ACST 865 Quantitative Methods in Financial Risk Management

SECOND SEMESTER 2009

Unit convenor: Nino Kordzakhia and Jiwook Jang
Prerequisites: ACST305/858(P) or ACST828(P) or STAT401/890(P) or Dean of Division Approval. Please consult the unit convenor if you do not meet any of the prerequisite requirements for the unit.

Students in this unit should read this unit outline carefully at the start of semester. It contains important information about the unit. If anything in it is unclear, please consult the unit convenor.

ABOUT THIS UNIT

This 4 credit point unit encompasses theoretical and practical aspects of quantification of three main types of financial risk, namely, market, credit and operational risk. The numerical and statistical modelling techniques introduced in the unit represent the tools adopted by actuarial and banking business to comply with advanced regulatory requirements.

Topics covered include:

- Credit Risk – the risk of default of counterparty
  1. Modelling credit risk: one-factor model
     - Estimation of default probabilities and correlation
  2. Correlation and dependence: copulas
  3. Traditional approaches: default probabilities and transition matrices
  4. Modelling credit risk: the structural and reduced form models
  5. Credit Derivatives: CDS, CDO and default times for first to default swaps

- Operational Risk – the risk of losses resulting from failed internal or external processes
  1. The elementary approaches
  2. Regulatory capital for operational risk

- Market Risk – the risk of change in the value of position due to changes in underlying market variable
  1. Risk factors and loss distributions
  2. The VAR measure and other risk measures
  3. Copulas revisited: Dependence and Multivariate modelling
  4. Market risk VaR: Linear Valuation
  5. Market risk VaR: Historical simulation and Monte Carlo simulation
  6. Back testing and Stress testing

ASSUMED KNOWLEDGE AND SKILLS

Some preliminary knowledge of discrete and continuous time models and related statistical modelling techniques utilised in pricing theory of financial derivatives is required. Students need to be able to use a computer to analyse problems in risk management. You should be able to use a word processing package (such as WORD), a spreadsheet (such as EXCEL), a statistical package (such as MINITAB) and a programming language (such as Visual Basic, Matlab or C++).
TEACHING STAFF

The staff involved in the teaching of this unit are

<table>
<thead>
<tr>
<th>Staff Member</th>
<th>Email</th>
<th>Telephone</th>
<th>Room</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Nino Kordzakhia</td>
<td><a href="mailto:nkordzak@efs.mq.edu.au">nkordzak@efs.mq.edu.au</a></td>
<td>9850 8549</td>
<td>E4A 537</td>
</tr>
<tr>
<td>(Unit Convenor)</td>
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<tr>
<td>Dr. Jiwook Jang</td>
<td><a href="mailto:jjang@efs.mq.edu.au">jjang@efs.mq.edu.au</a></td>
<td>9850 8575</td>
<td>E4A 613</td>
</tr>
<tr>
<td>(Unit Convenor)</td>
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<tr>
<td>Yu-Fan (Jack) Ng</td>
<td><a href="mailto:yng@efs.mq.edu.au">yng@efs.mq.edu.au</a></td>
<td></td>
<td>E4A 622C</td>
</tr>
<tr>
<td>(Unit Administrator)</td>
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</tr>
</tbody>
</table>

Nino Kordzakhia will be taking Week 1-7 lectures. Jiwook Jang will be taking Week 8-13 lectures.

Yu-Fan (Jack) Ng is a teaching administrator for this unit, who is responsible for all the administrative aspects of the unit. Administrative questions that are not covered in this unit outline should be directed to him on the Mail facility of the Blackboard.

All academic queries should be directed to the Unit Co-ordinators via the Macquarie University e-mail system.

CLASSES

The unit material is covered in the three hours that combines lectures and tutorials each week. Combined lectures and tutorials are held at the following times:

<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
<th>Location</th>
</tr>
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<tbody>
<tr>
<td>Thursday (Lecture)</td>
<td>9.00 am – 11:00 am</td>
<td>W6B 338</td>
</tr>
<tr>
<td>Thursday (Tutorial)</td>
<td>1.00 pm – 2:00 pm</td>
<td>W5C 311</td>
</tr>
</tbody>
</table>

There is no tutorial held during Week 1 and 8.

