Heriot-Watt University

MSc in Quantitative Financial Risk Management (QFRM)

Programme Information

2013–2014

Note The electronic copy of this PDF has http links embedded (i.e. “Scottish Credit and Qualifications Framework”). These links may not work properly in all .pdf readers, but the links should appear if a cursor is placed over them.

Disclaimer Every effort has been made to ensure the contents of this document are accurate at the time of printing. Unforeseen circumstances may necessitate changes to the procedures, curricula and syllabus described.

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National Degree Standards
All the undergraduate and taught postgraduate programmes offered by the Department of Actuarial Mathematics and Statistics (School of Mathematical and Computer Sciences), Heriot-Watt University, are compliant with the requirements of the Scottish Credit and Qualifications Framework (SCQF).
1 Introduction

This programme has been designed to address the demand in the financial services industry for advanced quantitative financial risk management skills. The events surrounding the financial crises of 2007-12 mean that financial risk management will be very important in the years ahead.

We study the models and methods used by risk managers in many sectors of the financial services industry. We also study the regulatory environment such as the Basel II capital adequacy framework in banking and Solvency II in insurance. We work closely with the Scottish Financial Risk Academy (SFRA, http://www.sfra.ac.uk) to offer a number of Special Topics projects and Dissertation projects offered by industry.

The programme follows the PRMIA - Professional Risk Managers International Association (http://www.primia.org) syllabus.

2 Programme Administration

The administration for the programme is handled by the Department of Actuarial Mathematics and Statistics at Heriot-Watt University, which is part of the School of Mathematical and Computer Sciences.

Programme Director

Dr Tim Johnson,
Department of Actuarial Mathematics and Statistics,
Room CMG05, Heriot-Watt University,
tel: 0131 451 8343
e-mail: T.C.Johnson@hw.ac.uk

Tim will act as a first point of contact for students who require advice or assistance for both academic and non-academic matters.

Programme Administrator

Jill Gunn,
Department of Actuarial Mathematics and Statistics,
Room EM 1.17,
tel: 0131 451 3334
e-mail: J.P.Gunn@hw.ac.uk

Jill is responsible for all programme administrative matters, is a member of the Programme Committee and is the secretary to the Board of Examiners.
3 Introductory Information

3.1 Enrolment

All student enrolment is completed on-line. You are responsible for ensuring your enrolment details are correct, and that you have enrolled for all modules that you wish to take. Information to assist with course selection will be provided at the Pre-Enrolment meeting. If you have any questions about enrolment you should speak to the Programme Administrator. Students are advised to enrol for all modules which they might be interested in taking in the first instance. Your choice of modules can be finalized at a later date.

You must enrol for either the PG Diploma in QFRM or the MSc in QFRM. If you change your mind and wish to change programme you may only do so before 30 September 2012 by advising the Programme Administrator in writing. International students should be aware that any programme changes will be notified to the UK Border Agency and this may have implications for your student visas.

No refunds of programme fees will be provided to students who leave the University without completing the programme for which they are registered for any reason (i.e. regardless of whether this departure is voluntary or because students have failed to qualify for the desired award).

3.2 Note from the Programme Director

The programme is demanding. In order to be successful you will have to work extremely hard, the Scottish Qualifications Authority state that each “credit” should be achieved after 10 hours effort, this means students are expected to spend 150 hours to achieve a pass (not an ‘A’) in, for example, Financial Markets. Typically there will be 40-60 hours lectures on a 15 credit course, so students need to be spending as much time working on a topic outside the classroom as they do in the classroom. Also, poor attendance at classes is likely to lead to poor performance.

We recommend that most students take Statistics as their option, the exception being students from a statistical sciences undergraduate degree, who have the option of taking Corporate Finance.

Anyone who finds they are struggling with any aspect of the coursework should alert the course lecturer at the first available opportunity. Staff are always happy to help but cannot do so if they are not aware that there is a problem. Your academic mentor (see Section 3.5) is also available during the year to provide support when needed. It is a programme requirement to meet with your mentor at least once a semester.
3.3 Important Dates

Semester Dates

<table>
<thead>
<tr>
<th>Activity</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semester 1 teaching</td>
<td>16 September 2013 – 6 December 2013</td>
</tr>
<tr>
<td>Semester 1 exams</td>
<td>9 December 2013 – 20 December 2013</td>
</tr>
<tr>
<td>Break</td>
<td>23 December 2013 – 10 January 2014</td>
</tr>
<tr>
<td>Semester 2 teaching</td>
<td>13 January 2014 – 4 April 2014</td>
</tr>
<tr>
<td>Break</td>
<td>7 April 2014 – 25 April 2014</td>
</tr>
<tr>
<td>Semester 2 exams</td>
<td>28 April 2014 – 23 May 2014</td>
</tr>
<tr>
<td>Dissertation (to be confirmed)</td>
<td>9 June 2014- 23 August 2014 (an 11 week period)</td>
</tr>
<tr>
<td>Graduation</td>
<td>20 November 2014 – 21 November 2014</td>
</tr>
</tbody>
</table>

Between the end of the Semester 2 exams and the beginning of the Dissertation period the Exam Board is held. The Exam Board has the authority to change grade boundary points and approve any re-scaling of marks, for this reason lecturers are unable to give any indication as to a student’s achievement on a course until after the Board. Within an hour or so of the Exam Board completing, results are distributed.

