SUBJECT REVIEW

2016 END-OF-YEAR EDITION

Contents

Preface

By now, you have probably ascertained that you may want to be an actuary. But what must one learn to become an actuary? A quick Google search for "actuarial science" will bring up this Wikipedia definition:

> Actuarial science is the discipline that applies mathematical and statistical methods to assess risk in insurance, finance and other industries and professions.

Perhaps this suggests a predominant study of mathematics, statistics, and finance. Nevertheless, this gives no headway as to what exactly an actuarial student may encounter in their university studies. As it turns out, the path to becoming an actuary is arduously complex, and the Actuarial Students' Society has recognised this.

This publication is the product of the society's efforts to create greater transparency regarding the subjects studied as part of an Actuarial Studies major under the *Bachelor of Commerce* degree. Through this, we hope that students hoping to graduate from the major may gain not only greater insight into the content studied in these subjects, but also general tips and advice that past students have provided based on their own experience. With authors coming from a range of different backgrounds, we hope to highlight the obstacles and challenges in each subject so that students may prepare themselves better for their studies.

In the 2016 end-of-year edition of the *Actuarial Students' Society Subject Review*, 9 new subjects were reviewed, in addition to updating reviews for each of the core subjects of the Actuarial Studies major. The *Actuarial Students' Society Subject Review* now contains up-to-date reviews for all core subjects in the 3-year undergraduate Actuarial Studies major, as well as reviews for the majority of subjects in the Honours-year program.

In 2017, there will be a few changes to the *Bachelor of Commerce* degree which will affect the experiences of future actuarial students. For instance, with the addition of FNCE10002 *Principles of Finance* as a core commerce subject, future actuarial students will no longer be required to complete FNCE20001 *Business Finance* to be eligible for their CT2 exemptions. This change will shift the breadth/elective subject that was previously available in first year into the second year of the degree.

Invariably, each review will be an expression of opinion — we urge readers to be conscious of this fact, as the subject experience may differ from individual to individual.

Please take note of the year and semester of each subject review. Subject content, structure, and personnel undergo continuous change, and it is important to recognise whether the reviewed curriculum has since been superseded. Such reviews will, however, still serve as a reliable reference for the general direction of the subject.

If you are interested in submitting a subject review for the next edition of this guide, please contact the Actuarial Students' Society at contact@melbourneactuary.com.

About the Actuarial Students' Society

The Actuarial Students' Society is the representative body for all Actuarial students at the University of Melbourne. Since being founded by Actuarial students in the mid-90s, the society has been an important link between students, the university, and employers. Our aim is to enhance the social and professional lives of our members. We help prospective actuaries build bridges and make connections with other students, mentors, and potential employers.

We host an array of events throughout the year and all students are welcome to attend. We provide valuable exposure to the industry at our premier event of the year, Contact Night, as well as career luncheons and workshops. Events such as Trivia Night, Poker Night, and Pool Night are great ways to make friends and have fun with fellow students and qualified actuaries in a relaxed, informal manner.

Our sponsors are industry leaders and always on the lookout for the best and brightest. We provide our members with information regarding internship and employment opportunities directly from our sponsors, along with many events where you can brush shoulders with practising actuaries.

For more information, including how to become a member, please visit our website or Facebook page:

www.melbourneactuary.com

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Disclaimer

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First-Year Subjects

ACCT10001 Accounting Reports and Analysis [SM1]

Exemption status	Not an exemption subject, but is a prerequisite for ACCT10002 *Introductory Financial Accounting* (CT2 *Finance and Financial Reporting* subject).
Lecturer(s)	Mr Noel Boys Professor Michael Davern
Weekly contact hours	1 × 2-hour lecture 1 × 1-hour tutorial

Assessments

Tutorial preparation and participation	5%
5 online tests	5 × 1%
Written Assignment 1, due in Week 5	10%
Written Assignment 2, due in Weeks 11 and 12	10%
3-hour end-of-semester exam	70%

Textbook recommendation	Birt, J., Chalmers, K., Maloney, S., Byrne, S., Brooks, A., & Oliver, J. (2014). *Accounting: Business Reporting for Decision Making* (5th ed.). New York, US: John Wiley & Sons.
Lecture capture	Full (both audio and video).
Year and semester reviewed	2016 Semester 1

Comments

Subject content

Most lectures in this course were taken by Noel Boys. This subject assumes no prior knowledge of accounting and covers basics of financial and management accounting, including:

- conceptual framework (1 week)
- financial statements including balance sheet, income statement and cash flow statement (5 weeks)
- ratio analysis (2 weeks)
- budgeting and cost–volume–profit analysis (2 weeks)

The other two weeks included an introduction to the course, exam advice, and an overview of accounting jointly taken by both lecturers.

I believe that this subject is well structured. We spent time covering the basics of transaction worksheets and financial statements in early lessons that provided a platform for following content. Likewise, financial accounting lays a foundation for discussion of management accounting and analysis.

ARA is quite a content-heavy subject but definitely manageable. There are many definitions and principles to remember; however, thankfully most of these are logical and intuitive. Whilst I acknowledge the importance of this subject in providing

This review was previously published in the 2016 mid-year edition of the *Actuarial Students' Society Subject Review*.

an introduction and framework to accounting, I found the subject content relatively dull. I personally enjoyed ratio analysis and budgeting as it essentially tied the subject together and was a departure from the rote-learning nature of financial accounting.

I used the lecture slides as a primary source of learning. Unfortunately, the textbook (unlike the ECON10004 *Introductory Microeconomics* one) was very dull and mundane. The lecturer provided sample solutions to selected questions from the textbook which were highly detailed and over-the-top. It is not expected that students answer questions in such detail, but it is certainly useful to see the scope in which questions can be answered. I skimmed through these questions and resorted to reading the solutions due to time constraints.

Lectures

All material covered in lectures can be found in the textbook. It is important to note, however, that due to the subjective nature of accounting, there is a multiplicity of approaches to many processes in this subject. For instance, some formulae or practices that are covered in lectures may differ from those presented in the textbook. The lecturer stresses that these differences are matters of personal preference and that students may take either route.

I found several of the early lectures quite dull. This is not attributed to the lecturer's style, but more a result of the course content. Noel Boys did a remarkable job in attempting to keep students entertained, especially in the last few lectures. I missed all four lectures streams due to timetable clashes, but thankfully the lecture recordings were sufficient. The lecturer uses a PowerPoint presentation in each lecture so text is easy to read. He speaks clearly and often uses examples to explain concepts that require some audience interaction. At times, however, his demonstrations on the document camera, such as examples of illegible numbers, are not recorded. It is stressed that these are primarily for humour so there is no issue.

Slides were generally released on the Sunday or Monday of the week, which may have meant that some people in the Monday stream were unable to print notes off in time for the lectures. These generally consist of 40–50 slides, but they are very concise with some useful diagrams and flowcharts. Occasionally, these slides contain slight errors, but these are often pointed out by the lecturer. Most students print these off and annotate them; others like to take their own notes. Certain lectures also have corresponding lecture illustrations, which are essentially blank financial statements that Noel works through during lectures.

