cardinality constraints
- Methods of computing the efficient frontier

Target Audience:

This workshop series is specially designed to provide insight into the discipline of optimisation for a wide range of individuals such as OR professionals, financial quantitative analysts, risk analysts, software developers, consultants and academics.

- OR professionals: This workshop series will help you to get up-to-date on the latest methodologies and receive exposure to the wide range of technologies and software now available in the field of optimisation.
- Quantitative analysts/Risk analysts: This workshop series gives you an overview of the wide range of technologies available, allowing you to define and conceptualise your business problems in terms of an optimisation problem.
- Software developers/IT: This workshop series provides instructions on how to embed optimisation models into software applications. It will also give you all the necessary information and techniques in order to understand optimisation modelling and data modelling integration.

Registration Fees:

1 day: £575 +VAT
2 days: £1025 +VAT
3 days: £1500 +VAT
4 days: £1750 +VAT
5 days: £1950 +VAT

Discounted rates for group bookings can also be arranged on request by contacting us on + 44 (0) 1895 819 488 or email info@optirisk-systems.com.

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Presenters:

Professor Gautam Mitra is an internationally renowned research scientist in the field of Operational Research in general and computational optimisation and modelling in particular. He has developed a world class research group in his area of specialisation with researchers from Europe, UK & USA. He has published five books and over a hundred and fifty research articles. He is an alumni of UCL and currently is a Visiting Professor of UCL. In 2004 he was awarded the title of 'Distinguished Professor' by Brunel University in recognition of his contributions in the domain of computational optimisation, risk analytics and modelling. Professor Mitra is a Director of OptiRisk Systems UK and OptiRisk India.

Dr. Christian Valente has a bachelor's degree, first class honours in Computer Science and subsequently an MSc in Artificial Intelligence from Politecnico di Milano, Italy (2004). He was a sponsored industry based PhD research student in Mathematical Sciences, at Brunel University. He joined OptiRisk Systems in 2005; the company, as the managing partner of the WEBOPT project (CRAFT programme of EU), sponsored his PhD research. Dr Valente's PhD research was on the topics of Stochastic Programming and parallel computing. Dr Valente leads the design team for AMPL IDE and Stochastic AMPL (SAMPL). These flagship products have been developed under contract from AMPL Optimization Inc. who are also a Partner of OptiRisk Systems. Dr Valente has designed and developed many optimisation based decision support systems and substantial industrial risk protection systems and acts as the main technological advisor for external projects. Dr Valente is fluent in Italian (his native language) and English and is also proficient in German.

Dr. Christina Erlwein-Sayer is a visiting researcher working on the topic of financial analytics in general and models and tools for portfolio construction and Asset and Liability Management in particular. Dr Erlwein-Sayer is sponsored under a joint project between OptiRisk Systems and its partner Fraunhofer ITWM in Kaiserslautern, Germany. She completed her PhD in Mathematics at Brunel University, London in 2008. Prior to the current assignment Dr Erlwein-Sayer had presented workshops on behalf of OptiRisk at the IIM Calcutta Financial Research and Trading Laboratory in Kolkata, and also in Mumbai. Dr Erlwein-Sayer was also the lead member of the training partnership between OptiRisk Systems and Fraunhofer ITWM and presented at many of the workshops; notable of these was the training delivered to the World Bank in Washington. Dr Erlwein-Sayer is fluent in German (her native language) and in English.

Dr Cristiano Arbex-Valle has a bachelor's degree in Computer Science and an MSc in Operations Research from Universidade Federal de Minas Gerais (UFMG), Belo Horizonte, Brazil. In 2011 Dr Valle joined OptiRisk as a software engineer and a researcher. In the year 2014 Dr Valle obtained his PhD in the department of Mathematical Sciences at Brunel University (UK) on the topic of optimisation techniques and financial modelling. In OptiRisk, Dr Valle contributes in two areas: (i) development and enhancement of FortSP which is acknowledged as the best of breed (Integer) Stochastic Programming solver. He is also (ii) in charge of developing financial analytics products [a] SAToolkit and [b] SSD Signals. SAToolkit captures the research results acquired by OptiRisk in the domain of Sentiment Analysis and SSD Signals is based on the company's research in the domain of Stochastic Dominance. Dr Valle is fluent in Portuguese (his native language) as well as in English; he also has advanced knowledge in Spanish and French.