Weekly lecture & tutorial materials will be available from the Blackboard. Solutions to the examples/exercises covered in lectures/tutorials will be available from the Blackboard after the lecture/tutorial.

Any alterations to the combined lecture or, tutorial times, locations or enrolments will be advised in lectures and/or on the Blackboard.

CONSULTATION HOURS

There will be no official consultation hours. If face-to-face consultations for academic queries are required, students should contact to the staff member teaching the relevant part of the course via the Macquarie University e-mail system to make an appointment.

REQUIRED AND RECOMMENDED TEXTS AND/OR MATERIALS

The recommended textbook is:

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<tr>
<th>Title</th>
<th>Author</th>
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</thead>
</table>
The textbook by Hull includes the worked examples and exercises. Two copies of this book will be placed in the Reserve Section of the Library.

Other recommended books for this course are:


UNIT WEB PAGE

Online Learning @ MQ now uses Blackboard CE6 for online units. You can access your online units from http://learn.mq.edu.au/ or via the myMQ Student Portal. Your Online Learning @ MQ username will be your standard Macquarie Student ID Number (an 8-digit number found on your Campus Card) and you should use your myMQ Student Portal password for your CE6 online units.

Answers to frequently asked questions and help with login problems are available from http://learn.mq.edu.au/ and from http://online.mq.edu.au/docs/tecinf.html. Before you use the website you should make sure that you are familiar with all of this information, including the Information Technology Security Policy and Rules and the Information Technology Usage Rules. The information also mentions a number of “plugins” that may be required. Of those listed, in this unit you will only need Acrobat Reader.

The website for this unit contains:

- **Course content:**
  - Unit outline. A copy of this unit outline.
  - Unit notes.
  - Weekly exercises and their answers.
  - Matlab codes.
  - Assignments. Assignment 1 and 2.
- **Mail.** To contact the teaching administrator and for the teaching administrator to contact you.

It is your responsibility to check the website regularly to make sure that you are up-to-date with announcements and with messages sent to your Mail address.

Remember to close your browser when you have finished using the site. If you don't, another person can use the still running browser to access the website with your account.

LEARNING OBJECTIVES AND OUTCOMES

The unit aims to cover the key properties of statistical models and measurement techniques specific to financial risk management with a focus on development of computational applications. Students will
be exposed to simulation and financial data analysis at the level of development of their own computational routines for a model parameterization and evaluation of model specific risk measures.

In addition to the discipline-based learning objectives, all academic programs at Macquarie seek to develop students’ generic skills in a range of areas. One of the aims of this unit is that students develop their skills in the following: **Critical analysis skills; Problem-solving skills; Creative thinking skills.**

### TEACHING AND LEARNING STRATEGY

The unit material is covered in the three hours that combines lectures and tutorials each week. The tutorial is an opportunity for you to attempt questions for each section of work, or to ask questions. In addition to the tutorial, you can have face-to-face consultations for academic queries, for which students should contact the staff member teaching that part of the course via the Macquarie University e-mail system to make an appointment.

#### WEEKLY SCHEDULE

<table>
<thead>
<tr>
<th>Week Number</th>
<th>Week Beginning</th>
<th>Lecture Topics</th>
<th>Due Thu 9 am</th>
<th>Tutorial</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3 August</td>
<td>One-factor model. Estimation of default probabilities and correlations.</td>
<td></td>
<td>NK</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>10 August</td>
<td>Correlation and dependence: copulas</td>
<td>Tutorial</td>
<td>NK</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>17 August</td>
<td>Default probabilities and transition matrices</td>
<td>Tutorial</td>
<td>NK</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>24 August</td>
<td>The structural models</td>
<td>Tutorial</td>
<td>NK</td>
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<tr>
<td>5</td>
<td>31 August</td>
<td>The reduced form models</td>
<td>Tutorial</td>
<td>NK</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>7 September</td>
<td>Credit Derivatives</td>
<td><strong>Assign 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>14 September</td>
<td>Introduction to Operational Risk</td>
<td>Tutorial</td>
<td>NK</td>
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</tr>
<tr>
<td><strong>STUDY BREAK</strong></td>
<td>21 September</td>
<td></td>
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<tr>
<td>8</td>
<td>6 October</td>
<td>Risk factors, loss distributions and VaR</td>
<td>JJ</td>
<td></td>
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<tr>
<td>9</td>
<td>12 October</td>
<td>Expected shortfall and Coherent Risk Measures</td>
<td>Tutorial</td>
<td>JJ</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>19 October</td>
<td>Multivariate modelling and Copulas</td>
<td>Tutorial</td>
<td>JJ</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>26 October</td>
<td>Market risk VaR: Linear Valuation</td>
<td>Tutorial</td>
<td>JJ</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>9 November</td>
<td>2. Monte Carlo Simulation method. Stress testing and Back testing</td>
<td>Tutorial</td>
<td>JJ</td>
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### RELATIONSHIP BETWEEN ASSESSMENT AND LEARNING OUTCOMES