Students undertaking this subject should be warned that several actions are highly frowned upon during lectures. Noel will cease speaking until unruly attendees stop speaking. Moreover, he stipulates clearly that photography in lectures is prohibited. I personally think it is stupid that people continue to dismiss his warnings and attempt to take photos right through to the last lecture. All the material is accessible from the LMS in the recording and the slides.

Tutorials

Tutorials in this subject were predominantly based upon discussion. Tutors sometimes briefly recapped the previous week's lecture or answered any questions at the beginning of tutorials. Each week a set of slides were presented containing approximately three or four questions adapted from the textbook. Students generally worked through these questions and discussed answers one at a time. Slides to most tutorials were not uploaded to the LMS. Therefore, whilst the discussion was very useful, retention was made harder by the fact that we did not have access to all the slides.

Assignments

There were two major assignments during the semester.

Assignment 1 was an individual assignment out of 30 marks that counted for 10% of the overall grade. Students were provided with a list of economic events and had to fill in a transaction worksheet, income statement, and balance sheet for the company. It was relatively simple and should generally have taken no more than a few hours. Marks were deducted for seemingly small errors such as bad formatting.

Assignment 2 was a group assignment (groups of four) out of 40 marks that accounted for 10% of the overall grade. Groups had to be formed within tutorials. Part A was to be completed over one week. Students had to calculate a set of ratios and conduct trend/vertical analyses on a set of data provided. This was worth 12 marks. Once the deadline had passed, a set of solutions was released. These then formed the basis of Part B, which was also completed over one week. Students were required to complete a report analysing these ratios and suggesting whether or not the company was a viable investment. This was worth 28 marks.

In general, assignment grading turnover was relatively fast, taking approximately one to two weeks for Assignment 1 and Assignment 2A to be returned. However, we did not receive Assignment 2B marks until after the exam. No feedback was provided for assignment 2B either, which could have been useful for the exam.

No summary statistics were provided for the cohort's performance on the assignments.

Online tests

There were five Wiley online tests held throughout the semester. Each test contained 20 pooled multiple-choice questions to be completed within an hour. Each test was worth 1% of the overall grade. Most of these questions were pure recall from the textbook, although some required simple calculations. However, this means that some questions required processes or formulae that were slightly different to those presented in the lectures as aforementioned. Some questions were marked incorrectly, and some students who realised brought this up on the OLT. Ultimately, each question accounted for 0.05%, which is relatively insignificant.

End-of-semester exam

The exam for this subject had 100 marks to be completed over three hours. It is a hurdle for passing the subject. In preparation, the lecturer provided a sample exam cover detailing the instructions, number of questions, and corresponding marks, as well as a list of phrases that people from a non-English speaking background may not understand (no dictionary is allowed in the exam). He also provided three past exams with irrelevant questions removed. These exams were not written by Noel, so they are quite different in style. This year's exam did not contain multiple-choice questions. It consisted of nine questions which covered each major topic in order. There was a balance between qualitative and quantitative questions, and students were required to prepare financial statements and budgets from scratch. Many students found the exam challenging and failed to "balance" the balance sheet.

Concluding remarks

This subject undoubtedly provides an insight into accounting. Many students decide upon completing this subject whether they wish to pursue accounting or not. It is well coordinated and easy to do well if you understand the underlying concepts.

ACCT10002 Introductory Financial Accounting [SM2]

Exemption status	CT2 *Finance and Financial Reporting*, in conjunction with FNCE20001 *Business Finance*. An average of 73 across this subject and one of • FNCE10002 *Principles of Finance* • FNCE20001 *Business Finance* is needed, with no fails.
Lecturer(s)	Mr Warren McKeown
Weekly contact hours	1 × 2-hour lecture 1 × 1-hour tutorial
Assessments	Tutorial attendance and participation 5% Wiley Plus Tests 2 × 5% MYOB Assignment 15% 3-hour end-of-semester exam 70%
Textbook recommendation	Carlon, S., Mladenovic, R., Loftus, J., Palm, C., Kimmel, P. D., Kieso, D. E., & Weygandt, J. J. (2010). *Financial Accounting Building Accounting Knowledge*. Milton, AU: John Wiley & Sons Australia.
Lecture capture	Full (both audio and video).
Year and semester reviewed	2016 Semester 2

Comments

Subject content

Concepts covered included (one lecture per dot point):

- Conceptual framework and company structure
- The Double Entry system
- Accrual accounting
- Inventory
- Bank reconciliation and receivables
- Non-current assets
- Liabilities
- Equity, dividends
- Cash Flow Statements
- Analysis – annual reports, debt/equity decisions
- GST
- Revision

This subject listed ACCT10001 *Accounting Reports and Analysis* as a prerequisite, but I found that there was a lot of crossover between the subjects. IFA essentially assumed no prior knowledge of accounting. IFA felt easier than *ARA* in the sense that the content was mostly the same, apart from the addition of the double-entry system.

Lectures

The lectures were based off the textbook, with slides containing screenshots from it. The lecturer was relatively good at explaining concepts, but sounded dull at times. Thankfully, we were always given 10 minute breaks during lectures and many finished early.

Most lectures had around 60 slides. However, Warren generally glossed over many of these, leaving students to read them at home. Some lectures also had accompanying "lecture illustrations" which were relatively useful. I found that I could get through without watching the lectures. The lecture slides and the textbook proved adequate.

Tutorials

Tutorials were based on weekly worksheets. Students were expected to complete these before each tutorial, but students in my tutorial were not penalised for failing to do so. I had the lecturer as my tutor (for the second accounting semester in a row). My tutor spent the tutorial displaying the answers on the document camera, which I felt wasn't very conducive to learning, since the answers were uploaded at the end of the week anyway. I preferred the discussion-style tutorials from *ARA*.

Assessments

The two Wiley tests had short answer questions, and required students to fill in the blanks. They were both graded out of 30. They were plagued with issues throughout both assessments. The first assignment also had a faulty "auto-grade" feature. Some students did not press "submit" and as such were not awarded any marks for those questions. Whilst the issue was fixed after several weeks, it was an administrative nightmare for the university. Moreover, students found that some accounts from the drop-down list were too similar, such as "Inventory" and "Merchandise"; "Accumulated Depreciation" and "Truck – Accumulated Depreciation".

On the other hand, the Perdisco assignment ran quite smoothly. Perdisco is the name of the company that designs the questions and data. Students were required to fill in financial statements and answer multiple choice questions about MYOB (the software in which data is entered) and hypothetical companies based on individualised data provided by Perdisco. Perdisco only allowed a limited number of students on the software for two hours each at a time, and only from 12pm–12am. However, by paying $25 students could complete the questions at any time. As for MYOB, students had the option of either using the Bouverie St labs or purchasing it from Perdisco for $20. I strongly suggest you vide the Perdisco Learning Centre before completing tasks. It should take about 10–15 hours, for a total of over 400 marks. I found that it was best to rectify all issues and errors in MYOB once answers to each stage were released.

End-of-Semester Exam

There were three semesters' worth of past exams and answers provided. I found these exams to be quite poorly written, with marks not always proportionate to effort required. Several questions were ambiguous, with answers failing to provide much clarification. For instance, we were informed that we did not need to remember any of the AASB numbers, however, these showed up occasionally in exams questions and sample answers.