3.4 Timetable

You will be provided with a personal copy of the timetable each semester, or they are available at http://www.macs.hw.ac.uk/timetable/. Copies will also be available in the wall holders outside the School Office (EM1.25). Occasionally it is necessary to make adjustments to the timetable, such as rescheduling a class – all changes will be notified on the class VISION pages or by email. Classes are timetabled to start and finish at 15 minutes past the hour. The standard Heriot-Watt practice is that classes start at 20 minutes past the hour and finish at 10 minutes past. Please be courteous to staff and fellow students by ensuring you arrive on time to all your classes.

3.5 Student Mentors

All Heriot-Watt students are allocated an academic Mentor. By default, the Programme Director will normally be assigned as your Mentor. If there are any changes to this default situation you will be informed early in first semester.

If you have any academic, personal or financial problems during the year your Mentor will be willing to advise or help you, but your Mentor has limited competence and for more serious problems they will advise who you should speak to for more expert advice.

You are advised to meet with your mentor at least once each semester. For international students this meeting is regarded as a required contact point for UK Borders Agency attendance monitoring purposes.

3.6 Other Students

You share your courses with students on other degrees and occasionally a PhD student will attend lectures.
3.7 Staff-Student Liaison

Heriot-Watt University places great emphasis on student feedback to improve the student experience, particularly with respect to the delivery of courses.

All students on the MSc should feel free to discuss aspects of the running of the programme directly with the Programme Director. However, issues which are relevant to the whole of the class should normally be raised with the Programme Director through a student representatives – ‘Class Rep(s)’ sitting on the AM&S Department’s Postgraduate Staff Student Liaison Committee.

At least one Class Rep (classes of less than 15 students normally need only one Rep) will be elected at the start of the year. Class Reps will engage with the Programme Director to monitor and review all aspects of the programme and act as the main communication channel between students on a Programme (the MSc) and the Programme Director. If an issue emerges with the Programme, the Programme Director will ask the Class Reps to discuss the issue with the class and report back.

3.8 Teaching Accommodation and Staff Accommodation

Classes may be held in any teaching rooms on campus. Students on other postgraduate programmes may join the class for certain modules or lectures. The academic staff of the Department of Actuarial Mathematics and Statistics all have their offices in the Colin Maclaurin (CM) building. Administrative staff and the MACS School Office are nearby in that section of the Earl Mountbatten building close to the CM building.

3.9 Computer Facilities

All enrolled students are issued with accounts on the University Desktop Service. This will give you an email account, and access to word-processing facilities and various packages which will be needed for some of the Diploma programmes and for the MSc projects.

There are details of computer lab locations and availability in the IT Help portal.

Students are expected to use the computing facilities in an appropriate and considerate way. Abuse of the facilities is subject to various disciplinary measures, ranging from a ban on access to the facilities to, in extreme and flagrant cases, expulsion from the University. Examples of abuse include monopolising a terminal for non-academic related purposes, running excessively long or inappropriate print jobs, and displaying, circulating or printing offensive material on or from the internet. Computer games and relay chat are specifically forbidden. Further information on policy regarding the abuse of computing facilities is available from Information Technology (IT).

You will be credited with a printing quota for use over the year. While an additional allocation will be made in the summer for those proceeding to the MSc, you are advised to use your quota sparingly.

3.9.1 On-line enrolment

You can usually work through a on-line enrolment by finding a vacant PC and logging on. The Computer Centre may not have details of all students. For these people the quick enrolment will not be possible and you should go to Student Services.
3.9.2 Contacting You

The Programme Director, Programme Administrator and lecturers and will regularly communicate with you by email. All emails will be sent to your Heriot-Watt email address (e.g. abc123@hw.ac.uk) and NOT to any personal email address you may have. It is your responsibility to find out what arrangements have been made and what information has been sent to you. You are expected to check your Heriot-Watt email in-box regularly and to make sure that there is always space in it for incoming messages - so remember to clear it out on a regular basis. You should also check the class VISION and website pages regularly for announcements and updates.

3.10 Student mail

Mail arriving for all students in the School is put in pigeon holes on the first floor of the Earl Mountbatten building – outside the School Office in room EM1.25.

3.11 Mobile phones

The use of mobile phones is strictly forbidden in all lectures, tutorial sessions and computer lab sessions. All mobile phones must be switched completely off during these times.

Mobile phones may not be taken into exam rooms during examinations.

3.12 Finance

Students are reminded that invoices are issued prior to or at enrolment and are payable immediately. Anyone who is experiencing difficulty in meeting their repayments should contact the Finance Office immediately.

The University has a strict policy regarding the payment of invoices and students who fail to meet this will have their student privileges withdrawn and may in some cases be subject to legal proceedings. If you are experiencing difficulties in meeting your payments it is essential that you contact the Finance Office at the first available opportunity. You may also wish to seek advice from your Student Welfare.

No student with outstanding debt will be permitted to graduate from the University, and in some cases students with debt may be prevented from continuing to the MSc dissertation stage of the programme.
4 Programme Structure

4.1 Components of the Degree

The taught component of the degree makes up 120 credits. There are seven mandatory modules making up 105 credits and consisting of

- **Enterprise Risk Management** (30 credits, Semesters 1 & 2) - a comprehensive treatment of financial risk management covering both quantitative and qualitative aspects.
- **Financial markets** (15 credits, Semester 1) - an introduction to the financial markets.
- **Derivative Markets and Pricing** (15 credits, Semester 1) - an introduction to derivative markets and how derivative products are priced.
- **Credit Risk Modelling** (15 credits, Semester 2) - a detailed treatment of the mathematics underpinning Basel Accord on banking supervision and Solvency II for insurance.
- **Time Series Analysis and Financial Econometrics** (15 credits, Semester 2) - analysis and modelling of financial data.
- **Special Topics in QFRM** (15 credits, Semester 2) - project on a specific aspect of QFRM. Most projects will be delivered by industry professionals through the Scottish Financial Risk Academy (www.sfra.ac.uk). For example there have been projects with Moody’s Analytics, the Royal Bank of Scotland, Lloyds Banking Group and Aberdeen Asset Management.
  
