

MSc in Mathematics and Finance

This document provides a definitive record of the main features of the programme and the learning outcomes that a typical student may reasonably be expected to achieve and demonstrate if s/he takes full advantage of the learning opportunities provided. This programme specification is primarily intended as a reference point for academic and support staff involved in delivering the programme and enabling student development and achievement, for its assessment by internal and external examiners, and in subsequent monitoring and review.

| Programme Information | | | | | |
|--|---------|---|----|-------|-----|
| Programme Title | | MSc in Mathematics and Finance | | | |
| Award(s) | | MSc | | | |
| Programme Code(s) | | G1U4 (1YFT) G1U424 (2YPT) | | | |
| Awarding Institution | | Imperial College London | | | |
| Teaching Institution | | Imperial College London | | | |
| Faculty | | Natural Sciences | | | |
| Department | | Mathematics | | | |
| Associateship | | N/A | | | |
| Main Location of Study | | South Kensington Campus - Huxley Building | | | |
| Mode and Period of Study | | Full Time: 1 calendar year (12 months) Part Time: 2 calendar years (24 months) | | | |
| Cohort Entry Points | | Annually in October | | | |
| Relevant QAA Benchmark Statement(s) and/or other external reference points | | Mathematics, Statistics and Operational Research | | | |
| Total Credits | PG Cert | ECTS: | | CATS: | |
| | PG Dip | | | | |
| | MSc | | 90 | | 180 |
| FHEQ Level | | Level 7 - Master's | | | |
| EHEA Level | | 2 nd cycle | | | |
| External Accreditor(s) | | N/A | | | |

Specification Details

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|--|---------------------|
| Student cohorts covered by specification | 2021-22 entry |
| Person Responsible for the specification | Dr Antoine Jacquier |
| Date of introduction of programme | September 2000 |
| Date of programme specification/revision | August 2021 |

Programme Overview

The MSc in Mathematics and Finance is a one-year programme focussed on a rigorous treatment and understanding of the mechanics of financial markets as well as the mathematical, statistical and programming tools required to pursue a career in this field. More specifically, the goals of the MSc in Mathematics and Finance are:

- To provide a high-quality education in Mathematics with a view towards application in Finance.
- To expose students, parallel to their assessed modules, to an active research environment, both within the College and through regular meetings with the industry.
- To teach students all the fundamental tools to pursue a strong career in quantitative finance, both through core modules and through a wide spectrum of elective modules that reflect the diversity of the financial industry.
- To equip students with a range of mathematical skills and data-related tools in problem-solving, project work and presentation – to enable them to take prominent roles in many sides of research and employment in investment banking and related areas.

Learning Outcomes

On successful completion of this programme students will have:

- A.** acquired a vast knowledge of the finance industry and the required quantitative tools;
- B.** developed their intellectual skills, both theoretically and to solve practical problems;
- C.** enhanced their practical skills, essential for a prominent career in the financial industry;
- D.** gained transferable skills, allowing them to take on important roles and become flexible in their careers.

A. Knowledge.

Throughout the programme, students will be able to:

1. Demonstrate greater understanding and application of a wide array of topics, from basic tools to current developments at the frontiers of quantitative finance.
2. Conduct research on a topic agreed with a supervisor, carry out extended investigative mathematical work as an individual project and write an original account thereof.
3. Develop, apply (and critically evaluate) numerical techniques used in the financial industry.

B. Intellectual Skills

Students will be able to:

1. Assimilate and understand a large body of complex concepts and their inter-relationships.
2. Demonstrate understanding of the role of logical mathematical argument and deductive reasoning, together with formal processes of mathematical proof.

3. Use a structured mathematical approach in problem solving, appreciating the importance of assumptions made and consequences of their violation.
4. Use Mathematics to describe and model financial contracts, including appropriate solution methods, and interpretation of the results.

C. Practical Skills

Through the different modules, and the regular meeting with the industry, students will be able to:

1. Program in C++, Python as R, the most important programming languages in finance.
2. Investigate, analyse and be critical about data to argue and present in a project.
3. Develop a professional understanding of relationships and behave as such in a working environment.

