

MSc Financial Analytics Modules

Asset Pricing

Overview

Course Content

The aims of this module are to:

- (i) provide students with the necessary theoretical and analytical tools which underpin the pricing of assets;
- (ii) familiarize students with the environment of a trading room

Areas to be covered include:

Financial markets

Overview of main markets; how firms and governments raise finance; financial instruments; trading securities.

Valuation

Valuing stocks.

Asset returns and portfolio theory

Measuring asset returns; theory of choice under uncertainty; mean-variance portfolio theory.

Asset-pricing models

Assessing the theoretical and empirical validity of various asset pricing models.

Equity markets

EMH; anomalies; behavioural finance

Learning Outcomes

Upon successful completion of this module, students will:

1. Be familiar with the various theories on individuals' investment decision making
2. apply techniques for formally assessing risk.
3. understand the methodologies employed in investigating asset pricing behaviour in the capital market
4. be able to critically evaluate the various asset pricing models in terms of both theory and empirical evidence

5. be able to critically appraise the EMH, anomalies and behavioural finance.
6. be familiar with the trading-room environment and the Bloomberg database.

Skills

This module provides opportunities for the student to acquire or enhance the following skills:-

- Subject-specific skills
 - o Use of computer-based packages to analyse and evaluate relevant data
 - o Ability to critically read and evaluate finance and risk-related academic literature
 - o Appreciation, construction and analysis of financial and economic models of practical risk situations

- Cognitive Skills
 - o Problem solving
 - o Logical reasoning
 - o Independent enquiry
 - o Critical evaluation and interpretation
 - o Self-assessment and reflection

- Transferable Skills
 - o The ability to synthesis information/data from a variety of sources
 - o Preparation and communication of ideas in both written and presentational forms
 - o Ability to work both independently and in groups
 - o Organisation and Time Management
 - o Use of IT

Data Driven Decision Making

Overview

The analysis of data is only useful if it contributes to improvements in business decision making. This module explores how businesses use data for making business decisions. This includes a focus on gaining business insights from the effective management and analysis of data, data visualisation and storytelling, and prescriptive analytics techniques. Students will have the opportunity to work with advanced visualisation and optimisation software such as tableau, excel, and R. The module will also consider the people side of analytics, placing analytical techniques for decision making in a business context, considering the managerial and organisational factors involved in becoming a data driven organisation.

Module content may include but is not limited to:

The role of analytics in decision making, at both operational and strategic levels

Data Visualisation: visualisation of a variety of types of data such as numeric, text, and geospatial data.

Prescriptive analytics and optimisation

The role of data driven decision making in organisations

Benefits, barriers, and limitations of data driven decision making

Ethical considerations in the use of data in decision making

Appreciation of the cultural differences in the use of data, and the potential for data to be used in wider national and international decision making (e.g. sustainable development, disaster planning, corporate social responsibility)

Learning Outcomes

Upon successful completion of the module students should be able to:

- Critically evaluate the use of data and analytics for decision making in organisations
- Design advanced data visualisations to solve complex business problems
- Design solutions to carry out prescriptive analytics tasks such as automated decision making and optimization
- Critically evaluate the legal and ethical considerations in the use of data for decision making.

Skills

This course provides opportunities for the students to enhance the following skills:

Identifying opportunities for data driven decision making in organisations, and the ability to execute such approaches to improve organisational decision making.

The ability to present complex data in a format that is comprehensible to a wide range of technical and non-technical audiences.

Critically reflect on the role of data in business decision making

The ability to use tools to develop advanced and effective data visualisations

The ability to use analytical techniques to develop prescriptive solutions to business problems.

Financial Data Analytics

Overview

The purpose of this course is to provide an introduction to econometric techniques used in finance. It contains a treatment of classical regression and an introduction to time series techniques. There will be an emphasis on applied work using econometric

packages.

The course is designed to give students both theoretical and practical experience of statistical and econometric techniques. A wide range of topics is typically covered including the basic regression model, which includes a discussion of the classical violations of this model and methods for their correction. Students will learn a computer statistical software package (R).

Learning Outcomes

Upon successful completion of this course students will have an understanding of:-

- the main issues relating to the appropriate econometric modelling of financial and economic time series;
- and have gained experience in the use of econometric software and be able to demonstrate their software skills in completing assignments;
- and be able to discuss, applied econometric research topics in finance;
- and have improved their data management, programming and research skills.