ACTL10001 Introduction to Actuarial Studies

Exemption status	Not an exemption subject, but a great introduction subject which covers the basics of financial mathematics.
Lecturer(s)	Dr Xueyuan (Shane) Wu
Weekly contact hours	2 × 1-hour lectures 1 × 1-hour tutorial
Assessments	2 Microsoft Excel group assignments 2 × 10% 45-minute mid-semester test in Week 8 10% 2-hour end-of-semester exam 70%
Textbook recommendation	Dickson, D. C. M., & Atkinson, M. E. (2011). *An Introduction to Actuarial Studies* (2nd ed.). Cheltenham, UK: Edward Elgar Publishing. I did not find this textbook mandatory for the subject as the lecture slides cover all examinable material, however it does provide more working examples and questions.
Lecture capture	Full (both audio and video).
Year and semester reviewed	2016 Semester 2

Comments

Subject content

Early in the semester, the focus will be on financial mathematics: simple/compound interest and discounts, bonds and coupons, series of payments, future and present values, and mortgages.

During weeks 5 to 8, demography is covered, including material such as population distributions, survival functions, life tables and mortality rates.

After this, the hard material is introduced. Here, we learn about how contingent payments and their associated values are calculated, how to value different types of insurance (life, endowment, term), finishing with some theory about actuarial practices in general insurance, health insurance, and superannuation in the last 2 weeks.

The first assignment tests the knowledge of the first 3 weeks, not including bonds and housing loans. Excel skills are necessary here to add series of payments for evaluating present/future values. Overall, a straightforward assignment.

The mid-semester test was in week 8 and tests the knowledge of the first 6 weeks, meaning all of financial maths and parts of demography. It was out of 35 marks with 45 minutes writing time. This test proved to be very difficult this year, with an average score of around 50%, so don't stress if you score lower than you expected. Memorising formulas and their applications is crucial to receiving marks in this test.

The second assignment tests the knowledge from weeks 4 to 10. This assignment was more difficult and longer than the first one.

Other Comments

> You think this subject is easy now — wait a few weeks
>
> Shane Wu

This perfectly describes the subject, as the first few lectures about simple and compound interest would bore anyone, but the first escalation is at the introduction of annuities and calculating present/future values.

Understanding the wording and formula uses are crucial to calculating the correct answers at this stage. There will be an abundance of formulas to remember throughout the semester, so it's better to understand the formula's meanings than to try and rote-memorise the symbols. Population and demography is fairly straightforward, with more formulas and easy theory. The second escalation is during weeks 8-10 when we learn about contingent payments. There is no clear shortcut to mastering this except plenty of practice and references to the lecture slides' worked solutions and formulas. Lecture capture will be your best friend as Shane's explanations are sufficient in aiding your understanding of the questions at hand.

Personally, I did not attend many lectures or tutorials, and still found the subject to be manageable. Tutorial questions have worked solutions, and are very useful to solve and understand before the mid-semester test and end-of-semester exam. Sometimes the worked solutions differ from the lecturer's working, or the solutions won't make sense, so ask your tutor or attend the consults. Overall, the key to this subject is understanding how variables are related rather than memorising the myriad of formulas given throughout the lectures, and know how to apply them in a worded question. There were practice exams given for revision, and closely resembled the actual exam, making great practice as worked solutions are also provided.

Overall, it will be hard to catch up on this subject once you fall behind as the concepts taught require lots of practice and understanding to master. Even worked solutions may be confusing if one does not have adequate understanding of the topic, especially during the later weeks of contingencies. This subject is the closest thing to experiencing work as an actuary in first year, which makes Introduction to Actuarial Studies my favourite subject in first year, with its various real life application examples and interesting proofs.

ECON10003 Introductory Macroeconomics [SM2]

Exemption status	Not an exemption subject, but is a prerequisite for ECON20001 *Intermediate Macroeconomics* (CT7 *Business Economics* subject).
Lecturer(s)	Professor Robert Dixon
Weekly contact hours	2 × 1-hour lectures 1 × 1-hour tutorial
Assessments	Tutorial attendance and participation 10% 2 online multiple-choice tests 10% 2 assignments 2 × 10% 2-hour end-of-semester exam 60%
Textbook recommendation	Bernanke, B., Olekalns, N., & Frank, R. H. (2014). *Principles of Macroeconomics* (4th ed.). North Ryde, AU: McGraw-Hill. ✓ The textbook was very useful and gave more in-depth explanations to concepts than that covered in lectures and often is needed to answer tutorial questions. Get it if you can, or there are copies in the Giblin Euson Library High Use (limited availability). A note on Third Edition of the textbook: Page references to Third Edition were provided. Required readings for chapters specific to Fourth Edition were also provided as PDF on LMS. Can't guarantee that will always be the case. So make your own judgement when purchasing an older edition.
Lecture capture	Full (both audio and video).
Year and semester reviewed	2016 Semester 2

Comments

As an introductory subject, ECON10003 was not particularly challenging but nonetheless, the subject was very interesting and worthwhile and potentially a WAM booster if you are willing to work consistently.

In my experience, the key to doing well in Intro Macro is to stay up to date. Every week you should try to get yourself in a position where you are able to answer and understand all tutorial questions for that week, which surprisingly doesn't take much time. And attend all tutorials! If you do that, the final exam will be a walk in the park.

Subject Content

Below is a timeline of the topics covered in 2016 Semester 2. It serves as a rough guide only, please refer to the official subject guide for current information.

1. National Accounts: what is GDP and measurements of GDP.
2. Consumer Price Index (CPI) and inflation targeting.
3. Measuring unemployment, equilibrium unemployment, and Okun's Law.
4. Labour market, Cobb-Douglas production function, and Walras' Law.

5. Keynesian cross model: short-term economic activity.
6. Fiscal policy and flow of funds analysis.
7. Money and Banking.
8. Aggregate demand and supply model.
9. Solow-Swan model: long-term economic growth.
10. International trade.
11. Exchange rates.
12. Balance of Payments (not examined).

The majority of topics were simple and well-taught. In this subject, you will learn a lot of different economic models, so it would be a good idea to have a solid and distinct understanding of all the underlying assumptions for each model and understand what would happen if an assumption didn't hold.

Compared to *Accelerated Mathematics 2*, Intro Macro moves like a snail. However, Dixon roughly covers a new topic every week, and with assessments coming up every 3–4 weeks, this is not a subject you want to fall behind in. That being said, it's entirely possible to pass this subject by cramming because all final exam questions are drawn from tutorial questions which can be rote-learnt if desperate.

If you are a little rusty with your calculus, it's a good idea to brush up on your basic differentiation techniques — namely chain rule, power rule and product rule.

Lectures

To put it simply, the lectures were boring and slow but worth attending (or at least viewing). Almost every lecture, I found myself many slides ahead of Dixon and simply tuning out his voice and going through the slides at my own pace. Despite the delivery of the lectures being extremely unengaging, he gave good explanations and explains the content thoroughly. So, have some caffeine beforehand and go to the lectures.

If you are finding it difficult to concentrate during lectures, it might be a good idea to print the slides out and annotate them to keep yourself focussed.

