# 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 criticially 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 Criticial 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

# Financial Market Structure

**Overview**

The aim of this module is to ensure that students understand the structure, dynamics and trading mechanisms of global financial markets, as well as appreciate the role of key institutions involved in these markets.

Areas to be covered:

1. Firstly, we analyse the role, structure and economic principles of the key players participating in financial markets.

2. Secondly, we examine the function and characteristics of two key markets: fixed income and foreign exchange.

3. Thirdly, we will analyse the trading mechanics of financial markets, and in doing so, we will examine the development and organisation of major exchanges.

**Learning Outcomes**

Upon successful completion of this module, students will have an understanding of:-
1. The structure and strategy of key participants in financial markets
2. The trading structures of financial markets
3. Development and organisation of major exchanges
4. How market structure will be reflected in pricing of securities, trading behaviour, trading mechanisms and market design
5. The role of information in financial markets and how it is processed in practice

**Skills**

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

• Subject-specific skills
o Ability to critically read and evaluate the academic microstructure literature
o Appreciation, construction and analysis of trading strategies

• 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 The ability to present and communicate complex ideas to a non-specialist audience
o Ability to work in groups
o Organisation and Time Management


## 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 Management

### Overview

The effective management of small and big data is a crucial component of all business analytics projects.
This module explores the theory and practice of managing data, including identifying and extracting data, data pre processing, data quality, data warehousing, relational databases, and big data solutions.

Course content may include, but is not limited to:
Structured and unstructured data
Data acquisition
Data extraction using SQL
Data storage (relational database management systems)
Big data solutions
Data preparation
Data quality
Security, legislation and ethical considerations

### Learning Outcomes

Upon successful completion of the module students should be able to:
• Evaluate the usefulness of a range of data sources and types in business decision making
• Design a data management solution
• Critically evaluate the main security, legal, and ethical considerations in the management of information

### Skills

This course provides opportunities for the students to enhance the following skills:
Database design
Data extraction and wrangling
Data storage
Data management, including SQL and other big data technologies

# 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

# Advanced Analytics & Machine Learning

## Overview

Machine learning is the core technology underpinning predictive analytics and artificial intelligence, as well as many other analytical tasks.

This module will build on the skills developed in the statistics module in terms of both programming and more advanced statistical techniques, namely the application of machine learning algorithms.

Topics may include but are not limited to:
• The analytics process

- Analytics tools
- Feature selection
- Supervised learning
- Unsupervised learning
- Evaluating model performance
- Programming machine learning models
- Evaluation of the ethical implications of the use of algorithms e.g. the potential for reinforcing bias, security and privacy.

**Learning Outcomes**

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

- Critically evaluate a range of analytics tools and algorithms
- Understand and apply key programming concepts as they pertain to machine learning
- Design a predictive analytics solution

**Skills**

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

- Application of advanced algorithms for business decision making
- Programming skills
- Problem solving

# **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