D. Transferable Skills

Apart from the purely technical aspects of the programme, students will be able to:

1. Solve open-ended problems and problems with well-defined solutions by formulating them in precise terms, identifying key issues and trying different approaches to make progress.
2. Carry out an independent critical investigation of practical problems using textbooks, research literature, and online information and databases.
3. Communicate effectively by listening carefully and presenting complex information in a clear and concise manner orally, in writing and using new technologies.
4. Use analytical skills, paying attention to detail and using technical language correctly.
5. Work independently, use their initiative, organise themselves to meet deadlines, plan and execute an extended project.
6. Work and interact constructively with others.

The Imperial Graduate Attributes are a set of core competencies which we expect students to achieve through completion of any Imperial College degree programme. The Graduate Attributes are available at: www.imperial.ac.uk/students/academic-support/graduate-attributes

Entry Requirements

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|------------------------------|--|
| Academic Requirement | <p>This minimum requirement is normally a 2:1 Bachelor's degree with Honours in Mathematics or a First Class Honours degree in Physics Sciences with strong mathematical content, i.e. with a majority of Mathematics modules and an emphasis on Analysis, Probability, Statistics and Differential Equations.</p> <p>Degrees in Accounting, Economics, Finance, Business or Management with very little Mathematics content will not meet our entry requirements.</p> |
| Non-academic Requirements | None |
| English Language Requirement | <p>Higher requirement IELTS score of 7.0 overall (minimum 6.5 in all elements).</p> |

The programme's competency standards documents can be found at:

www.imperial.ac.uk/media/imperial-college/faculty-of-natural-sciences/department-of-mathematics/public/study/admissions/pg/msc/DASILVA.pdf

| Learning & Teaching Strategy | |
|--|---|
| Scheduled Learning & Teaching Methods | <ul style="list-style-type: none"> • Tutorials • Lectures • Problem sheets • Office hours |
| E-learning & Blended Learning Methods | <ul style="list-style-type: none"> • Online Programming activities (through Jupyter notebooks) • Online trading competitions (optional) |
| Project Learning Methods | <ul style="list-style-type: none"> • From June to September, students work on their MSc theses, either through an internship (external placement) or internally |
| Placement Learning Methods | <ul style="list-style-type: none"> • Dissertation / oral assessment |
| Assessment Strategy | |
| Assessment Methods | <ul style="list-style-type: none"> • Assessment of the modules is by unseen written examination and/or coursework • There is a compulsory major research project. Projects are assessed through production of a dissertation and oral presentation. |
| Academic Feedback Policy | |
| <p>Assessed coursework done as part of a module are marked within weeks and returned to the student with comments.</p> <p>Students are encouraged to discuss any difficulties with the module lecturer, and mid-term feedback is provided for every module so that any issue can be sorted out before the end of the module. Every lecturer is available through office hours and/or email discussions.</p> <p>Meetings with MSc representatives are organised in November and February, and feedback is always taken into account seriously.</p> <p>Every student has an internal mentor, among staff, whom they meet twice a term to discuss their progress, the choice of electives, their placements and theses.</p> <p>We further have an end-of-year survey asking for feedback regarding both the course contents and the Thesis project and placement.</p> | |
| Re-sit Policy | |
| <p>The College's Policy on Re-sits is available at: http://www.imperial.ac.uk/student-records-and-data/for-current-students/undergraduate-and-taught-postgraduate/exams-assessments-and-regulations/</p> | |

Mitigating Circumstances Policy

The College's Policy on Mitigating Circumstances is available at: <http://www.imperial.ac.uk/student-records-and-data/for-current-students/undergraduate-and-taught-postgraduate/exams-assessments-and-regulations/>

| Programme Structure | | | | | |
|--|-------------|----------------------|-----------------------|-------------|-----------|
| Full-time | Pre-session | Term One | Term Two | Term Three | Term Four |
| Core Modules | 0 | 4 | 3 | 0 | 0 |
| Elective Modules (5 required) | 0 | 3 (2 recommended) | 12 (3 recommended) | 0 | 0 |
| Project | 0 | 0 | 0 | 1 | 1 |
| Part-time (Year One) | Pre-session | Term One | Term Two | Term Three | Term Four |
| Core Modules | 0 | 2 | 2 | 0 | 0 |
| Elective Modules (Total of 5 is required over 2 years) | 0 | 1 | 5 | 0 | 0 |
| Projects | 0 | 0 | 0 | 0 | 0 |
| Part-time (Year Two) | Pre-session | Term One | Term Two | Term Three | Term Four |
| Core Modules | 0 | 2 | 1 | 0 | 0 |
| Elective Modules | 0 | 1 | 6 | 0 | 0 |
| Projects | 0 | 0 | 0 | 1 | 1 |
| Assessment Dates & Deadlines | | | | | |
| Written Examinations | | January, Summer | | | |
| Coursework Assessments | | Continuous | | | |
| Project Deadlines | | Mid-September | | | |
| Practical Assessments | | None | | | |
| Assessment Structure | | | | | |
| Programme Component | | | ECTS | % Weighting | |
| 7 Core modules | | | 52.50 | 58% | |