Skills

Subject-specific Skills

- The ability to construct arguments and exercise problem solving skills in finance
- The ability to use computer-based mathematical/statistical/econometric packages to analyse and evaluate relevant data
- The ability to read and evaluate finance and risk-related academic literature

Cognitive Skills

- Problem solving
- Logical reasoning
- Independent enquiry
- Critical evaluation and interpretation
- Self-assessment and reflection

Transferable Skills

- The ability to synthesise information/data from a variety of sources
- The preparation and communication of ideas in finance, information economics and risk management
- Organisation and time management
- Problem solving and critical analysis
- Work-based skills; use of IT, including word-processing, email, internet and statistical/econometric/risk management packages
- The ability to communicate quantitative and qualitative information together with analysis, argument and commentary

Data Mining

Overview

This module focuses on the application of data mining using python. The module will begin with core coding and data mining tasks in python, before focusing in on mining unstructured data. Much of the data produced today is unstructured, such as social media posts, textual documents, images and video. Mining this unstructured data provides businesses with the opportunity to gain substantial benefits through the development of new and improved products and processes and improved decision making. Extracting value from unstructured data requires additional tools and techniques, compared with those required to analyse smaller structured datasets. This module covers the key analytics tools and techniques needed to gain value from unstructured data. The module will cover the variety of sources and uses of unstructured data, with a particular focus on the practical analysis of textual data. The module will be delivered using the python programming language, which is one of the most popular coding languages in analytics. It therefore also serves to introduce students to this important coding language, complementing the R coding skills developed on other modules.

Course content may include, but is not limited to:

Python Coding

Applications of unstructured data analytics

Sources of unstructured data

Processing, exploring and visualising textual data

Supervised and unsupervised learning with unstructured data

Ethical considerations in the use of unstructured data

Learning Outcomes

Upon successful completion of the module students should be able to:

- Critically evaluate the role of data mining and unstructured data in organisations
- Develop and communicate data mining solutions using python
- Develop and communicate machine learning solutions using unstructured data

Skills

This course provides opportunities for the students to enhance the following skills:

Python coding skills

Exploration and visualisation of unstructured data

Supervised learning with unstructured data

Unsupervised learning with unstructured data

Advanced Financial Data Analytics

Overview

The aims of this module are to:

Deepen participants' understanding of financial predictions and decision-making by exploring the revolutionary impact of combining econometrics and machine learning in financial analytics.

Integrate machine learning and classical financial time series econometrics to tackle complex financial problems characterised by uncertainty and conflicting objectives.

Explore the role of machine learning in processing large datasets and accurately modelling the complexities of financial markets.

Advocate for adopting a growth mindset for learning advanced financial data analytics, emphasising embracing challenges, persisting through setbacks, leveraging criticism, and finding lessons in others' success.

Equip participants with the necessary insights and tools to navigate the sophisticated realm of financial analytics, encouraging a lifelong commitment to learning and development in the field.

Learning Outcomes

Upon successful completion of this module students will be able to:

1. Extract meaning from noisy financial data
2. Critique stylised facts of financial data for economic inference
3. Evaluate the output of statistical tests

Skills

This module provides opportunities for the student to acquire or enhance the following skills:

1. Problem solving – innovative ability to implement statistical tests
2. Logical reasoning – analysing data
3. Digital Proficiency – ability to write code
4. Abstraction – developing generic re-usable solutions
5. Critical Thinking – applying and interpreting statistics

Financial Modelling in Python

Overview

The aims of this module are to:

- i. develop the students' computational skills
- ii. introduce a range of numerical techniques of importance in finance
- iii. familiarise students with financial models and how to implement them

Areas to be covered include:

A primer on financial instrument pricing

- o Bonds, forwards, options
- o Discounting
- o Probability distributions
- o Expectation theory

Python

- o Arrays and data structures
- o Programming constructs
- o Functions and classes

Numerical Methods

- o Root finding
- o Linear Algebra

Financial Modelling

- o Stochastic processes
- o Interest rate models

Option Pricing

- o Black Scholes Merton
- o The Greeks
- o Lattice Models
- o Model extensions

Monte Carlo

- o Monte Carlo simulation
- o Variance reduction
- o Markov Chains

Credit Risk

- o Merton Model

Learning Outcomes

Upon successful completion of this module, students will:

1. Describe and discuss the modelling frameworks used to value financial instruments.
2. Understand the salient features of prominent derivatives contracts.