Dixon does not annotate lecture slides. The slides will be uploaded to the LMS before the lectures that week along with extra reading material that the lecturer encourages you to read, but the extra material is not examinable or referred to during lectures or tutorials.

Tutorials

Go to these tutorials, not only for the 10% tutorial attendance and participation marks but also attending tutorials forces you to stay on top of the subject, which is key to doing well.

It is mandatory that you complete the blue sheet questions before attending tutorials and the tutors will be checking them. To best prepare for a tutorial, you should at a minimum complete the blue sheet questions and complete the required readings if you have time.

Tutorials normally begin with a discussion of the blue sheet questions, and then students are given time to work through pink sheet questions and responses are discussed. The class was split into groups of 4–5 students, normally based on the table you were sitting at. You will be asked to work through pink sheet questions as a group and present to the rest of the class and answer any questions from the audience, including the tutor. You will be assessed on your contribution to

the group and presentation for the 'participation' part of your tutorial mark. My tutor's guideline was that everyone should speak.

Pink sheet questions are similar in style to the blue sheet questions but are a little bit more difficult. Answers to blue sheet questions were posted on the LMS, however, no answers are provided for pink sheets other than the discussions during tutorials.

If you miss a tutorial, you were able to attend a make-up tutorial with ease. Due to the large cohort size for Intro Macro, you can find tutorials running in almost all time slots. Make sure you notify your tutor that you have attended a make-up tutorial to have your attendance counted towards your mark.

Assessments

Assignments

There were two assignments each worth 10% and can be done in a group of a maximum of 3 people or individually. Each assignment consisted of 3 questions of short answer style, similar to tutorial questions but are more in-depth and requires a more thorough discussion. However, they were mostly straightforward and it was actually very easy to fall into the trap of overthinking the questions. Most people were able to achieve very high marks on the assignments. Personally, I didn't enjoy the assignments. I found them to be not challenging nor value-adding, but I'm not complaining.

Multiple Choice Tests

As part of the assessments, there were two Online Multiple Choice Tests of 15 questions, each worth 5% of the total mark. The first test was based on content in the first 2 tutorials and was due in week 4. The second one was based on tutorials 3–9 and was due in week 7. These tests were tough, so take your time and prepare for them.

End-of-Semester Exam

Dixon made it very clear throughout the semester that exam questions are "all drawn solely from our 2016 tutorial and/or assignment work", which means if something didn't appear in a tutorial or assignment, it was not examinable (e.g. week 12 content). However, every subject coordinator is different, so don't expect this will always be the case.

For revision, I went through every tutorial question. Make sure you revise every single question, even if it's something that's not covered in lectures — if it shows up in a tutorial sheet, you can be asked about it. Ask people in my cohort about "automatic stabilisers".

In conclusion, I enjoyed this subject. Learning the content felt worthwhile and the teaching staff was to a great extent supportive and knowledgeable. Many thanks to my tutor for his patience and commitment.

Good luck!

ECON10004 Introductory Microeconomics [SM1]

Exemption status	CT7 *Business Economics*, in conjunction with ECON20001 *Intermediate Macroeconomics*. Satisfactory performance in both subjects' end-of-semester exams is needed.
Lecturer(s)	Professor Nisvan Erkal
Weekly contact hours	2 × 1-hour lectures 1 × 1-hour tutorial
Assessments	Tutorial attendance and participation 10% Online multiple-choice test in Week 4 5% Written Assignment 1 due in Week 6 10% Written Assignment 2 due in Week 10 15% 2-hour end-of-semester exam 60%
Textbook recommendation	Gans, J., King, S., Byford, M., & Mankiw, N. G. (2014). *Principles of Microeconomics: Australia and New Zealand Edition* (6th ed.). South Melbourne, AU: Cengage Learning Australia. Borland, J. (2013). *Microeconomics: Case Studies and Applications* (2nd ed.). South Melbourne, AU: Cengage Learning Australia. There are also some other recommended readings that are not textbooks. Harford, T. (2013). *The Undercover Economist* (2nd ed.). London, UK: Abacus. McMillan, J. (2002). *Reinventing the Bazaar: A Natural History of Markets*. New York, US: WW Norton.
Lecture capture	Full (both audio and video). The video of the recording will show the annotated slides under the document camera.
Year and semester reviewed	2016 Semester 1

Comments

Subject content

This subject assumes no prior knowledge of economics and covers three major topics:

- Markets (4 weeks): comparative statics, welfare, international trade, and market failure
- Firms (4 weeks): costs and the price/quantity decision, the effect of competition, and price discrimination
- Game theory (2 weeks): simultaneous and sequential games and their application to oligopolies

It is well structured, as many concepts introduced early on are built upon throughout the subject. While I find the interrelated nature of content in this subject conducive to my learning, it also means that students will need to have a sound understanding of the content presented in lectures to keep up with the course. However, this is generally considered an "easy" subject that relies to an extent on common sense, so this should not be an issue for many students. The most challenging

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topic is firm theory: in particular understanding how to draw graphs that represent costs and revenue. Personally, I found this topic interesting as it is highly applicable to real life situations. I particularly enjoyed game theory.

Initially, I reviewed lecture notes and the textbook and compiled a set of notes. However, I found that in general the lecture notes were sufficient. Whilst this subject does rely on some rote-learning, I found that it was more useful to focus on applying concepts learned to real-world situations and completing the revision questions. It would have been beneficial to read more of Jeff Borland's case studies book, as it would have given me a better informed approach to analysing and explaining economic decisions and their effects, which forms a significant part of Assignment 2.

Lectures

Most of the material covered by the lecturer can be found in the textbook. However, in a subject with many graphs and diagrams, I found the lectures highly useful as Nisvan worked through lectures and examples on the document camera. At times, however, Nisvan would spend 10–15 minutes covering announcements and summarising newspaper articles which caused lectures to fall behind. Her notes are clear and succinct, with each week's notes consisting of around 15 partial slides. Most students print these off and annotate them, but some prefer to take their own notes in notebooks or simply watch the lecture without note taking. These slides were mostly released on a weekly basis the night before the Tuesday lecture. During lectures, little audience interaction is required. If any, it is mostly just recall from previous lectures.

There are four lecture streams, which offers students flexibility when they have other commitments. Lectures are almost purely conducted through annotating slides on the document camera. The only material that cannot be found on the recordings are YouTube videos (which are not recorded due to copyright issues but links are provided on the LMS) and physical demonstrations with audience participation which arise when discussing firm bottlenecks and game theory. However, based on the lecture recordings, one can clearly ascertain the point being made. The only material presented exclusively at lectures was a printed copy of the subject guide in the first week. This can, however, also be found on the LMS. Therefore, students are not disadvantaged by watching lectures at home.

