MSc in Mathematics and Finance
Imperial College London, 2022-2023

Welcome Letter and Reading List

Congratulations on joining the MSc in Mathematics and Finance at Imperial College London this September. We look forward to welcoming you here and, in the meantime, would like to give you some information about the programme itself and how you can prepare yourself for the course.

The academic contents of the MSc in Mathematics and Finance are both highly theoretical and practical, combining technical modules in Mathematics (analysis, stochastic processes, numerical methods, Statistics, data analysis, machine learning, quantum computing) as well as more finance-oriented topics (option pricing, algorithmic trading, risk management, interest rates, market microstructure). Most of the modules will have some coding component, and a strong knowledge of programming is necessary in order to obtain the degree. In order to help you prepare as optimally as possible, we recommend that you get familiar with the following reading list before the beginning of the programme.

Computing

Coding is an essential part of the daily task of quantitative analysts and data scientists, and C++ has historically been the main languages used in the financial industry. We will teach you C++, but it is highly recommended that you already have some notions beforehand. A good reference to start is

B. Stroustrup (designer of C++), *Programming: Principles and Practice Using C++*

Aside from C++, Python has become an essential language in the financial industry; it is open source, interpreted, high-level, multipurpose and cross-platform. It also allows easy manipulation of data (with direct imports from Yahoo Finance or Google), an essential feature in the current Big Data context. Several modules in the MSc programme use Python, and we strongly recommend you have a first look at it. Full details about the language itself and its installation are available at www.python.org. A good finance-oriented reference is

Y. Hilpisch, *Python for Finance: Analyze Big Financial Data*.

There are of course many other useful programming languages and computing environment (R, C#, Java, MATLAB, S+), but a large part of the financial industry (such as banks, hedge funds, and regulators) seem to be now shifting towards a combination of C++ for its speed and Python for its ease of use and compatibility and its wide-ranging libraries.

At the interface between Computing, Mathematics and Statistics, Machine Learning has become an essential tool in the financial industry, and a good overview is available at

OECD (2021), *Artificial Intelligence, Machine Learning and Big Data in Finance: Opportunities, Challenges, and Implications for Policy Makers*.

Mathematics

The Imperial College MSc in Mathematical Finance is both highly theoretical and very practical. The theoretical aspects rely on a strong background in Mathematics, with a particular focus on analysis and probability. The main references for the Analysis background are

- W. Rudin, *Principles of Mathematical Analysis* (McGraw-Hill, 1976)
- G.B. Folland, *Real analysis, modern techniques and their applications* (John Wiley & Sons, 1984)

Rudin's book should be part of your Undergraduate background. Folland's monograph goes deeper in Analysis, covering Functional Analysis and some elements of Measure Theory. For background on Probability and Statistics, you should look at

- G. Grimmett, D. Stirzaker, *Probability and Random Processes* (OUP, 2001)
- J. Jacod, P. Protter, *Probability essentials* (Springer, 2004)
- D. Hand, *Statistics: A Very Short Introduction* (OUP, 2008)

Partial Differential Equations are also fundamental in Mathematical Finance, and we highly recommend the following book for a review on the topic:

S.J. Farlow, *Partial Differential Equations for Scientists and Engineers* (Dover, 1993)

We highly recommend you to familiarise yourself (or refresh your memories) on these topics. Grimmett and Stirzaker's book contains both standard Probability theory (random variables, generating functions, convergence), as well as some essential results—which will be covered in the MSc—on stochastic processes. Some familiarity with standard probability theory concept would definitely be an advantage.

Finance

Even though the underlying tools of quantitative analysis in banks, hedge funds and FinTech are highly mathematical, one should not lose track of the surrounding context and objectives. Standard (non-mathematical) book about options derivatives are

- J. Hull, *Options, Futures, and Other Derivatives* (Prentice Hall, 2005).
- M. Joshi, *The Concepts and Practice of Mathematical Finance* (CUP, 2008).

If you wish to learn about the history and the making of quantitative finance, we recommend the following novels, to read with a pinch of critical mind:

- A. Admati, M. Hellwig, *The banker's new clothes* (Princeton University Press, 2014)
- S. Patterson, *The Quants, the Maths geniuses who brought down Wall Street*
- M. Lewis, *Liar's Poker* (Hodder Paperbacks, 2006).
- M. Lewis, *Flash Boys* (Penguin, 2015).

Internet also has a lot of information, and the following videos will get you familiar with quantitative finance:

- Quants - The Alchemists of Wall Street.
- Money & Speed: Inside the Black Box.
- Interview: Marco Avellaneda: 'The era of the pure quant is over'.
- An interview with Jim Simons, the founder of Renaissance Technologies.
- An interview with Damiano Brigo about the situation of quantitative finance today.
- A.E. Khandani, A.W. Lo: What happened to the Quants in August 2007?

The following websites should also be checked regularly:

- Bloomberg is a financial software company providing analytics, equity trading platform, data services, and news to financial companies.
- The Financial Times is one of the main newspaper regarding business and economics.

Other activities during the year

Apart from lectures, coursework and exams, your academic year at Imperial College will be filled with Practitioners' Lectures, weekly Careers in Quantitative Finance, and research seminars.