MATHEMATICAL INSTITUTE
UNIVERSITY OF OXFORD

24-29 St Giles', Oxford, OX1 3LB

PROGRAMME SPECIFICATION FOR THE MSc IN MATHEMATICAL AND COMPUTATIONAL FINANCE

1. Awarding Institution/Body

University of Oxford

2. Teaching Institution

University of Oxford

3. Programme accredited by

n/a

4. Final award

Masters

5. Programme

Mathematical and Computational Finance

6. UCAS Code

n/a

7. Relevant subject benchmark statement

Mathematics, Computing and Operational Research

8. Date of Programme Specification

October 2010 (earlier drafts October 2009, June 2008, September 2007, October 2007 and July 2006)

9. Programme aims

The programme aims:

- to provide graduates with a strong mathematical background with the skills necessary to apply their expertise to the solution of real finance problems.
- to provide students with a systematic understanding of core areas in mathematical models, techniques and numerical analysis in finance as well as source advanced topics in one or more of these areas.
- to develop the student's skills so that they are able to
  - (i) formulate a well posed problem from a description in financial language.
  - (ii) carry out relevant mathematical analysis.
  - (iii) develop an appropriate numerical scheme.
  - (iv) present and interpret these results.
- Lay the formulation for further research for a career as a quantitative analyst in a financial or other institution.

10. Programme outcomes

A.

Students will gain a knowledge of:	*Related teaching/learning methods and assessment*
1. Core methods of mathematics and finance.	1. Lectures and classes in terms 1 & 2, written examination in December and April
2. Core methods of numerical analysis.	2. Lectures and classes in terms 1 & 2, written examination in December and April.
3. Practical Numerical Analysis	3. Introductory course on MATLAB in September, C++ courses in Hilary Term and in or shortly after Trinity Term. Weekly practical sessions in Hilary Term and Michaelmas Term based on either MATLAB or C++. The C++ courses are assessed by practical examinations.
4. Options in Modelling, Methods and Numerical Analysis.	4. Each student follows a specified number of courses and writes up a mini project on each for assessment.
5. Dissertation on a specific problem	5. Students write a report of between 25 and 40 pages in some depth on a specific problem, and give an oral presentation on their results.

B. Students have the opportunity to develop the following skills during the course

I. Intellectual skills
1. The ability to demonstrate knowledge of key mathematical and financial concepts and topics, both explicitly and by applying them to the solution of problems.
2. The ability to comprehend problems, abstract the essentials of problems and formulate them mathematically and in symbolic form so as to facilitate their analysis and solution.
3. The ability to grasp how mathematical processes may be applied to problems, including where appropriate, an understanding that this might give only a partial solution.
4. The ability to select and apply appropriate mathematical processes.
5. The ability to construct and develop logical mathematical arguments with clear identification of assumptions and conclusions.
6. The ability to use computational and more general IT facilities as an aid to mathematical processes and for acquiring any further information that is needed and available.
7. The ability to present mathematical arguments and conclusions from them with clarity and accuracy, in forms suitable for the audiences being addressed
8. The ability to formulate a financial problem in mathematical terms, solve the resulting equations analytically or numerically, and give interpretations of the solutions.

Teaching/learning methods and strategies
These are acquired through lectures, classes, practical classes, studying recommended textbooks and through work done for projects, extended essays and dissertations. In addition regular sessions are held on 'research skills'.

II. Mathematical related practical skills	
1. Calculating fluently and accurately in abstract notation.	1. Practised throughout the course in problem work for classes.
2. Use of mathematics computer packages especially MATLAB and C++.	2. Practised throughout course especially in practical numerical analysis classes.

III. General skills	***Teaching/Learning methods and strategies***
1. To analyse and solve problems, and to reason logically and creatively.	1. Weekly mathematical problem sheets with class support often requiring significant development of ideas beyond material found in lectures and books.
2. Effective communication and presentation orally.	2. Presentation of solutions in classes and at dissertation stage.
3. The ability to learn independently.	3. The dissertation and special topics require students to put together material from a number of sources including lectures, text-books, and electronic sources, in their own time.
4. Independent time management.	4. Requirement to produce substantial amounts of written work against class deadlines; necessity to balance academic and non-academic activities without continuous oversight.
5. To think critically about solutions and to defend an intellectual position.	5. Discussion and criticism in classes and with supervisor.
6. Collaboration.	6. Modelling classes involve group work so that students share ideas and develop the practice of crediting others for their contributions.
7. Use of information and technology.	7. Compulsory practical work; extensive use of computing techniques and data analysis.