3. Translate financial problems into mathematical models with appropriate numerical solutions
4. Have experience using Python to implement financial models
5. Critically evaluate the efficacy of different approaches to derivative pricing

Skills

This module provides opportunities for the student to acquire or enhance the following skills:

- Subject-specific skills
 - o The ability to appreciate, construct and analyse mathematical, statistical, and financial models
 - o Use of coding languages to implement financial models.
- Cognitive Skills
 - o Problem solving
 - o Abstraction
 - o Logical reasoning
 - o Critical evaluation and interpretation
 - o Self-assessment and reflection
- Transferable Skills
 - o Organisation and time management
 - o Use computational technology

AI & Trading

Overview

This course will introduce the modern practices in finance of using algorithms to extract computer-age statistical inference. The purpose of this course is not to introduce students to the vast array of machine learning algorithms. Instead, the goal is to introduce the emerging field of Financial Machine Learning as a complement to traditional financial research techniques.

This course presents machine learning as a non-linear extension of various topics in quantitative economics, such as financial econometrics. This course will introduce best practice techniques in financial data science, which can help illicit economically meaningful signals and answer recent financial research questions.

Learning Outcomes

On successful completion of the course, students will be able to:

1. Evaluate fundamental financial machine learning principles

2. Synthesize theory to build investment strategies
3. Formulate code to solve problems encountered in finance

Skills

This module provides opportunities for the student to acquire or enhance the following skills:

1. Problem solving – innovative ability to design and develop algorithms
2. Logical reasoning – developing code to implement solutions
3. Digital Proficiency – ability to write code
4. Practice Ready – building empirical investment strategies
5. Critical Thinking – understanding how to create robust test plans

Derivatives

Overview

The aim of this course is to develop in students a theoretical and practical knowledge of derivative instruments.

This module provides participants with an exhaustive coverage of widely used derivative products stressing pricing and uses for financial engineering and risk management. The module provides an overview of derivative instruments, markets, participants and uses. It focuses on the pricing and uses of futures, forwards and options. The cost of carry relationship, the binomial approach, the Black-Scholes model and its variants are detailed to equip participants with the basic tools for pricing derivatives. The module examines practical uses of derivative securities as risk management tools for corporations and financial institutions.

Areas to be covered include:

THE MOVEMENT OF FUTURES PRICES: some basic facts. CTAs, managed futures, hedge funds. Financialization of Commodity Markets. Time series momentum.

MEAN VARIANCE APPROACHES TO HEDGE RATIO DETERMINATION, STOCK INDEX FUTURES AND HEDGING EFFECTIVENESS: The mean-variance approach to hedge ratio construction. Hedging with stock index futures. Hedging effectiveness and hedge ratio estimation - OLS, ECM and GARCH procedures. Duration and Expiration effects.

THE STOCHASTIC PROCESS OF ASSET PRICES AND THE DERIVATION OF THE BLACK-SCHOLES MODEL: The Wiener process and rare events in financial markets; Ito processes; Ito's lemma; generalised Ito's lemma; Black-Scholes differential equation; Black-Scholes pricing formula; options on stocks paying known dividends; pseudo-

American model; option on stock indices, currency options and options on futures;

VOLATILITY: Estimating volatility: historical; implied - application of Newton-Raphson. Empirical characteristics of volatility: smiles; term structure skew; mean reversion; Forecasting volatility: application of GARCH; empirical evidence of volatility forecasts - implied versus historical; Bisection.

EXOTIC OPTIONS: Types of exotic options - barrier options; lookback options; strike options; binary or digital options; compound options; and chooser options.

INTEREST RATE DERIVATIVES: The standard market models; models of short rate; HJM and LMM models.

RISK AND REGULATION WITH EMPHASIS ON VALUE AT RISK: Regulation of Financial Institutions; value at risk and forecast accuracy; capital adequacy and value at risk; value at risk and the variance covariance approach; value at risk and non-parametric methods such as historical simulation and bootstrapping; value at risk and linear and non-linear positions.

CREDIT RISK AND CREDIT DERIVATIVES: Default probabilities; Recovery rates; Default correlation; Credit default swaps; Asset-backed securities.

REAL OPTIONS: The option to expand, contract, default, abandon and switch. The valuation of real options in the face of compoundness, interaction between options and ownership. Real options and the valuation of internet companies.