Tutorials

This subject uses a blue/pink sheet system. Each sheet consists of a few questions. Students will complete a blue sheet at home that covers the previous week's lectures (ideally before their tutorial) and then consolidate this by completing a pink sheet in class that is slightly harder. Blue and pink sheets are uploaded at the end of the week, along with answers to the blue sheet. In a way, this is an incentive for students to attend tutorials, as tutors work through the pink sheet. Tutors mark students based on participation, and if students fail to attend at least seven tutorials in the semester, they will lose one tutorial mark for each extra tutorial missed. Tutorials are mainly structured around the pink sheet. However tutors sometimes revise material presented in the previous week's lectures. Students are given time to complete each question before the tutor presents the answers. At times, due to the rushed nature of tutorials, there is little scope for discussion among peers while completing questions. It is easy to attend make-up tutorials as there is a list of all tutorials on the LMS. The temporary tutor will sign students' pink sheet for presentation to their tutor in the following week. My tutorial was on Monday morning which was before the Tuesday lectures. However, due to poor time management and failure to complete lectures on time as aforementioned, this meant that I was unable to complete some questions in both the blue and pink sheets without guidance from the tutor.

Assignments and assessments

There were two major individual assignments throughout the semester. Students were given approximately three weeks to complete each one, but that included the mid-semester break for the first assignment. Assignment 1 was out of 40 marks, whilst Assignment 2 was split into two parts — Part A out of 40 and Part B out of 20.

Assignment 1 (covering markets and welfare) and Assignment 2A (covering welfare and firm economics) were highly similar. Four excerpts from *The Economist* articles were presented with accompanying multi-part questions, requiring students to explain economic events and their implications. There is a word limit of 1000 words for each, which requires students to be succinct. Sometimes, questions were ambiguous and had too much scope for interpretation, meaning students were unsure what assumptions they should make and therefore how to answer questions. Here, the Online Tutor was highly helpful, providing some guidance as to what was expected of us. The marking allocation also confused students, as Assignment 1 was originally allocated 10 marks (later changed to 40 when results were released), and in Assignment 2A some questions had many marks allocated for seemingly short and simple answers. It was recommended that students draw graphs on the computer; however, this became very tedious so I resorted to drawing them by hand.

Assignment 2B was a case study. Students were required to explain an economic event or activity that had appeared in the news or been observed by the student. There was a word limit of 500 for this section. This was a fulfilling assignment, as it not only allowed students to revise previous concepts, but it encouraged us to be creative and think of real-world applications of economics.

Marking was quite lenient, with half-marks awarded in some instances. The lecturer noted that she was impressed with the quality of assignments; however, there were no summary statistics for the cohort's performance. Being one of the most popular subjects at the university, it is understandable that feedback comments were sparse. There was not much transparency regarding cross-marking so I cannot comment on consistency of marking. In this semester, there was an issue with the LMS that coincided with the submission deadline for Assignment 1. This caused the deadline to be extended by a day.

There was only one test in Week 4 that covered comparative statics and concepts such as opportunity cost. It was a 40-minute multiple-choice test of 10 questions that was conducted on the LMS over two days. Being an online test, students were able to access their notes at home whilst completing the test or ask other students who had already completed the test (albeit with different values) for advice. Two written practice tests and one online test were provided, although they were much easier than the online test. In addition, there was a review session that was conducted by the head tutor. According to the lecturer, a score of 9–10 was excellent, 7–8 was good and less than 7 meant students needed to revise concepts. Once again, summary statistics were not provided.

However, even though summary statistics were not provided, the head tutor released an excel spreadsheet during SWOT-VAC with marks from each assessment and indicative tutorial grades ('Y' if greater than 4 and 'N' otherwise). These are sorted by student number.

End-of-semester exam

The exam ran for 2 hours and allowed just over one minute per mark. It is not a hurdle for passing the subject. In preparation, four past exams and corresponding solutions were provided. One of these was written by the current lecturer. The exams in this subject are relatively predictable. There are three sections; multiple-choice, "Who is right?" and traditional short-answer questions. This year, there were 10 multiple-choice questions worth four marks each, so essentially each incorrect answer to a multiple-choice question lowers the final grade by 2. Section B presents sets of two statements, which in the past have been by Alan Accountant and Edwina Economist. Wisely, they decided to use tutor names this year, as it became

a trend that the economist was always correct. This section was worth 36 marks. The final section was short-answer and required several graphs. It was worth 34 marks. Overall, the exam was relatively straightforward with some challenging questions.

Necessary resources

There were two textbooks for this subject — *Principles of Microeconomics* and *Case Studies*. I bought the e-book for both of these. The textbook is normally $150, whereas the e-book is approximately half the price. Any edition is fine, as the subject guide presents page numbers corresponding to each edition. Explanations are very clear and examples including ice-cream and The Beatles are enjoyable. Some copies are available in the library; however, these are mostly High Use copies. The lecturer provided an extract from a book on game theory, as she believed that it was not covered sufficiently in the textbook.

Supplementary resources

There is a wide variety of resources that are available to students. The head tutor runs review sessions after each major topic, and there are documents containing key learning points and solutions for each topic. Tutors also have consultations and pit-stop tutorials. The Online Tutor was very friendly and helpful, responding to hundreds of questions even though many were repeats.

Concluding remarks

Ultimately, this subject requires students to be able to use graphs and diagrams as well as words to explain economic activity. Many students enjoy it because it requires "common sense". It is generally considered an "easy" H1 subject. However, students should not be overconfident as the exam is slightly harder than the assignments.

MAST10007 Linear Algebra [SUM]

Exemption status	Not an exemption subject; however, you will need either • an average of at least 75 across this subject and MAST10006 *Calculus 2* or • a total of at least 135 across this subject and MAST10009 *Accelerated Mathematics 2* to continue the major and enrol in ACTL20001 *Financial Mathematics I*.
Lecturer(s)	Professor Peter Forrester
Weekly contact hours	6 × 1-hour lectures 2 × 1-hour tutorial 2 × 1-hour computer lab session Contact hours occur over 2 days a week for 6 weeks. Each day consists of half of the week's contact hours.
Assessments	4 individual assignments 20% 3-hour end-of-semester exam 80%
Textbook recommendation	None; the lecture notes are sufficient. Just work through the slides as Peter goes along, and complete the homework slides once the relevant topic has been covered.
Lecture capture	None.
Year and semester reviewed	2016 Summer Term

Comments

Subject content

This subject covers six main topics:

1. linear equations
2. matrices and determinants
3. euclidean vector spaces
4. linear transformations
5. inner product spaces
6. eigenvalues and eigenvectors

Note: The area related to cryptography is not covered as in-depth as the normal semesters.

The content matter covered in this subject isn't too challenging but a good understanding of the different terms and how they differ is very important. What is the difference between "the image" and "the basis of the image"? The kernel, rank, nullity — many of these terms can be easily mistaken as each other and need to be distinguished properly. Peter does all of this as second nature so do pay attention and find ways to help yourself remember them, i.e. some weird acronym, repetition etc.

This review was previously published in the 2016 mid-year edition of the *Actuarial Students' Society Subject Review*.

Lectures

Peter goes through the concepts at a very fast pace which is as expected of an intensive subject. It's not that hard, but make sure you are following at all times, because once you fall behind, you fall behind.

Peter sometimes goes off on tangents to deepen understanding, but what I've realised is that you really only need to understand the general gist of what he is trying to say and rewrite what he has been ranting on for half an hour in about four lines or so. If you really have no idea what he's going on about, just look at the example questions and solutions to deduce the logic behind it. Peter's rantings is usually just a more rigorous explanation of these ideas.