Assessment

The core is assessed by four two-hour written examinations. Options will usually be assessed on the basis of mini-projects. The compulsory courses in Financial Computing with C++ are assessed by 2 practical examinations. All students write a short dissertation, and give an oral presentation based on it, which will also be assessed.

The written examination tests core competence, the mini-projects and other assessments for options allow students to explore a limited area in more depth and gain experience in writing, while the dissertation tests competence in assembling a larger body of knowledge and presenting a synthesis of it; it also offers good students the opportunity to demonstrate originality.

The 2 three-hour practical examinations, are for the courses in Financial Computing with C++, which are exercises including programming and analysis of practical problems.

11. Programme structures and features

Introductory Courses

Introduction to Partial Differential Equations	Intro week
Introduction to Probability	Intro week
Introduction to Matlab	Intro week

These courses are all held in the Introductory week and are not assessed.

Core Lecture Courses

Practical Stochastic Calculus	MT
Stochastic Differential Equations	MT
Asset Pricing and Portfolio Theory	MT
Financial Derivatives 1	MT
Numerical Methods 1: Finite Difference Methods	MT/HT
Stochastic Calculus and Fixed Income Markets	HT
Financial Derivatives 2	HT
Numerical Methods 2: Monte Carlo Methods	MT/HT
Stochastic Control and Dynamic Asset Allocation 1	HT

These courses are all compulsory and are assessed by four written examinations, each of two hours duration. Two of the examinations (Papers A and B) will be based on Michaelmas Term courses and will be held before the start of Hilary Term (times will be specified on the course website). Two of the examinations (Papers C and D) will be based on Hilary Term courses and will be held before the start of Trinity Term (times will be specified on the course website).

Optional Lecture Courses

Each Student should choose two optional lecture courses from the following list.

Quantitative Risk Management (joint with part-time MSc)	HT + Easter vacation
Advanced Modelling Topics 2 (Credit, Energy, Insurance) (joint with part-time MSc)	Easter Vacation
Stochastic Control and Dynamic Asset Allocation 2	TT
Optimisation in Finance	TT
Financial Time Series Analysis	TT

Programming Courses

Financial Computing with C++ (Part I)	in HT
Financial Computing with C++ (Part II)	in or shortly after TT

These courses are compulsory and are assessed by 2 three-hour practical programming examinations.

The course is based around the standard three-term year, but it ends in July. The vacation periods are used intensively. Students carry out extensive practical (programming) work during the course and in particular the vacations are used for intensive computing courses. There will be a heavy course load during the early terms and most mini-projects are written in the vacations, which are also be used for preparation for the written examinations.

The dissertation is written during Trinity Term. The outcome might typically be a 30-page thesis involving a combination of review of existing literature, development and programming of algorithms for a particular problem, analysis of data, simulation, and theoretical analysis. The role of the supervisor is to assist in choosing a topic, to suggest relevant reading, and initial approaches, to respond to difficulties as they arise and to read and comment on a draft of the dissertation.

12. Support for students and their learning

There is a lending library in the Mathematical Institute (which will be reinforced in the area of the course). Students have access to the Radcliffe Science Library and other Oxford libraries for journals and periodicals. There is also a library in each student's college.

Computer facilities are provided by the Department with a wide range of workstations available for use by students on-site or remotely from their colleges or rooms. The network of IT resources and support within the University is extensive, especially the Oxford University Computing Services which provide facilities for graduates and an extensive range of training programmes. Colleges also provide good IT resources and support officers prepared to train and assist students. Students can download all information about the course from the course website.