  If offered, the Economic Scenario Generation topics offered by Moody’s are compulsory.

Students should choose one of two optional modules in the first semester

- **Statistical Methods** (15 credits, Semester 1) - a foundation course in probability and statistics.
- **Corporate Finance** (15 credits, Semester 1) - for those with a strong background in statistics but little experience of finance.

**Important:** A pass in Statistical Methods is required to achieve PRIMIA exemption (see Section 4.2) and so if you are looking to achieve PRM you should not take Corporate Finance. The Programme Director advises that any student who has not studied statistics in the context of mathematical sciences (mathematics, statistics, actuarial science), takes the Statistical Methods option.

The restricted number of optional modules is a consequence of the degree following the PRMIA syllabus and PRIMIA accreditation.

Modules are usually assessed by examination at the end of the semester in which they are taught, a notable exemption is that Enterprise Risk Management I is examined in the Summer, not at the end of Semester I. Some modules have an element of continuous assessment, whether a mid-term test or project work in addition to a written exam while Special Topics in Risk Management has no exam and is assessed through coursework.

Students opting for the MSc, rather than the Diploma, will also write a Dissertation.

- **Dissertation** (60 credits) - an extended project that can be either theoretical, undertaken with an academic supervisor, or more practical, delivered by industry professionals through the Scottish Financial Risk Academy (www.sfra.ac.uk). Companies offering dissertations through the
SFRA include Aviva, Moody’s Analytics, J.P. Morgan Chase, Kames Capital (AEGON), Lloyd’s Banking Group, RBS and Standard Life Investments. Access to an industrial dissertation is competitive across a number of masters degrees offered by Scottish Universities and students are selected solely by the company offering the project.

4.2 Professional Risk Managers International Association

The Department of Actuarial Mathematics and Statistics is a University Partner of the Professional Risk Managers International Association (PRIMIA) and the MSc in Quantitative Financial Risk Management is accredited by PRIMIA.

In order to be exempt from the PRM Level I and II exams, students must

1. Pass (achieve more than 50%) at their first attempt the following courses:
   - Enterprise Risk Management I.
   - Enterprise Risk Management II.
   - Statistical Methods.
   - Financial markets.
   - Derivative Markets and Pricing.
   - Credit Risk Modelling.
   - Time Series Analysis.
   - Financial Econometrics.
   - Special Topics in QFRM.

2. Achieve an average of 60% across all exams.

In order to obtain the PRM designation, students satisfying these criteria need to

1. Complete Exams III & IV of the PRM.
2. Provide a transcript form Heriot-Watt, which will be supplied by the Course Administrator.
3. Pay a $25 exemption fee.

4.3 Progression and Degree Classifications

Students can register for a Masters or Diploma in quantitative Financial Risk Management. Students registered for the MSc degree need to satisfy certain progression criteria, enabling them to proceed onto the Dissertation. If they fail to meet these criteria, given below, they will graduate with a Diploma or Certificate, according to the circumstances.

4.3.1 Masters Degree in QFRM

To proceed to the Dissertation students need to

- Pass all 120 credits at grade A-E (30% – 100%).
- Pass 75 credits at grade A-C (50% – 100%).
• Achieve an average grade of 50% across all 120 credits.

Students will then be awarded a Masters if they achieve a grade A-C (50%–100%) on the Dissertation. Students will be awarded a distinction in the Masters if they

• Achieve an average grade of more than 70% across all the 120 taught credits.

• Achieve a grade A (70%–100%) in the Dissertation.

4.3.2 Postgraduate Diploma in QFRM

Students who choose not to progress to the Masters or do not meet the progression requirements after the April/May exams may be awarded the **Postgraduate Diploma in QFRM**. The requirement for this degree is an average mark of over 40% in their best 120 credits, at least 75 credits at grade D (40%-100%), and passing modules (at grade E, 30%-40%) of at least 120 credits. Student’s will achieve a distinction in the Diploma if they achieve an average mark of over 70% in their best 120 credits.

4.3.3 Postgraduate Certificate in QFRM

Students who do not meet the requirements for the award of the Postgraduate Diploma after the April/May exams may be awarded the **Postgraduate Certificate in QFRM**. The requirement for this degree is an average mark of over 40% in the best best 60 credits, passing modules (at grade D, 40%-100%) of at least 45 credits, and passing modules (at grade E, 30%-40%) of at least 60 credits, of which at least 30 credits must be passed (at grade E or above) in compulsory modules.

4.4 Resit examinations

Students who do not automatically satisfy the requirements for immediate progression onto the MSc dissertation may be permitted to resit up to **three** modules. The opportunity to resit a further specified paper will be granted at the discretion of the Exam Board. If all requirements for progression are met after the re-assessment, the MSc dissertation may then be undertaken in the following summer.

There will be one opportunity to resit a given examination. Modules taught by the School of Management and Languages can normally be re-sat in June, at the start of the Dissertation Period. However in general the resit examination will be at the next available opportunity (that is, at in their usual assessment diet in the following academic year.)

Students are not able to resit for PRIMIA exemptions.

4.5 Certificates

On successful completion of the degree (MSc or Postgraduate Diploma) you will receive a Heriot-Watt degree certificate. Normally this is presented at the graduation ceremony at Heriot-Watt University in November although you can receive it by post if you are unable to attend in person.
5 Information on Assessment Procedures

Generally speaking, immediately you feel that there are issues (health, financial, family, personal) that may prevent your successful completion of the degree you should inform someone. Normally you should contact the Programme Director but if the matter is of a personal nature you can contact Student Welfare in confidence, who will then inform the Programme Director that you have issues of a personal nature without giving details.