Tutorials, assignments, and exam preparation

Go to tutorials! Tutorials are where you learn how to use the ideas you have been taught to answer exam-style questions, so it also doubles up as exam preparation. Same applies for assignments. Master these along with the past papers, and you will master the exam. Since this is the summer intensive they don't tend to make things too tricky. Questions should be quite similar to what you have been given throughout the semester and are quite predictable. In case of the one or two tricks which are used to distinguished the best from the good, this is where a very good understanding would help.

The lab sessions are not very useful for understanding or exam preparation, but now I've realised it's actually very good preparation for second-year MAST20004 *Probability* and MAST20005 *Statistics*, where lab sessions are so crucial to doing well in the subject.

Concluding remarks

I took this subject as my only subject during Summer Semester, so it was my only focus for 8 weeks (6 weeks of teaching followed by the exam), which probably made my life easier. Once again, I say this subject isn't hard, but a very good understanding is required to do well. Do not expect scaling to save you like in many other actuarial subjects. 75 should be your aim, and it can be deceptively harder than you think. Do not underestimate this subject.

MAST10008 Accelerated Mathematics 1 (1)

Exemption status	Not an exemption subject; however, you will need either • an average of at least 60 across this subject and MAST10009 *Accelerated Mathematics 2* or • a total of at least 135 across this subject and MAST10006 *Calculus 2* to continue the major and enrol in ACTL20001 *Financial Mathematics I*.
Lecturer(s)	Associate Professor Paul Norbury
Weekly contact hours	4 × 1-hour lectures 1 × 1-hour tutorial 1 × 1-hour MATLAB tutorial
Assessments	3 Maple online tests 6% 3 individual assignments 9% MATLAB test 5% 3-hour end-of-semester exam 80%
Textbook recommendation	✓ Get the yellow workbook on your first day of class. Anton, H., & Rorres, C. (2013). *Elementary Linear Algebra: Applications Version* (11th ed.). New York, US: John Wiley & Sons.
Lecture capture	Full (both audio and video). The video of the recording will show the annotated slides under the document camera.
Year and semester reviewed	2016 Semester 1

Comments

Subject content

This subject covers linear algebra, with topics including:

- Systems of linear equations, Gaussian elimination, matrix algebra, determinants, dot product, cross product, lines, and planes (3 weeks)
- Number systems and proof (1 week)
- Complex numbers (1/2 week)
- Vector spaces, subspaces, linear combinations, spanning sets, basis, dimension, row and column spaces, inner product, norm, and distance (3 weeks)
- Curve fitting (1/2 week)
- Linear transformations, image and kernel, matrix representation, change of basis, eigenvalues and eigenvectors, diagonalisation, orthogonal projection, Markov chains, diagonalisation of symmetric matrices and their applications to conic surfaces (3 weeks)

This review was previously published in the 2016 mid-year edition of the *Actuarial Students' Society Subject Review*.

- Functions of two variables, level curves, linear approximation, stationary points, and double integrals (1 week)

In my opinion, the most difficult topic was linear transformation: in particular picturing and understanding change of bases and matrix representations of linear transformations. Whilst there are definitely some very formulaic aspects to this course, such as row reduction, Gram–Schmidt process and finding eigenvalues and eigenvectors, there are definitely times when a deeper understanding of the material is required. In this course, there is quite a lot of assumed knowledge. Students should remember all the formulae for differentiation and integration from VCE Specialist Mathematics, as well as compound and double angle formulae to name a few. There is no formula sheet on the exams, so students will either need to remember algorithms (such as the Gram–Schmidt process and the formula for orthogonal projection) or be able to derive them in the exam. Moreover, calculators are prohibited on the exam, so students should have quick mental arithmetic skills. I completed the workbook questions for half the semester; however, due to an increased workload, I slacked off towards the end of the semester. As tutorials are dedicated towards working on selected questions from the workbook together, this hindered my ability to contribute to discussion as it was my first time seeing the questions.

Lectures

The lectures in this subject are extremely important. With four lectures per week, it is very fast-paced. Missing more than one lecture in a row can leave you significantly far behind. Paul's lectures are highly structured. They begin with the customary "Let's begin the lecture" and a short recap of the previous lecture's content. Somewhere during the middle of the lecture, he will say, "Let's pause there," allowing students to stretch and talk for a couple of minutes. These interludes allow Paul time to ponder examples he wants to discuss, raise subject announcements, or tell us about various mathematicians and their relevance to the subject (linear algebra). Finally, he will end with "Let's finish there". Paul is highly engaging with many humorous anecdotes to share.

Lectures are conducted on partial slides on the document camera. Unfortunately, the document camera in Elisabeth Murdoch Theatre A is horrible and has issues focussing. It caused visibility issues for all students due to the blurriness of text. Lecture slides are uploaded promptly on the Friday before the week's lectures, providing students with ample time to print them off. Lectures were fully recorded on the document camera; however, at times Paul would write on the secondary document camera which was not recorded (although this mainly occurred when he was discussing extra material during his interlude). Attending the lectures and watching the recordings are both beneficial in their own ways. Attending lectures is useful as Paul often refers to the secondary document camera and occasionally makes hand gestures for explanation during lectures. On the other hand, especially for people who sit at the back of the theatre, it is often hard to decipher what Paul is writing because of the small font which is exacerbated by the issues with the document camera. He also does not provide scans of lecture slides. Therefore, it is often useful to check the lecture recording to clarify what he has written.

Sometimes, Paul makes minor arithmetic errors. However, these are offset by the speed at which he performs and writes calculations. They are usually corrected relatively swiftly. Paul sometimes uses jargon such as "trivial" and "tautology", which can be confusing. However, the meaning can usually be gleaned from the context. There is only one lecture stream; however, the lectures are recorded almost instantly.

Tutorials

Tutorials run for two hours, split evenly between question practice and MATLAB. While attendance is taken for this subject, it does not count towards your final grade. Attending make-up tutorials is relatively easy, with tutors relatively happy to accommodate extra students.

In the practice sessions, students work in groups of approximately five, doing selected questions (stipulated by the tutor at the start of the class) on the board. Students are encouraged to discuss and work together, with the tutor providing assistance as necessary. Some tutors also choose to recap material from lectures. For students who are on top of the workbook questions, these sessions are not very useful as they will just be watching other students struggle with questions.

MATLAB sessions are slightly different. Two tutorial classes will combine to join one lab session. There is a worksheet for each week with instructions on what to do and questions relating to the content of that session. These are available along with lecture slides before the week of the lab. Some sessions are useful as they enhance our understanding by allowing us to visualise planes and lines (such as the determinants and cross product labs), but others seem slightly less relevant such as the fractals lesson. Time management is also an issue. Some sessions, such as the Hamming code session can be completed relatively quickly, but others such as the fractals session are almost impossible to complete within the allotted time. When it comes to MATLAB, it is clear that there is a very broad range of abilities. Some people will struggle with understanding what to do, whilst others may not need any assistance from tutors.

Assignments

In total, there were six assignments: three online Maple assignments and three written assignments.