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|--------------------|-------|------|
| 5 Elective modules | 25 | 28% |
| Research Project | 12.50 | 14% |
| Total | 90 | 100% |

Marking Scheme

To pass the taught component of the program, a student must:

- Achieve a passing mark of 50% on at least 10 modules, and;
- Achieve an overall average mark greater than or equal to 50%.

Project theses are marked out of 100; the pass mark is 50%.

To be awarded the MSc degree, a student must pass both the Taught component and the Research component of the programme listed above.

To be awarded the **MSc with Merit** a student must:

- Pass all taught modules offered as described above, at the first attempt;
- Achieve an overall average of 60% or more in the taught component;
- Achieve a mark of 60% or more for the project thesis;
- Discretion will be given to award a merit to a candidate who obtains a mark between 40 - 49 in one module but obtains an average of 60 or above in the taught component and project.

To be awarded the **MSc with Distinction** a student must:

- Pass all taught modules offered as described above, at the first attempt;
- Achieve an overall average of 70% or more in the taught component;
- Achieve a mark of 70% or more for the project thesis;
- Discretion will be given to award a merit to a candidate who obtains a mark between 45 - 49 in one module but obtains an average of 70 or above in the taught component and project.

Candidates should only be considered for promotion to pass, merit or distinction if their aggregate mark is within 2.5% of the relevant borderline. Nevertheless, candidates whom the Board deems to have exceptional circumstances may be considered for promotion even if their aggregate mark is more than 2.5% from the borderline. In such cases the necessary extra marks should be credited to bring the candidate's aggregate mark into the higher range.

| Indicative MSc Module List |
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| Introduction to Option pricing |
| Stochastic Processes |
| Quantitative Risk Management |
| Statistical Methods in Finance |
| Computing in C++ |
| Interest Rate Models with Credit Risk, Collateral, Funding Liquidity Risk and Multiple Curves |
| Simulation Methods for Finance |
| Algorithmic Trading and Machine Learning |
| Advances in Machine Learning |
| Convex Optimisation |
| Stochastic Calculus for Finance |
| Advanced Topics in Data Science: Rough Path in Machine Learning |
| Market Microstructure |
| Deep Learning |
| Topics in Derivatives Pricing |
| Stochastic Control in Finance |
| Portfolio Management |
| Algorithmic and High-Frequency Trading |
| Selected Topics in Quantitative Finance |
| Numerical Methods in Finance |
| Python for Finance |
| Data Science for Fintech Regtech and Suptech: Methodological Foundations and Key Applications |
| Quantum Computing in Finance |
| Summer Research Project |

| Indicative Module List | | | | | | | | | | | | |
|------------------------|--|-------------------|------|--------------|------------------------|-------------------------|----------------|----------------------|----------------------|----------------|---------------|------|
| Code | Title | Core/ Elective | Year | L&T Hours | Ind. Study Hours | Place- ment Hours | Total Hours | % Written Exam | % Course- work | % Practical | FHEQ Level | ECTS |
| MATH97236 | Introduction to Option pricing | Core | | 40 | 150 | | 190 | 80% | 20% | 0% | 7 | 7.5 |
| MATH97113 | Stochastic Processes | Core | | 40 | 150 | | 190 | 100% | 0% | 0% | 7 | 7.5 |
| MATH97108 | Quantitative Risk Management | Core | | 40 | 150 | | 190 | 70% | 30% | 0% | 7 | 7.5 |
| MATH97115 | Statistical Methods in Finance | Core | | 40 | 150 | | 190 | 85% | 15% | 0% | 7 | 7.5 |
| MATH97112 | Computing in C++ | Core | | 40 | 150 | | 190 | 75% | 25% | 0% | 7 | 7.5 |
| MATH97114 | Interest Rate Models | Core | | 40 | 150 | | 190 | 100% | 0% | 0% | 7 | 7.5 |
| MATH97116 | Simulation Methods for Finance | Core | | 40 | 150 | | 190 | 80% | 20% | 0% | 7 | 7.5 |
| MATH97109 | Algorithmic Trading and Machine Learning | Elective | | 15 | 110 | | 125 | 100% | 0% | 0% | 7 | 5.00 |
| MATH97119 | Advances in Machine Learning | Elective | | 15 | 110 | | 125 | 75% | 25% | 0% | 7 | 5.00 |
| MATH97117 | Convex Optimisation | Elective | | 15 | 110 | | 125 | 85% | 15% | 0% | 7 | 5.00 |
| MATH97228 | Stochastic Calculus for Finance | Elective | | 15 | 110 | | 125 | 90% | 10% | 0% | 7 | 5.00 |
| MATH97229 | Advanced Topics in Data Science: Signatures and Rough Path in Machine Learning | Elective | | 15 | 110 | | 125 | 50% | 50% | 0% | 7 | 5.00 |
| MATH97230 | Market Microstructure | Elective | | 15 | 110 | | 125 | 10% | 90% | 0% | 7 | 5.00 |
| MATH97231 | Deep Learning | Elective | | 15 | 110 | | 125 | 90% | 10% | 0% | 7 | 5.00 |