All problems can be resolved successfully and students graduate providing the student informs someone in good time.

It is the students’ responsibility to ensure that they adhere to the University’s regulations with regard to examinations (Section 9).

5.1 Disability and Special Needs

Some of you on the MSc may have some form of disability or have special needs. Examples include students with hearing, eyesight problems or physical disabilities. We are very happy to make special arrangements to help you as much as we can to make your year here a successful one.

The University has a special needs adviser. If you do think there is something that we can help with then you should first make contact with the Special Needs adviser.

The special needs adviser is also a useful person to contact during the year for some problems that might arise during the year, such as if you break a bone.

5.2 Notification of Special Circumstances/Medical Certificates

It is very important that you notify the Programme Director as soon as possible of any special circumstances (such as illness or death of a close relative) which could adversely affect your studies and/or examination performance. Details of the Policy are at Special Circumstances Policy at http://www.hw.ac.uk/registry/resources/special-circumstances-policy.pdf and the form at: http://www.hw.ac.uk/registry/forms.htm (under Examinations & Assessments). In the case of illness, a medical certificate must be supplied as soon as possible to the Programme Administrator. The Examiners will always take such circumstances into account where appropriate, but the later the notification, the less scope there is to do so. Notification of special circumstances must be given before the examination diet concerned.

Late notification will normally mean that no account can be taken of the circumstances. With regards to submission of project work, students are required to take reasonable precautionary measures to keep their work in progress safe such as regular backups of computer files. For further details, see the University Regulations.

5.3 Dictionaries in Examinations

Students whose first language is not English may use an appropriate dictionary in examinations. However, the dictionary will be checked by exam invigilators and removed if there is anything (other than the owners name in English) written in them.
5.4 Calculators in Examinations

Where a calculator is required for the completion of an examination, a student may use any basic scientific calculator, except the following: graphics calculator, programmable calculator and a calculator which features text storage or retrieval facilities (see http://www.hw.ac.uk/registry/resources/approvedcalculatorguidance.pdf).

5.5 Plagiarism

The University has a strict policy on Plagiarism – passing off as one’s own the ideas or writing of another. All students should be familiar with the University’s policy on plagiarism (English/Chinese).

Plagiarism undermines every academic principle. Plagiarism is cheating and the Department, the School, and the University treat it very seriously indeed. This is relevant for all students and has implications for course work, exams and the writing of MSc dissertations. The sanctions for plagiarism range from the discounting of the plagiarised work, the course or dissertation completely, withholding of the degree or Diploma concerned, or ultimately to expulsion from the University.

Anyone indulging in plagiarism of any kind can expect no sympathy or understanding from the University. Typically plagiarised work is discounted and will normally result in the student failing the relevant course.

We will automatically assess work which we feel is plagiarised, the system is extremely powerful in employing the Internet to identify source documents. Copying text verbatim from any electronic source (or book or journal article that is available electronically) without attribution will be identified as plagiarism.

If you have the slightest doubt about any aspect of this matter and of how your own work relates to it, you must discuss it with the Programme Director before submitting any work.
6 Synopses of Taught Modules

Enterprise Risk Management I (F71ER)
(15 credits, semesters 1)

Lecturer: Prof A. Cairns

Aim

To provide: an introduction to the advanced statistical methods underpinning Financial Risk Management (FRM) and Enterprise Risk Management (ERM), including credit risk; a thorough grounding in the wide range of risks facing a company. To develop key risk assessment skills.

Summary

Much of the course will focus on a small number of financial risks that banks and insurers are exposed to. We will discuss how these risks can be analysed and the methods discussed in lectures will be implemented in the weekly computer labs.

At the end of the course you should be able to:

- Demonstrate an understanding of the different reasons for measuring financial risk.
- Describe and apply the different measures of financial risk.
- Define what is meant by a coherent measure of risk.
- Determine the main characteristics of a univariate financial time series.
- Use appropriate statistical and computational methods to determine the fatness of the tails of returns data.
- Describe and apply the main univariate and multivariate distributions to financial data.
- Describe and apply the fundamental concepts and theorems in Extreme Value Theory (EVT).
- Describe how analysis of financial data using EVT differs from traditional statistical methods.
- Describe and apply the main statistical methods in EVT to financial data.
- Demonstrate how multivariate returns can be described using marginal distributions and copulas.
- Describe and apply the main copulas.
- Explain how the use of different copulas can affect the returns distribution on a portfolio containing two assets.
- Describe some empirical techniques that can be applied to financial time series data to establish the presence of stochastic volatility.
- Describe some simple time series models for stochastic volatility and explain how these affect the distribution of returns over time.
• Use appropriate statistical software to analyse problems involving financial risk.

**Syllabus** In this course we will cover the following topics

• **Introduction**
  – What is ERM and why is it worthwhile
  – Direct and indirect stakeholders in an enterprise
  – Different types of risk

• **Quantitative analysis of financial data**
  – Quantifiable and non-quantifiable risks
  – Modelling univariate financial time series; model fitting and diagnostic tests
  – Extreme value theory
  – Econometric models for stochastic volatility
  – Modelling multivariate risks including the use of copulas
  – Different measures of correlation and dependency
  – Risk measures; coherent risk measures
  – Scenario analysis and stress testing
  – Model and parameter risk

**Texts** The required reading for the lecture course will be a set of printed lecture notes that I will provide.

For additional reading, an excellent textbook is that by McNeil, Frey and Embrechts (2005).