The Maple assignments are relatively easy. Students are given three attempts, with an unlimited time limit to complete each attempt. The best grade is taken as your final grade for that assignment. The first assignment covered row reduction, systems of linear equations, matrix algebra, and inverses. The second assignment covered cross product, dot product, lines, and planes. The final maple assignment covered dimension, basis, linear dependence, and orthonormal basis. As most of these are relatively formulaic, students generally get 100%. It is often careless mistakes or notation errors that cause students to lose marks.

The written assignments are much more challenging. There are approximately seven questions in each; however only half are marked. Each question is marked out of five. There are usually a couple of relatively formulaic and easy questions, but there will be a couple of more challenging questions that require proof or much more thought. These cover all the content in the course apart from the final sections on conic surfaces and functions of two variables. Marking is generally quite strict as notation and inclusion of sufficient explanation in proofs is required.

Summary statistics for students' performance in this course were generally not provided, besides a comment from Paul that nearly everyone scored full marks in the first couple of Maple assignments.

Assessments

The MATLAB test was the only timed assessment throughout the semester. It covered much of the material that was presented in the lab sessions. A 45-minute assessment, it consisted of short-answer questions and a programming question where students were required to show the tutor their script working. Most students struggled with this. There was a practice test available that was quite similar to the actual test. Paul remarked during a lecture that students' performance in the subject is generally very high; however it is quite the opposite in the MATLAB test.

End-of-semester exam

The exam for this subject is usually worth 100 marks and runs for 3 hours. There are about six years of past exams on the Baillieu library (and corresponding answers posted on the LMS) and three "Typical Exam Questions" sets (of which two

have full solutions and one has answers). These are relatively good indications of the level of exam questions. However, in my opinion, the standard has slowly risen throughout the years. There are relatively simple stock-standard questions including matrix "rank", orthonormal basis, or induction proof questions that appear every year; however there are also other separator questions such as proofs that are much harder to predict. The day before the exam I went to Paul's consult. Apart from achieving the world record of having the most people ever to sit on his office couch, it was a highly useful opportunity. He explained several concepts at a slightly deeper level and provided some valuable advice for the exam. This year, I found the exam to be relatively consistent with previous years. There were definitely some easy marks there but also a few questions that required deeper thinking.

Necessary resources

The recommended textbook is *Elementary Linear Algebra*. Lecture slides have references to the relevant chapters. I did not buy this textbook as I found Paul's notes sufficient; however, copies can be found in the library. It did not cover complex numbers or functions of two variables. The main resource for practice questions is the workbook which is uploaded to the LMS. There are many questions; however, all the proof questions come with the solution "Proof required". This means students are often unable to mark their proof.

Software

The main software used in this subject is MATLAB. Students are able to download this from the University's website, and it is also available on university computers. I was relatively proficient with MATLAB. From the lab sheets, I was able to ascertain what to do, even if I did not understand how or why it worked. Familiarity with MATLAB does not affect performance in this subject, apart from the MATLAB test in Week 12 of course.

Concluding remarks

Accelerated Mathematics 1 is a challenging subject, but with good basics it is relatively easy to get a decent score.

MAST10008 Accelerated Mathematics 1 (2)

Exemption status	Not an exemption subject; however, you will need either • an average of at least 60 across this subject and MAST10009 *Accelerated Mathematics 2* or • a total of at least 135 across this subject and MAST10006 *Calculus 2* to continue the major and enrol in ACTL20001 *Financial Mathematics I*.
Lecturer(s)	Associate Professor Paul Norbury
Weekly contact hours	4 × 1-hour lectures 1 × 1-hour tutorial 1 × 1-hour MATLAB tutorial
Assessments	3 Maple online tests 6% 3 individual assignments 9% MATLAB test 5% 3-hour end-of-semester exam 80%
Textbook recommendation	✓ Get the yellow workbook on your first day of class. Anton, H., & Rorres, C. (2013). *Elementary Linear Algebra: Applications Version* (11th ed.). New York, US: John Wiley & Sons. This was the recommended text. I did not have this text and found that it wasn't necessary. The lecturer will post some free material on the LMS. Free software such as MATLAB and Mathematica is downloadable from the University's website.
Lecture capture	Full (both audio and video). 100% of the material used in the lecture are recorded as all working out and examples are done on the slides. However, the reflection of light on the pages is sometimes harsh, making the writing illegible. Good for catching up or reviewing material at your own pace.
Year and semester reviewed	2016 Semester 1

Comments

Subject content

The entire subject is very matrix-oriented, so it is crucial you understand the basics of matrices in order to build your knowledge. The first few weeks will be about matrix operations, row echelon form and matrix manipulation, as well as revision from VCE Mathematical Methods and Specialist Mathematics such as vector spaces and linear transformations. Other topics in the semester consist of, in chronological order: proofs, proof by induction, lines of best fit, orthogonal projections, eigenvectors, multivariable calculus, and other subtopics.

This review was previously published in the 2016 mid-year edition of the *Actuarial Students' Society Subject Review*.

Positive aspects

The lecturer is interesting and quite friendly. The material is mostly straightforward and there are tons of YouTube videos on just about every topic. The lecture recording is wonderful and I recommend you use it. The material is not so difficult if you can handle the speed it is delivered.

Negative aspects

The course moves at a very fast pace, and the lecturer only covers the basics of a topic before throwing students into the deep end through the workbook questions. It is hard to catch up if you fall behind a few lectures, as each lecture builds upon previously learnt knowledge. However, lecture capture and Khan Academy can help you catch up. The lecturer can be confusing at times, taking back previous statements about some parts of theory. Marking of written assignments differs depending on how harsh your tutor is, such that sometimes incorrect notation or expression will result in the deduction of many marks.

Concluding remarks

Overall, I would give this subject a difficulty of 3.5/5, as it is mainly falling behind that will put you in trouble, and the content is mainly straightforward. The tutorials are actually very helpful in areas of understanding and problem-solving, as the style is to work in groups to answer some questions with tutor assistance if needed. Parts of the lectures can also be helpful, such as the two or three worked examples explained each lecture, so it's recommended that you attend or watch them online. Tutorial attendance is recommended as it helps solidify knowledge learnt in previous lectures, and the group-based activities aid learning new methods of problem-solving. The most valuable advice I can give overall is just to not fall behind with lectures; keep up to date with workbook questions, and you should be fine!