The following table gives an indication of the relative weighting of the assessment components:

<table>
<thead>
<tr>
<th>Assignment 1</th>
<th>Assignment 2</th>
<th>Final Examination</th>
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<tr>
<td>20%</td>
<td>20%</td>
<td>60%</td>
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</tbody>
</table>

**Assignment**

- Assignment 1 due: **Thursday 10 September 2009, 9:00 am**
- Assignment 2 due: **Thursday 5 November 2009, 9:00 am**
Assignments should be handed to the Unit Convenor at the commencement of the lecture in the week the assignment is due. **Late assignments will not be marked.**

Although you may discuss general aspects of the assignments with other students, you will be required to certify that the assignments are all your own work, and to provide your detailed working immediately on request if required. Further details of the assignments will be provided in class.

**Exam**

The final examination (3 hours with 10 minutes reading time) is worth 60% of the final assessment for the unit. The examination will cover the entire course. There will be a mix of calculation questions and short answer questions that require you to demonstrate a deeper understanding of the material.

You will be allowed to take to take a calculator that is silent and has no text-retrieval capacity plus one A4 page into the exam (handwritten or typed and filled in on one or two sides).

The University Examination period in Second Half Year 2009 is from 18 November to 4 December.

You are expected to present yourself for examination at the time and place designated in the University Examination Timetable. The timetable will be available in Draft form approximately eight weeks before the commencement of the examinations and in Final form approximately four weeks before the commencement of the examinations. [http://www.timetables.mq.edu.au/exam](http://www.timetables.mq.edu.au/exam)

The only exception to not sitting an examination at the designated time is because of documented illness or unavoidable disruption. In these circumstances you may wish to consider applying for Special Consideration. Information about unavoidable disruption and the special consideration process is available at [http://www.reg.mq.edu.au/Forms/APSCon.pdf](http://www.reg.mq.edu.au/Forms/APSCon.pdf)

If a Supplementary Examination is granted as a result of the Special Consideration process the examination will be scheduled after the conclusion of the official examination period. (Individual Faculties may wish to signal when the Faculties’ Supplementary Exams are normally scheduled.)

You are advised that it is Macquarie University policy not to set early examinations for individuals or groups of students. All students are expected to ensure that they are available until the end of the teaching semester, that is the final day of the official examination period.

**Examination Rules**

Normal examination rules apply to the conduct of the final examination. These rules are set out under the heading “Conduct of Examinations” in the Student Information – Assessment section of the current Macquarie University Handbook of Undergraduate Studies. Students are responsible for familiarising themselves with these rules prior to the final examination.

You should ensure that your handwriting in the final examination is legible. Sections of work that are not legible will not be marked.

Academic Senate has resolved that no mobile phones should be brought into examination rooms. Mobile phones must be switched off and sealed in closed bags during class tests.

Calculators will be allowed in the final examination but a clear indication of the steps involved in every calculation must be shown. Any machines that have a text-retrieval capacity, whether or not they have a full alphabet on the keyboard, are not allowed. Calculators may be checked at the commencement of final exam, and the make/model may be recorded.
Dictionaries will not be permitted in the final examination.

**CLASS ETIQUETTE**

Mobile phones should be switched off during all lectures and tutorials. If there is an important reason for you to keep your phone on you should request to be allowed to do so before the start of the class.

Lectures commence at 5 minutes past the hour and you are expected to be punctual. You are expected to keep talking to a minimum so as not to disrupt your fellow students (and the lecturer!).