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DAY 1—Part 1: Theory and Applications of Linear & Integer Programming

TIME	TOPIC
9.00	**REGISTRATION AND COFFEE**
9.30	• **Introduction and Overview** • **Introduction to LP Terminology, model representation and mathematical models** • **An Introduction to Modelling via AMPLDev** Participants will learn how to use various functionalities of AMPL Studio • **An Introduction to AMPL Syntax** A formal presentation of basic AMPL modelling constructs • **Efficient/Structured Modelling** A process to create an efficient model starting from the problem that is presented. [Example taken from portfolio construction.] • **Goal programming/Elastic Constraints** Presentation of an introductory financial model that includes goal programming
13.15	**LUNCH**
14.15	• **Using EXCEL as data source for AMPL** How to connect an AMPL model to Excel • **Financial Models workshop** Participants investigate, formulate and solve an introductory financial model using AMPL • **Hands-on models partial description: bond stripping, portfolio construction and ALM** Description of the models to be used for the hands on session and hints for the implementation • **Hands-On Session** The attendees should form groups and implement one of the models presented in the previous session
17.30	**END**

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DAY 2—Part 1: Theory and Applications of Linear & Integer Programming

TIME	TOPIC
9.00	**REGISTRATION AND COFFEE**
9.30	• **Mixed Integer Programming Problems** Integer problems involving binary variables, semi-continuous variables and special ordered set variables are introduced. A few discrete programming problems are explained. • **Case Study: IP with buying threshold** An IP model illustrated for portfolios with cardinality constraints • **An Introduction to AMPL Scripting Functionalities** Introduction to AMPL's powerful scripting functionalities • **Continuation of Hands-On Session** The groups should continue the implementation of the chosen models and prepare brief presentations of their results
13.00	**LUNCH**
14.00	• **Introducing AMPL API** How to embed optimisation models in applications • **Part I: Heuristic for solving Integer Programs using AMPL Script** Different kind of heuristics to speed up solution of problems are proposed here and prototyped using AMPL scripting functionalities • **Part II: AMPL API Implementation of AMPL script procedures** Examples of integration of models and scripts into applications • **Attendees' presentations and feedback** The groups have ten minutes each to present the model they implemented and their results.
17.00	**END**

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DAY 3—Part 2: Optimisation under Uncertainty: Stochastic Programming and Robust Optimisation

TIME	TOPIC
9.00	REGISTRATION AND COFFEE
9.30	• **Stochastic Programming and Scenario Generation: A modelling perspective** The role of scenario generation in SP is illustrated • **Scenario Generation: Overview and Desirable Properties** • **Hands-on: formulation of SP models in AMPL and SAMPL** An extended statement of the earlier ALM model
12.30	LUNCH
13.30	• **Hands-on** Creation of a prototype ALM application by connecting market data, formulated model, scenario generation and results presentation • **Investigation and Simulation: Two-stage SP, ICCP and Robust Optimisation** • **Formulation of SP models in SAMPL** Various SP models will be described and attendees will be helped in their implementation in SAMPL
17.00	END

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DAY 4—Part 2: Optimisation under Uncertainty: Stochastic Programming and Robust Optimisation

TIME	TOPIC
9.00	REGISTRATION AND COFFEE
9.30	• **Stochastic Programming: optimum decision making under uncertainty—an overview** A theoretical background to decision making under uncertainty will be given, with a particular focus on stochastic programming • **Stochastic Programming and Risk Measures** **Multiple Formulations of Multiple Asset and Liability Management (ALM) Problems as Alternative Stochastic Programming Models**
12.30	LUNCH
13.30	• **Hands-on: Expected Value, Wait and See and Deterministic Equivalent—an ALM model** Various models are described and attendees are helped with their implementation in AMPL • **Formulation in AMPL** AMPL extensions to represent Stochastic Programming and Robust Optimisation problems, and problems with (Integrated) Chance Constraints • **SAMPL Example: an ALM model** An ALM model will be refined by the introduction of uncertainty and expressed using AAMPL syntax • **Solution Methods for Stochastic Programming** • **Introduction to Robust Optimisation Models (Family)**
17.30	END

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DAY 5—Part 3: Risk and Return Analysis for Asset Allocation

TIME	TOPIC
9.00	REGISTRATION AND COFFEE
9.30	• Introduction and Overview • Formulation of Quadratic Programming problems and Mean Variance Efficient Frontier • Hands-on: Representation of Discrete Constraints in Portfolio Planning • Hands-on: Computation of Mean Variance Efficient Frontier • Mean Variance and CVAR: a multi-objective model
12.30	LUNCH
13.30	• Portfolio Construction using Stochastic Dominance and Reference Distribution • SP Models for Portfolio Construction with Trading Constraints • Stochastic Programming Models for ALM
17.00	END

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