The majority of the topics covered in the lecture course are discussed in detail in this book.

The book by Crouhy, Galai and Mark (2006) is also an excellent one (modestly priced!) covering the non-quantitative parts of the course.


**Assessment**

20% of the mark will be from coursework during Semester 1. 80% will be based on a 2 hour exam in the **Summer** exam diet

Further information and course materials are available at [http://www.ma.hw.ac.uk/~andrewc/erm/](http://www.ma.hw.ac.uk/~andrewc/erm/)
Financial Markets (C31FM)
(15 credits, semester 1)

Lecturer: Dr B. Xu.

Aims
This course is designed to give students a critical understanding of financial markets, the nature of the assets traded in them, and the price-setting process. The course concentrates on equity and bond markets.

Summary
After studying this course, students should:

- Understand the functions of financial markets and the difficulties involved in their operation.
- Understand the roles of the various institutions involved in financial markets
- Be able to critically appraise the differences in financial market structures found in major developed economies
- Understand technical and fundamental analysis of share prices
- Have the ability to critically evaluate the Efficient Markets Hypothesis
- Understand the logic of diversification and the implications of this logic for share prices; understand the forces affecting share liquidity
- Have the ability to critically evaluate the performance of an equity fund manager
- Understand the sources of bond price risk and the factors affecting bond prices

Syllabus

1. Financial Markets
   - The logic and underlying problems of financial markets
   - Participants in financial markets
     - Capital users (especially companies)
     - Investing institutions
     - Liquidity-creating institutions
     - Information generating institutions
   - Types of claim: Equity claims; debt claims: the equity risk premium
   - Financial structure and company valuation
   - Differences in national financial market systems
2. Equity Investment

- Technical and fundamental analysis
- The total return concept
- The efficient markets hypothesis
- Diversification and the Capital Asset Pricing Model
- Investment Performance Measurement
- Liquidity

3. Bond Investment

- Bond debt vs. bank loans
- Types of bond: bond issuance and trading
- Bond risk
  - Default risk and bond rating agencies
  - Interest rate risk: duration: converting
- The term structure of interest rates.

Recommended Texts


Assessment

20% of the overall assessment will be based on a ‘mid-term’ at the end of October/beginning of November.

There will be a 2 hour examination counting towards the remaining 80% of the course assessment during the Semester 1 Assessment Period (December).
Derivatives Markets and Pricing (F71DV)
(15 credits, semester 1)

Lecturers: Dr A. Wiese

Aim

The aims of this course are:

- To provide a thorough grounding in the operation of derivative markets
- To provide an introduction to the methods of hedging using option and forward contracts, with particular emphasis on bond (interest rate) markets
- To provide students with a good understanding of the principles of no-arbitrage pricing
- To introduce mathematical concepts related to stochastic processes
- To teach students the CRR (discrete time binomial) model for derivative pricing
- To introduce the Wiener process and the BSM option pricing model

Syllabus

- Introduction and Forward Contracts
- Options
- Hedging with Futures and Options
- Interest Rate Derivatives and Swaps
- No-Arbitrage Pricing of Forwards
- Single Period Derivative Pricing
- Mathematical Foundations of Multi-Period Derivative Pricing
- The Binomial Model
- Continuous Time Models

Texts


Corporate Finance (C31CF)
(15 credits, semester 1 option)

Lecturer: Dr M. Sherif

Aim

The purpose of this course is to provide an overview of some new and exciting research paths in the field of corporate finance. The course will emphasize the major decision arenas facing a firm, and develop the tools required to be a competitive professional in today’s environment. Therefore, the aim of this course is to introduce students to some contemporary topics in corporate finance and their reflection on the fundamental decision to be taken within the corporate finance world.

Summary

The topics will include some or all of

- Valuation
- Cost of capital and asset pricing models
- Investing in Risky Projects and Capital budgeting
- Capital Structure Puzzle
- Leases and lease analysis.
- Agency theory and asymmetric information
- Convertibles and warrants:
- Corporate Liabilities and Real Options
- Private equity and family firms
- Raising capital: bank loans; bond issues; public offers; seasoned equity offers.
- Risk Management
- Debt policy and dividend policy

Assessment

70% of the mark for the course will be from a written examination at the end of semester 1; 30% of the mark will be from coursework during semester 1
Statistical Methods (F71SM)
(15 credits, semester 1 option)

Lecturer: Dr V. Shneer / Dr J. Cruise

Aim

This course aims to provide postgraduate students taking the MSc in Actuarial Science, the MSc in Financial Mathematics, and other programmes with a broad knowledge of the principal areas of mathematical statistics and statistical methods widely used in insurance and finance.

Summary

At the end of studying this course, students should be able to:

- Summarise and display data.
- Perform basic probability calculations.
- Calculate moments and the expected values of other functions of random variables.
- Apply the central limit theorem.
- Obtain estimators of parameters of certain common distributions.
- Determine properties of estimators: efficiency, Cramèr-Rao lower bound, (approx. large-sample) distribution.
- Perform inference on parameter estimates: obtain confidence intervals and carry out hypothesis testing.
- Fit a linear regression model.

Syllabus

- Summary and display of data
- Introduction to probability
- Random variables
- Models for count data
- Models for measurements
- Jointly distributed random variables
- Linear combinations of random variables
- The central limit theorem
- Sampling distributions
- Estimation of parameters
- Hypothesis testing
- Linear regression

**Main Texts**


*New Cambridge Statistical Tables*: (2nd Ed.), Lindley & Scott, C.U.P.