| Indicative Module List | | | | | | | | | | | | |
|------------------------|---|-------------------|------|--------------|------------------------|-------------------------|----------------|----------------------|----------------------|----------------|---------------|-------|
| Code | Title | Core/ Elective | Year | L&T Hours | Ind. Study Hours | Place- ment Hours | Total Hours | % Written Exam | % Course- work | % Practical | FHEQ Level | ECTS |
| MATH97120 | Topics in Derivatives Pricing | Elective | | 15 | 110 | | 125 | 70% | 30% | 0% | 7 | 5.00 |
| MATH97232 | Stochastic Control in Finance | Elective | | 15 | 110 | | 125 | 85% | 15% | 0% | 7 | 5.00 |
| MATH97235 | Portfolio Management | Elective | | 15 | 110 | | 125 | 70% | 30% | 0% | 7 | 5.00 |
| MATH97233 | Algorithmic and High-Frequency Trading | Elective | | 15 | 110 | | 125 | 85% | 15% | 0% | 7 | 5.00 |
| MATH97234 | Selected Topics in Quantitative Finance | Elective | | 15 | 110 | | 125 | 0% | 100% | 0% | 7 | 5.00 |
| MATH97110 | Numerical Methods in Finance | Elective | | 15 | 110 | | 125 | 70% | 30% | 0% | 7 | 5.00 |
| MATH97308 | Python for Finance | Core | | 20 | 110 | | 125 | 0% | 100% | 0% | 7 | 0.00 |
| MATH97406 | Data Science for Fintech Regtech and Suptech: Methodological Foundations and Key Applications | Elective | | 15 | 110 | | 125 | 0% | 100% | 0% | 7 | 5.00 |
| MATH97407 | Quantum Computing in Finance | Elective | | 15 | 110 | | 125 | 0% | 100% | 0% | 7 | 5.00 |
| MATH97003 | Summer Research Project | Core | | | | 400 | 400 | 100% | 0% | 0% | 7 | 12.50 |

| Supporting Information |
|---|
| The Programme Handbook is available at: Insert link |
| The Module Handbook is available at: Insert link |
| The College's entry requirements for postgraduate programmes can be found at: www.imperial.ac.uk/study/pg/apply/requirements |
| The College's Quality & Enhancement Framework is available at: www.imperial.ac.uk/registry/proceduresandregulations/qualityassurance |
| The College's Academic and Examination Regulations can be found at: www.imperial.ac.uk/about/governance/academic-governance/regulations |
| Imperial College is an independent corporation whose legal status derives from a Royal Charter granted under Letters Patent in 1907. In 2007 a Supplemental Charter and Statutes was granted by HM Queen Elizabeth II. This Supplemental Charter, which came into force on the date of the College's Centenary, 8th July 2007, established the College as a University with the name and style of "The Imperial College of Science, Technology and Medicine". www.imperial.ac.uk/admin-services/secretariat/college-governance/charters/ |
| Imperial College London is regulated by the Office for Students (OfS) www.officeforstudents.org.uk/ |

| Modifications | | | |
|------------------------------|----------------------|---------------|-----------------|
| Description | Approved | Date | Paper Reference |
| Revised programme structure. | Programmes Committee | February 2021 | PC |