Each student is appointed a supervisor with whom they meet regularly. The student may turn to the Course Directors who holds regular office hours and can offer advice on course content and options. All information about the course is web based and the Academic Administrator for the programme keeps the web pages up-to-date. Within college each student will have an advisor and there will be a Tutor for Graduates, and a Senior Tutor. Each college has an extensive support structure of advisors, welfare officers and peer support groups, and the University counselling service offers a range of assistance.

A week long induction week is held before term starts to introduce students to MATLAB, revise some of the required topics in probability and partial differential equations, and to deal with administrative matters.

Lecture courses are supported by problem sheets and classes. Some of the classes, especially in mathematical modelling, require extensive working in groups and oral presentations.

In addition to the academic side of the course, regular additional events are organised to develop students' research skills more broadly. Courses are delivered in scientific writing and presentation, software packages, and LaTeX.

Extensive facilities for language development are available through the University's Language Centre.

13. Criteria for admission

The normal minimum criterion for admission is a 2:1 degree in Mathematics or a related discipline, or equivalent qualification. Most students have qualifications considerably better than this minimum and evidence of motivations for work in this area.

Applications are made to the departments and after consideration by the MSc admissions committee they are passed on to Colleges.

At least three references from people who are familiar with the applicant's work or study achievements are required and great reliance is put on the opinions expressed by the academics.

For applicants whose first language is not English, the usual criteria of English proficiency are applied.

UK applicants are normally interviewed by an admissions committee.

A full statement of Admissions Criteria is appended.

14. Methods for evaluating and improving the quality and standards of learning

The programme is administered by a Supervisory Committee. This committee meets three times a year in addition to conducting business as necessary by email. Day-to-day operations are coordinated by the Course Director.

Student feedback is sought on all aspects of the course. Lectures are appraised in the usual way and a course questionnaire is completed at the end of Trinity Term. The responses to the questionnaire are analysed and brought to the next Supervisory Committee meeting. Students are eligible to serve on departmental consultative committees with graduate students, which have the right to raise any matter with the Supervisory Committee. Suggestions for improvements in the course are also solicited from employers. The external examiner provides useful comments and his/her

annual report is scruntinized by the Supervisory Committee which reports to both departmental committees and to the division.

Responsibility for the course is vested in the Mathematical, Physical and Life Sciences Division. The Divisional Board has formal responsibility for the maintenance of educational quality and standards in the broad subject areas, and exercises its responsibility through its Academic Committee, and in particular the scrutiny it gives to new course proposals and proposed course revisions, to reports of examiners, and to more general questions of academic policy.

The Division carries out reviews of the course. Changes in regulations require Divisional and EPSC approval. The Divisional Board is also responsible for academic appointments and for the arrangements (including mentoring, appraisal, and reviews of performance) for the support of newly appointed lecturers and for monitoring their teaching competence.

15. Regulations of assessment

The course is assessed as described in Sections 10 & 11 above. 40% of the marks are attributed to core courses, 20% to optional topics, 10% for both C++ practical examinations and 30% to the dissertation. There are two or three Examiners internal to Oxford and also an external examiner. Dissertations are read by at least two examiners or assessors. Dissertations are marked on grounds of mathematical/scientific content and presentation in print. The examiners receive the student's marks on the coursework modules and put all the information together to decide on the final result. The marking of coursework is done by lecturers with clear instructions to provide uniformity.

In order to pass the course, students need to show that:

(i) they have an understanding of the core areas of financial mathematics and scientific computing.

(ii) they have acquired the skills laid out in section 9.

(iii) they have presented a coherent well-researched dissertation and are able to defend it orally.

A distinction is awarded to any candidate whose average USM on the three components of the course (weighted 40% written examinations, 20% options and 10% for both C++ practical examinations, 30% dissertation and presentation, and after rounding) is 70 or more and who has a USM of 70 or more on two components of the course and 60 or more on the other.

An External Examiner is appointed in order:

(1) To verify that standards are appropriate to the award, in part by comparison with the standards of comparable institutions, and to ensure that the assessment procedures and the regulations governing them are fair and otherwise appropriate.

(2) To ensure that the conduct of the examination and the determination of awards has been fairly conducted, and that individual student performances has been judged in accordance with the regulations and conventions of the Examining Board. This will entail signing the Final List as an endorsement that the processes of examinations have been fairly conducted.