**Other Reading**


*Introduction to Probability and Statistics*: (8th Ed.), W. Mendenhall and R.J.Beaver, PWS, Kent

**Assessment**

Statistical Methods will be examined by a 2-hour examination at the end of the first semester.
Enterprise Risk Management II (F71EM)
(15 credits, semester 2)

Lecturer: Prof A. Cairns

Aims: The aims of this module are:

- Demonstrate a good understanding of the different sources of credit risk and credit spreads.
- Show an awareness of the different approaches to modelling and managing credit risk.
- To provide a good grounding in the best practice of risk management within an organisation.
- To understand economic measures of capital and capital allocation.
- To have a thorough understanding of operational risk in its various forms.
- To identify and measure risks and then to take actions to mitigate risks and exploit risky opportunities through good risk management strategies.

Summary On completion of this module the student should be able to:

- Show an awareness of the Basel II and Solvency II and other regulatory environments and implement their main requirements.
- Evaluate market risk using a standard method under pillar 1 of Basel II.
- Demonstrate an understanding of the main international guidelines on good risk management practice and good governance.
- Understand how a ratings agency assess risk management practice and use this to improve risk management practice in an organization.
- Show how to measure the economic value of a risky venture and how this can be used to influence decision making.
- Understand the different methods for how to allocate capital within an organization and apply these methods in a variety of situations.
- Demonstrate a good understanding of the different types of operational risks that might arise in an organization, and be able to identify potential operational risks in a given scenario.
- Use quantitative and qualitative methods for analyzing operational risk.
- Analyse multivariate operational risk data using standard methods under Basel II and internal models.
- Analyse real and hypothetical case studies of good and bad risk management practice.
- Analyse real and hypothetical scenarios from the perspective of different stakeholders.
- Demonstrate how to establish at Board level an organisation’s risk appetite, risk objectives and risk tolerances.
• Show to optimize risk and opportunities given Board-level constraints on risk appetite and risk tolerances
• Determine an organisation’s overall risk exposure
• Develop and recommend strategies for active management of risks using a variety of methods
• Recommend risk mitigation strategies by transfer of risk
• Develop strategies for management and mitigation of credit risk
• Recommend risk reduction strategies without transferring risk to an external agency
• Demonstrate an understanding of the pros and cons of the different approaches to risk mitigation
• Show an understanding of modern methods for immunization of interest-rate risk
• Show an understanding of the importance of asset-liability modeling for a financial institution
• Develop a risk-management control cycle appropriate to a given scenario

**Syllabus**

• Regulatory regimes
  – Basel II and Solvency II: underlying principles and calculation methods
• Risk management control cycle
  – Describe typical risk management control cycles and explain the relevance of each component
• Risk management governance and culture
  – Sarbanes-Oxley and other international risk frameworks; underlying principles
  – Risk management governance structures and the risk management culture
  – Governance issues including agency, audit and legal risk
  – Rating agency assessments of an organisation’s risk management operation
• Economic capital
  – Economic measures of value and their uses in corporate decision making
  – Capital allocation and the role of risk measures
• Operational risk
  – Examples of operational risk
  – Non-quantitative and quantitative methods and tools for managing operational risk
  – Different ways of quantifying operational risk under Basel II
• Case studies
  – Examples of past disasters and good practice and the lessons to be learned
  – Risk analysis of real and hypothetical scenarios including non-quantifiable risks; views of different stakeholders
• Risk management and optimisation
  – Articulating an organisation’s risk appetite and risk objectives; translating these into risk tolerances.
  – Determining an organisation’s overall risk exposure
  – How risks and risky opportunities affect the selection of strategy
  – Developing and recommending strategies for risk optimisation
    * Methods for transferring risk to other organisations including financial derivatives, securitisation, insurance, reinsurance, insurance-linked securities
    * Techniques for managing credit risk
    * Different types of securitisation
    * Risk reduction within an organisation
    * Advantages and disadvantages of different approaches to risk reduction; e.g. costs and benefits; information asymmetry; transparency; liquidity; basis risk; moral hazard
    * Dynamic versus static hedging using financial derivatives; practical considerations
    * Modern approaches to immunisation of interest-rate risk
    * Asset-liability modelling
    * Optimising risks and opportunities relative to the Board’s declared risk appetite and risk tolerances
  – Contagion and credit risk
    * Different sources of credit risk; contagion
    * Corporate bonds and components of credit spreads
    * Different theoretical and commercial approaches to modelling credit risk

Texts


As well as


Assessment

80% of the mark for the course will be from a written examination at the end of semester 2; 20% of the mark will be from coursework during semester 2.

Further information and course materials are available at

http://www.ma.hw.ac.uk/~andrewc/erm/
Credit Risk Modelling (F71CM)
(15 credits, semester 2)

Lecturer: Prof A. McNeil

Aims

This course will introduce students to quantitative models for measuring and managing credit risk. It also aims to provide students with an understanding of the credit risk methodology used in the financial industry and the regulatory framework in which the credit risk models operate.

Syllabus

- Introduction to credit risk: credit-risky instruments, defaults, ratings
- Merton’s model of the default of a firm
- Common industry models (KMV, CreditMetrics, CreditRisk+)
- Modelling dependence between defaults with factor models
- Mixture models of default
- The Basel regulatory capital formula
- Calculating the portfolio credit loss distribution
- Introduction to credit derivatives: CDS and CDOs

Texts


Assessment

Credit Risk Management will be examined by a 2-hour exam.
Time Series Analysis (F71TS)
(7.5 credits, semester 2)

Lecturer: Prof A. McNeil

Aims
This course will introduce students to the main concepts underlying the analysis of time series, the involved statistical and mathematical tools and their applications in finance and actuarial science.