Learning Outcomes

Upon successful completion of this module, students will have an understanding of:-

1. understand the mechanisms of futures and forward market
2. price futures and forward instruments
3. understand the mechanisms of options markets
4. understand concepts of stochastic processes and its application in financial modelling
5. understand and derive binomial tree model
6. understand and derive Black-Scholes-Merton model
7. estimate historical and implied volatility
8. construct hedges using futures and options

Skills

This module provides opportunities for the student to acquire or enhance the following skills:

Subject-specific Skills

- The ability to construct arguments and exercise problem solving skills in the context of theories of finance and risk management
- The ability to use computer-based mathematical / statistical / econometric packages to analyse and evaluate relevant data
- The ability to read and evaluate finance and risk-related academic literature
- The ability to appreciate, construct and analyse mathematical, statistical, financial and economic models of practical risk situations
- The ability to connect business problems with risk management
- The ability to marry regulatory structure with the principles of risk sharing and risk mitigation

Cognitive Skills

- Problem solving
- Logical reasoning
- Independent enquiry
- Critical evaluation and interpretation
- Self assessment and reflection

Transferable Skills

- The ability to synthesise information/data from a variety of sources including from databases, books, journal articles and the internet
- The preparation and communication of ideas in finance, information economics and risk management in both written and presentational forms
- The ability to work both independently and in groups
- Organisation and time management
- Problem solving and critical analysis
- Work-based skills; use of IT, including word-processing, email, internet and statistical/econometric/risk management packages
- The ability to communicate quantitative and qualitative information together with analysis, argument and commentary in a form appropriate to different intended audiences

Applied Research Project

Overview

The applied research project provides students with the opportunity to utilise the knowledge and skills acquired over the previous two semesters to plan, develop and produce a substantial piece of original, independent applied research.

Lectures and computer-based workshops will cover the following areas:

1. Research Methodology
2. Fundamental analysis and strategy analysis
3. Data Management, Analysis, Visualisation and Inference
4. Financial analysis [ratios/cash flows], forecasting profit & EPS.
5. Valuation 1: DDM and DCF approach
6. Valuation 2: EVA and Price- multiples
7. Critical assessment of model adequacy
8. Presenting Information and Data

Learning Outcomes

Upon successful completion of this project, students will:

1. Demonstrate an ability to design and manage a piece of individual research.
2. Apply knowledge and skills developed in previous modules to contemporary issues in financial markets.
3. Establish links between financial theory and financial practice.
4. Exhibit intellectual discipline in identifying and critique the appropriate information.
5. Identify appropriate econometric methods for critically analysing a contemporary issue in finance.
6. Critically evaluate the appropriateness of modelling assumptions.
7. Present their thinking in a professional industry-style research paper.

Skills

This applied research project provides opportunities for the student to acquire or enhance the following skills:

• Subject-specific skills

- Use of computer-based packages to analyse and evaluate relevant data
- Ability to critically read and evaluate finance and risk-related academic literature
- Appreciation, construction and analysis of financial and economic models of practical risk situations

• Cognitive Skills

- Problem solving
- Logical reasoning
- Independent enquiry
- Critical evaluation and interpretation
- Self-assessment and reflection
- Intellectual humility
- Intellectual discipline

• Transferable Skills

- The ability to synthesis information/data from a variety of sources
- Preparation and communication of ideas in both written and presentational forms
- Ability to work both independently
- Organisation and Time Management
- Use of IT

Dissertation - MSc Financial Analytics

Overview

The aim of the dissertation is to provide students with the skills needed for the advanced analysis of relevant datasets, to allow them to demonstrate an understanding of the relevant literature and to derive and test hypotheses and to draw appropriate conclusions.

Learning Outcomes

On completion of the dissertation students will have an understanding of:

- how to conduct a review of the current and relevant literature of the subject area chosen for the research study;
- how to derive hypotheses or formulate research questions;
- how to use data extracted from datasets or interviews to test hypotheses or answer research questions;
- how to draw conclusions and identify the limitations of the study and scope for further research.

Skills

This module provides opportunities for the student to acquire or enhance the following skills:-

- Communication
- Effective and independent learning
- Specific research skills relevant to the chosen research topic
- Data analysis skills relevant to the chosen research topic
- Quantitative Finance and econometric skills