Imperial College London
Department of Mathematics

MSc Course in Mathematics and Finance: Course Information

We look forward to welcoming you on the 2014-2015 course, beginning on October 5. The purpose of this document is to suggest some ways in which you can prepare yourself for the course, and to inform you about the computing equipment you will need.

Pre-Course Preparation

Our course modestly aims to be both the most theoretical and the most practical one in the subject. Quantitative finance as practised today is based on sophisticated mathematical theories of probability and random processes. We provide graduate-level in-depth instruction in these areas, to equip you with the ability not only to understand current work but also to tackle new problems for yourself as they arise. You need this 'tool kit' of basic understanding. You also need the ability to turn the theory into reality, i.e. to write computer code to implement option pricing models, Monte Carlo simulations, risk analysis and the like. For this we provide instruction in the C++ programming language. Finally, you need first-hand knowledge of the industry and of the work that quantitative analysts do, and this we aim to provide by organizing, wherever possible, industry-based project placements over the summer period.

The course covers stochastic analysis, mathematical finance, financial economics, numerical analysis and computing. To be well-prepared in these areas we suggest the following.

Computing

To be a professional in quantitative finance, the ability to write computer code quickly and well is essential. In the course we teach C and then C++. If you have done no programming in languages such as C, Basic, Fortran etc then you *must get started* before the course begins. We will review C from scratch, but *you will be seriously handicapped if you arrive on Day 1 with no knowledge of programming*. The best preparation is to learn some C programming, using for example

T. Zhang, *Sams Teach Yourself C in 24 Hours*, Sams Publishing 2000 [ISBN 0-67-231861X]

(or any other book that appeals to you. Of course, you can't really do it in 24 hours!) If you already know C, move on to C++ (we use Microsoft Visual C++). You could also practise on Visual Basic (bundled up with Microsoft Excel), or on Matlab, if you have that available.

Mathematical and statistical topics

We assume knowledge up to the level of a first degree in Mathematics in analysis and probability. If your first degree is in mathematics, you will have taken a course in Real Analysis, covering topics such as continuity, convergence, compactness etc. You need to make sure you are 'up to speed' on these topics. If your first degree is in another area such as physics or engineering, you will have used mathematics in quite sophisticated ways but you will *not* have the basic real analysis background and you must get to grips with this: you have to 'learn the language'. A suitable textbook is

R.G. Bartle and D.R. Sherbert, *Introduction to Real Analysis*, 3rd ed. Wiley 2000

Everything in this book is relevant except Chapter 10. Possible lower-cost alternatives are

J.M. Howie, *Real Analysis*, Springer Undergraduate Mathematics Series
S. Abbott, *Understanding Real Analysis* (Undergraduate Text in Mathematics), Springer, 2010
S. Lang, *Undergraduate Analysis* (Undergraduate Text in Mathematics), Springer, 2005

We also suppose that you will be aware with basic Complex Analysis.

T.W. Gamelin, *Complex Analysis* (Undergraduate Text in Mathematics), by, Springer, 2001

In probability, you are expected to be familiar with the basic notions of probability distributions, means, variances, density functions, moment generating functions etc, and with the standard distributions of statistics such as the normal and exponential distributions. It would also be helpful to know something about simple stochastic processes such as random walks and discrete-time Markov processes. An easy-going introduction is provided by

D. Stirzaker, *Probability and Random Variables: a Beginner's Guide*
Cambridge University Press [ISBN 0-521-64445-3]

If you are already familiar with this material, try

G.R. Grimmett and D. Stirzaker, *Probability and Random Processes*, 3rd edition
Oxford University Press 2001 [ISBN 0-19-857222-0]

This book contains a wealth of information. The basic material in Chapters 1 to 5 we will assume you know. Random processes are covered in our course, but if you have time it would be helpful to take a look at some of the material in Chapters 7, 8, 12, 13 too. If you're feeling ambitious you could look at

D. Williams, Probability with Martingales, Cambridge UP 1991 [ISBN 0-521-40605-6]

The main textbook used in the first term of the course is

M. Capinski and E. Kopp, *Measure, Integral and Probability*, Springer 1999 [ISBN 3-540-76260-4]

We don't expect you to know this material when you enter the course, but you could give yourself a head start by looking at some of it, say the first 4 chapters.

Finance

We assume no background in Finance, but of course any knowledge you have can only be helpful. The standard textbook is

John Hull, *Options, Futures and Other Derivatives*, 7th edition, Prentice Hall 2008 [ISBN 0-13-046592-5]

This book contains a huge amount of information and will be useful throughout the course and beyond. Every quant analyst has it on her or his desk. Read the first 6 chapters for a survey of financial markets and how they work.