Syllabus

- White noise series, univariate stationary and integrated non-stationary random series.
- Backwards shift operator, backwards difference operator, and the roots of the characteristic equation of a time series.
- Define a time series through a general linear filter of another stationary random series (particularly of a white noise series).
- Well known models for linear processes – stationary autoregressive (AR), moving average (MA), autoregressive moving average (ARMA); nonstationary integrated ARMA (ARIMA).
- Random walks with and without drift, particularly those with normally distributed increments.
- A short introduction to multivariate time series models, in particular VAR model.
- Cointegrated processes.
- Estimation, diagnosis and identification of time series models.
- Non-linear (e.g. TAR and GARCH), non-stationary (e.g. regression with stationary errors) time series models.
- Applications of time series models and forecasts from time series data using Box-Jenkins method and extrapolation.
- Smoothing techniques applied to time series and seasonal adjustment.

- Recommended Texts


Assessment

Time Series Analysis and Financial Econometrics will be examined synoptically by a 3-hour exam.
Financial Econometrics (C21FE)
(7.5 credits, semester 2)

Lecturers: Dr A. Christev (coordinator) and Dr J. Brzeszczynski

Aim
To introduce the methods of econometrics and their application to financial data.

Syllabus

- Economic and financial data
- Basic econometric methods; simultaneity, identification
- Econometric methods
- Non-spherical disturbances
- ARCH models
- GARCH models
- Vector autoregression and Granger causality
- Unit roots
- Cointegration
- Error correction models
- Applied studies in financial econometric methods

Texts


Assessment
Financial Econometrics and Time Series Analysis will be examined synoptically by a 3-hour exam.
Special Topics in Risk Management (F71SR)
(15 credits, semester 2)

Lecturer: The topics are presented by industry professionals and assessed by academics. The Programme Director will lead the guided reading in the first half of the semester.

Aim
The aim of this course is to give students the opportunity to learn about recent developments in quantitative risk management and to give exposure to a number of topics that are not covered in taught modules.
It also prepares the students for dissertation projects.

Summary
At the heart of the Special Topics are four equally weighted guided reading projects, two of which will normally include practical experience of Moody’s Economic Scenario Generator. The remaining two projects will be freely selected from the Scottish Financial Risk Academy’s annual portfolio of industry offered projects.
The projects are usually undertaken in the latter part of the semester, in the first 4-6 week students will be prepared for the projects through assessed guided reading including, but not limited to:

- Report writing
- Presentation skills
- Computational skills (simulation, R, the use of LaTeX)

Examples of topics offered in in the past include:

- Retail Credit Risk (Royal Bank of Scotland)
- Banking Fundamentals (Royal Bank of Scotland)
- Trading Risk Models (Lloyds Banking Group)
- Counterparty Credit Risk (Credit Suisse)
- Asset Management (Aberdeen Asset Management)
- Real World Projections using the ESG (Moody’s Analytics)
- Liability Valuation using the ESG (Moody’s Analytics)

The projects involving the Moody’s Economic Scenario Generator (or similar financial software) covers the following topics:

- Architecture of integrated risk models
- Modelling interest rates in practice
- Modelling the macroeconomy in practice
- Modelling equities in practice
- Modelling credit risk in practice
- Modelling risk interactions and correlations
- Valuing risky assets in practice
- Integrated risk models for economic capital
- Integrated risk models for stress testing and scenario analysis
- Integrated risk models for decision making and management

**Assessment**

This course will be assessed by four pieces of coursework, two reports, and two presentations presentation that should be completed prior to the Semester 2 examination period. The essay should not normally exceed 10 pages, and presentations will be strictly limited to 20 minutes with 5-10 minutes for questions.

If Moody’s Analytics ESG topics are offered, they are compulsory.
7 Dissertations

7.1 Choosing a Project

From the beginning of June, students on the QFRM M.Sc. should begin working on their dissertations. These can be projects that are supervised internally, or they may be supervised externally in collaboration with a company (‘a placement’) arranged through the SFRA.

A list of possible projects will be distributed to students in Semester 2 (before the exams). The topics will vary from year to year, depending on the research or other interests of the staff and the priorities of the SFRA partner companies. The SFRA website lists previous Dissertation projects offered by industry (http://www.sfra.ac.uk/msc_placements.php).

We make the following suggestions for alternatives to those discussed above:

- Students are strongly encouraged, as they learn more in the first and in particular second semester, to devise projects on topics they are interested in. They should take their idea with the programme director to discuss it further and check its suitability, or to identify the most suitable supervisor.

- Students are also strongly encouraged to seek the opportunity to do their project in collaboration with an outside partner in a bank or financial institution (for example, a potential employer). The project will have to be devised again by the student and/or the contact in industry and must be approved by a member of academic staff. A number of good projects have been initiated in this way in the past.

- Obviously, as the programme proceeds, the more ideas you will have about what you would like to do. In theory the special topics are designed to get you to dip into the research literature to assist you in thinking up a suitable project.

- At the end of the second semester, students will be invited to nominate the four or five projects they would most like to do, in order of preference. We will then do our best to allocate projects to students in a fair way. If certain projects are over-subscribed, then relevant information may be taken into account (for example, rank order in the class in the examinations, performance in individual papers, or choice of special topics). Naturally, if you have already arranged a project/placement and supervisor this procedure will be unnecessary.

- Joint, or group-work, projects are permitted. That is, if two or three students (not more) wish to conduct a piece of collaborative research together, but then proceed to write up individual dissertations, this is will be permitted. However, the proposal will be first scrutinized and then monitored by a member of staff and students will be heavily penalised if similar theses are submitted. Such proposals will only be considered if there is evidence that whilst students will work together and pooling ideas, there is sufficient scope for individuality.