**PLAGIARISM**

The University defines plagiarism in its rules: "Plagiarism involves using the work of another person and presenting it as one's own." Plagiarism is a serious breach of the University's rules and carries significant penalties. You must read the University's practices and procedures on plagiarism. These can be found in the *Handbook of Undergraduate Studies* or on the web at: [http://www.student.mq.edu.au/plagiarism](http://www.student.mq.edu.au/plagiarism)

The policies and procedures explain what plagiarism is, how to avoid it, the procedures that will be taken in cases of suspected plagiarism, and the penalties if you are found guilty. Penalties may include a deduction of marks, failure in the unit, and/or referral to the University Discipline Committee.

**UNIVERSITY POLICY ON GRADING**

Macquarie University uses the grades HD, D, Cr, P, PC and F for grading the achievements of students in units of study. The meaning of each symbol is explained in the Bachelor Degree Rules in the current Macquarie University Handbook of Undergraduate Studies. Your final result will include one of these grades plus a standardised numerical grade (SNG).

The numerical marks resulting from assessment of your work in this unit will be used as an initial indicator of the quality of your learning and understanding. The use of these numerical marks is, however, only a starting point in determining the appropriate grade. In particular, note that the SNG ranges mentioned in the Handbook of Undergraduate Studies are not the raw marks. To obtain a grade you must satisfy the qualitative definition of that grade. Once your grade has been determined, you are allocated an SNG indicating your approximate position amongst students assigned that grade.

Academic Senate has a set of guidelines on the distribution of grades across the range from fail to high distinction. It is important that you realise that the policy does not require that a minimum number of students are to be failed in any unit. In fact it does something like the opposite, in requiring examiners to explain their actions if more than 20% of students fail in a unit. For an explanation of the policy see [http://senate.mq.edu.au/rules/Guidelines2003.doc](http://senate.mq.edu.au/rules/Guidelines2003.doc) or [http://senate.mq.edu.au/rules/detailedguidelines.doc](http://senate.mq.edu.au/rules/detailedguidelines.doc).

**ELECTRONIC COMMUNICATION AND YOUR STUDENT FILE**

Every business keeps a record of its correspondence with its customers. The University is no exception and it maintains a file for every student. Staff are required to ensure that copies of all correspondence with you are added to your file. Historically, “correspondence” meant letters, but nowadays it also includes electronic communication such as email. Staff have some discretion here and might not file copies of trivial emails, but it is difficult to define precise boundaries here, so it is safer to assume that any email you send to a staff member will be added to your file.
Some people regard email as more ephemeral than a letter and thus tend to take less care with issues such as clarity of expression, grammar and spelling. Before sending an email to a staff member, a good question to ask yourself is: “If a member of staff is reviewing my student file prior to writing a reference for me, and they see a copy of this email, would that staff member gain a favourable impression of my level of communication skills?”

In this context, email includes communications you send to staff with the mail tool in the unit's website. It does not normally include postings you make to the discussion area. However, in those very rare cases where a student makes an inappropriate posting to the discussion area, a copy of the posting would be added to that student’s file.

**STUDENT SUPPORT SERVICES**

Macquarie University provides a range of Academic Student Support Services. Details of these services can be accessed at [http://www.student.mq.edu.au](http://www.student.mq.edu.au).

**BESS.** The (Faculty of) Business and Economics Student Services (BESS) is located in room E4B106 and offers photocopying facilities, reading areas and reference material.

**ACSTINFO.** This ACSTINFO site is used to distribute information to all students majoring in actuarial studies. The information supplied may include administrative information and job advertisements. You will retain access to this site during the vacation following the end of this semester. It is to your advantage to ensure you read information on this web site regularly. You should not assume that information posted there will also be repeated in lectures. When you first access the site, please read the section labelled “How to use this site”. This contains useful information that will help you determine when there is new information on the site that you should read.

**FEEDBACK**

We would welcome your feedback on any aspect of the unit.

If you see that something could be improved, let us know your ideas and if we agree that your ideas are good we will make changes. You can give us feedback in lectures or by posting to the website (anonymously if need be).

We hope not to see any feedback in the end-of-semester unit evaluations that we haven’t heard about already and therefore had the opportunity to respond to. Please get involved in making this unit as useful and rewarding as possible.

Nino Kordzakhia  and  Jiwook Jang
30 July 2009