External Examiners are expected to report to the Vice-Chancellor in each year in which they act. Their reports are expected to cover all the following points:

- the standards demonstrated by the students
- the extent to which standards are appropriate for the award
- the design, structure and marking of assessments
- the procedures for assessment and examinations
- whether or not external examiners have had sufficient access to, and the power to call upon, any material necessary to make the required judgements
- students' performance in relation to their peers in comparable courses
- the coherence of the policies and procedures relating to external examiners and their consonance with the explicit roles required of them
- the basis and rationale for any comparisons made
- the strengths and weaknesses of the students as a cohort
- the quality of teaching and learning which may be indicated by student performance.

The report is addressed to the Vice-Chancellor, and will be considered by the relevant divisional board, the faculty/department and by the University's Educational Policy and Standards Committee.

Where an external examiner's report contains particular suggestions or criticisms, it is the responsibility of the faculty/department to ensure that full consideration is given to these, to institute further discussion or action, and to inform the external examiner within a reasonable time of what is done.

16. Indicators of quality and standards

The external examiner's report indicates the standard of the course in relation to others world wide.

The number of excellently-qualified applicants indicates the perceived standard of the course.

APPENDIX: the Departmental admissions criteria.

GRADUATE ADMISSIONS CRITERIA FOR MPLS SUBJECTS

Course title: MSc in Mathematical and Computational Finance

1. Introduction

In relation to the admission of students wishing to undertake a graduate programme, and in the context of giving appropriate attention to relevant equal opportunities principles and legislation, the University regards as an overriding priority:

I. *For taught course degrees, the admission of the most suitably qualified candidates well matched to their chosen course;*

II. *For research degrees, the admission of the most suitably qualified candidates for whom the University can provide appropriate research opportunities and supervision;*

III. *The selection of the most academically able set of candidates who meet the admissions criteria for the available places.*

2. Criteria

Applications will normally be considered in the light of a candidate's ability to meet the following criteria:

2.1. Academic ability

a. *The applicant has provided appropriate indications of proven and potential academic excellence. Appropriate indicators may include two or more references, academic transcripts or their equivalent, samples of academic work produced by the student, and performance at interview(s)*

b. *The applicant has provided sufficient evidence, in the view of the assessors, to suggest that they have the academic ability and commitment to pursue the chosen programme to a successful conclusion within the required time limits.*

c. *Applicants are normally expected to have achieved an upper second class or first class Honours Degree (or equivalent) in Mathematics or a related discipline.*

2.2. English language requirement

Applicants whose first language is not English are required to provide evidence of proficiency in English. Candidates are normally expected to meet the following criteria [this is the minimum language requirement]: For IELTS an overall score of 7.5 with at least 7.0 in each component. For TOEFL an overall score of 630 with a Test of Written English (TWE) of 5.0, or for the computer-based TOEFL test, an overall score of 267 with an Essay Writing score of 5.0, or an overall score of 109 in the internet based test. Cambridge Certificate of Proficiency in English (CPE) Grade B

2.3. Suitability

a. *The programme of study that the applicant wishes to pursue is well suited to the academic interests and abilities to which they have drawn attention in their application and (where appropriate) the applicant has undertaken any preliminary academic work or course which is normally considered indispensable to acceptance on the proposed programme of study.*

b. *The relevant faculty/department is able to provide appropriate supervision and facilities for the candidate's chosen programme of work (the allocation of graduate supervision is the responsibility of the department/faculty and it is not always possible to accommodate the preferences of incoming graduate students to work with a particular member of staff).*

Well qualified candidates may not be offered a place because:

- *secure funding is not available (places offered on a conditional basis will not be confirmed without a financial guarantee);*
- *there are constraints on the availability of research facilities (especially laboratory and library space) and on supervision;*
- *there are limitations on the size of taught graduate courses;*
- *there are limitations on the numbers of students which can be admitted onto research programmes other candidates have been judged to match more closely the admissions criteria.*

It should also be noted that acceptance on a particular course gives no guarantee of final success, and all courses require the student to develop their learning and skills to new levels in order to pass taught course examinations or successfully to undertake all the assessment hurdles of a research programme.