Remember that this is only a rough guideline. It is up to you to talk with staff about possible ideas. Whilst staff will offer suggestions, it is better that the student becomes involved in this process too. Don’t forget the golden rule if you are suggesting your own project: everything is subject to approval, and the criteria for having approval is that you will have convinced a member of staff to supervise you!!

7.2 Types of Dissertation

This list is not exhaustive, nor are its members mutually exclusive; it is just meant to give some ideas about what makes an acceptable dissertation.
• A *subject review* surveys a chosen area, summarising the research literature and providing an overview of its development, importance, methodology and outstanding problems.

• A *theoretical essay* describes, in considerable depth, some piece of mathematical theory relevant to finance. Papers in research journals are often very terse and assume a lot of prior knowledge on the part of the reader; and acceptable project could be to explain a recent paper, making its results more accessible and putting them in context.

• A *numerical project* would describe and implement one or more numerical methods for pricing, hedging or reserving for derivatives or portfolios, and perhaps aim to measure how well it performed using real or simulated data.

• A *data-based project* would analyse market or other data, fitting them to suitable models and drawing conclusions.

• A *software project* could aim to develop useful software for specific financial problems, perhaps as part of a placement with a financial institution.

7.3 Supervision

Arrangements need to be fluid, as staff have many other things to do beside project supervision (including holidays). Students should establish appropriate supervision arrangements with their supervisors at the start of the project. If you are involved in a pair of linked projects on the same area with the same supervisor, you should expect joint meetings with the supervisor in the early stages. Contact your supervisor as soon as possible to arrange a first meeting when you can discuss a rough timetable, in case he or she is about to leave town! Temporary substitute supervision may sometimes be arranged. If you have an external placement, you will need to make arrangements with both supervisors to ensure that you meet the requirements of the MSc degree.

As a matter of courtesy to your supervisor you should always arrive on time for your arranged meetings. You should never fail to turn up at a meeting without good reason. If you have to cancel an appointment then you should endeavour to contact your supervisor in advance.

7.4 Timetable

The dissertation period lasts 11 weeks, starting in early June. It is suggested that project work should be near completion by late July. This may vary depending on how much work is being written up as the project progresses. A first draft of the completed project should normally be ready in early August, but precise timing of this should be agreed with the supervisor.

As a rule of thumb, you have about four weeks to read around the subject; four weeks to do a piece of work; and three weeks to pull the dissertation together. That does not mean that you should wait for two months before drafting anything!

The deadline for handing in projects will be announced early in the summer by the programme director.

7.5 Format of the Dissertation

This section contains some guidance on what may be expected of a satisfactory dissertation.

• The main text of the dissertation must not exceed 30 pages, based upon a 12-point font size and 1.0-line spacing (that is, the same font size and line spacing as in this document). One
page of text typically contains 300-350 words. The main text referred to here does not include such things as tables, graphs, figures, references, appendices and computer code. As a general rule the inclusion of computer code is not encouraged unless it is central to the aim of the project. If there is any doubt over any of these requirements then please consult your supervisor.

- Past experience suggests that the best dissertations are written up as the project progresses. This allows supervisors to comment, which can lead to improvements. Also many students don’t seem to realise just how time-consuming writing up can be! Past experience also suggests that taking too much time off does not lead to good dissertations. We suggest you take your longest holiday break in late September after submission.

- Past experience suggests that poor dissertations can often be the result of: a poor record of attendance at supervisions; writing the dissertation at the last minute, particularly where the supervisor has not even seen a first draft.

- Dissertations must contain:
  - a cover page which gives the title of the project, the name of the student, and the year;
  - an abstract;
  - a detailed list of contents at the start;
  - an introduction to the project and the dissertation;
  - proper structure in the main body of the text including section numbering;
  - conclusions;
  - a full and detailed list of references;
  - acknowledgement of all persons who have contributed to the development of the project.

Failure to comply with this structure may mean that, instead of being awarded a pass, a candidate is asked to resubmit the project after revision. This will result in a delay in the award of the MSc until June the following year.

- Dissertations must use consistent mathematical notation throughout.

- Some questions that the examiners will be asking:
  - Does the introduction say clearly what the dissertation is about?
  - How well has the student explained the area of work and summarised the relevant literature?
  - Does the dissertation show evidence of learning beyond the material of the taught modules and special topics?
  - If the dissertation is mainly a survey, is it complete and up to date, and has the student shown clearly, by summarising and comparing the literature in their own words, that they have mastered the subject?
  - If the dissertation involves numerical work, is it described clearly enough for someone else to reproduce the calculations, if required, and do the conclusions demonstrate that the student understands what he or she has done?
  - Does the dissertation have a logical structure?
  - Are books and journal articles adequately referenced?
  - Where the results of numerical and other work are being discussed is this just a statement of what the results are or does the text contain real interpretation of the results. For example, does the text explain why the results are as they are?
• It is not necessary, and in fact would be quite uncommon, for a dissertation to contain truly original work that would be classified as research. What matters is that it shows the student’s own understanding of the chosen subject (not the supervisor’s!).

• Remember, it is your work that is being examined and not the supervisor’s. In particular, the supervisor is not there to proof-read your drafts or to teach you to write in English.

• Style and layout are up to the student subject to the constraints on structure detailed above. However, it is a good idea to look through a few journal articles and note the elements of good style. Remember, the examiners are researchers which means that they are, to a large extent, professional authors, and will not appreciate having to navigate a badly laid-out or sloppily-written dissertation.