MAST10009 Accelerated Mathematics 2

Exemption status	Not an exemption subject; however, you will need either • an average of at least 60 across this subject and MAST10008 *Accelerated Mathematics 1* or • a total of at least 135 across this subject and MAST10007 *Linear Algebra* to continue the major and enrol in ACTL20001 *Financial Mathematics I*.
Lecturer(s)	Professor Barry Hughes
Weekly contact hours	4 × 1-hour lectures 1 × 1-hour tutorial
Assessments	2 individual assignments 2 × 5% 45-minute mid-semester test 10% 3-hour end-of-semester exam 80%
Textbook recommendation	MAST10009 Accelerated Mathematics 2 — Textbook Matched to the Lectures for 2016
Lecture capture	Full (both audio and video).
Year and semester reviewed	2016 Semester 2

Comments

Subject content

This subject covers content from Real Analysis and Calculus 2, including:

- Sequences — convergence, divergence, Landau symbols, limit theorems, Cauchy and contractive sequences (6 lectures)
- Functions, Limits and Continuity (8 lectures)
- Differential Calculus — mean value theorem, l'Hôpital's rule, iterative solutions, Taylor polynomials, hyperbolic functions, inverse hyperbolic functions (9 lectures)
- Mid-Semester Test (1 lecture)
- Integral Calculus — Riemann integrals, integration techniques (4 lectures)
- Differential Equations — first-order and second order linear ODEs; applications to: population models, mixing, motion with drag, electric circuits (8 lectures)
- Improper Integrals — applications: probability density functions, Fourier transforms (3 lectures)
- Infinite Series — convergence, power series, complex series, Fourier series (7 lectures)
- Revision of past exams (2 lectures)

This subject was markedly different to MAST10008 *Accelerated Mathematics 1*, with the only notable area of crossover being integration with the complex exponential. This subject, in the lecturer's words is essentially the "purest" take on applied mathematics. There was a vast amount of content covered in AM2. However, we were constantly reminded that AM2 was only the tip of the iceberg. To truly solve all of life's problems, we need to take MAST30021 *Complex Analysis*.

Lectures

There were four lectures per week in this subject. Each lecture had accompanying slides (which were mostly the same as the textbook) which covered the main theory in the subject. Each lecture had accompanying examples, to which the lecturer completed working on the blackboard. I found the worked examples highly useful for completing exercises at the end of each lecture, as the textbook mostly covered theory. The lecture capture consisted of the slides and audio. If you do happen to miss a lecture, you may either copy the notes from someone else, or if you are skilled enough you may take notes based on the audio recording. It should be noted that for later lectures there are selected worked examples at the back of the book.

Please do not take photos of the lecturer or the worked examples, as you are sure to be reprimanded.

Barry is a highly entertaining lecturer. He delivers lectures with enthusiasm and confidence. His most memorable lecture comes in lecture 7, the first lecture on functions. You will definitely pick up several new words in your vocabulary, including "lizard brain" and "antisocial mathematics". In response to the previous subject review, we did use decimals precisely once during lectures.

Tutorials

Tutorials ran for one hour, and tutors generally chose several questions from the exercises in the textbook. Students worked in groups on the whiteboards whilst tutors walked around providing guidance. My tutor had a policy where students were forbidden from consulting the textbook while answering questions. I believe this was highly restrictive as many students resorted to standing around the whiteboard clueless. Whilst attendance was recorded for tutorials, it did not contribute towards our grade.

Assignments

In total, there were two written assignments for this subject. The first assignment covered sequences, and the second covered MAST10006 *Calculus 2* concepts including integration and differential equations. Each assignment was graded out of 100 marks, with worked solutions provided. I believe the marking for this subject was largely inconsistent between tutorials. Students from different tutorials with highly similar answers (there is no suggestion of any collusion here) were graded differently. The lecturer stated that any discrepancy in marks would largely be negligible in the long run, which is true to some extent. If you thought that marking for AM1 was tough, marking for AM2 is even tougher.

Mid-semester test

The 45-minute mid-semester test was held precisely half-way through the semester. The lecturer stressed that definitions should be understood and memorised. Sure enough, this test required a strong grasp of the definitions provided in the course.

End-of-semester exam

The exam for this subject is usually worth 150 marks and runs for three hours. There are about six years of past exams in the Baillieu library. Answers were unavailable although Barry ran through some questions in the last two lectures. These past exams were generally good indicators of the standard of the 2016 exam. Students in my cohort were prepared for a Taylor–Lagrange question — however, this failed to materialise.

Barry's consultations were engaging and useful. Even if I did not have questions, I still learned from listening to him explain concepts. Make sure to collect a stamp on your textbook.

Second-Year Subjects

ACTL20001 Financial Mathematics I

Exemption status	CT1 *Financial Mathematics*, in conjunction with ACTL20002 *Financial Mathematics II*. Satisfactory performance in both subjects' end-of-semester exams is needed.
Lecturer(s)	Professor Daniel Dufresne
Weekly contact hours	2 × 1-hour lectures 1 × 1-hour tutorial
Assessments	Group assignment, due start of Week 5 10% Group assignment, due start of Week 11 10% 45-minute mid-semester test in Week 7 10% 2-hour end-of-semester exam 70%
Textbook recommendation	Fitzherbert, R., & Pitt, D. (2012). *Compound Interest and its applications*. Melbourne, AU: University of Melbourne Custom Book Centre. ✓ The textbook is highly recommended, as it is a very good complement to the slides and provides a useful set of practice problems.
Lecture capture	Full (both audio and video).
Year and semester reviewed	2016 Semester 1

Comments

Subject content

- Simple and compound interest
- Effective rates, concept of present value and discounted value
- Nominal and equivalent rates of discount
- Time-varying rates, general nominal rate, accumulation factors, consistent markets
- Continuously compounded rate of interest (CCR) and relationships with accumulation factors
- Nominal rates, discounted value as a function of CCR
- Inequalities and limits of $d^{(p)}$, $i^{(p)}$ etc.
- Valuing unit payments at unit intervals
- Level continuous payments
- Calculation techniques which require adjustment
- Valuing cash flows with linear variations
- Valuing generalised cash flow, compounding under reinvestment vs payment as due
- Solving equations of value and associated conditions for a unique solution
- Loan contracts — calculating repayments

This review was previously published in the 2016 mid-year edition of the *Actuarial Students' Society Subject Review*.

- Loan contracts — renegotiations, flat rates
- Project evaluation
- General overview of equities, securities, bonds, hybrids, and derivatives
- General overview of futures, hedging, options, forwards, and interest rate swaps

The subject is well structured and continuously builds upon the content that is taught in lectures. Daniel begins by exposing students to the various types of interest rates that appear — simple, compound, forces — in different time periods — quarterly, half-yearly, yearly etc. In addition, there are nominal and effective rates. Discount rates are then studied in a similar method. Daniel will then work through the common actuarial symbols, annuities, and accumulations which students were exposed to during the course of ACTL10001 *Introduction to Actuarial Studies*.

Using this material, students then become familiar with calculating the present values and accumulations of cash flows using different interest rates as well as solving equations of value. This is where the content becomes trickier, with interest rates becoming a function of time or perhaps payment frequency becoming irregular, continuous, or also a function of time.

Leading on from this, you move onto loan contracts and business projects, which is the application of valuing cash flows and solving equations of value. Following this, students are exposed to loan repayment schedules and flat-rate loan contracts, which is not too difficult.

Towards the end of the subject, the lectures become more theoretical with the introduction to various asset types such as property, bonds, and derivatives. It is good to understand this section, but one can get away by rote-learning. This part of the syllabus was allocated six or seven marks on the end-of-semester exam.

It is also important to mention that if you did not study MAST10009 *Accelerated Mathematics 2* to satisfy the requirements for this subject, there is some extra study to do in regards to Taylor polynomials and Taylor series. However, do not fear — as a student who studied MAST10006 *Calculus 2*, there is an abundance of resources online that can be read or videos that can be watched to understand these concepts. Furthermore, Daniel posts some useful resources on the LMS that will also help. In addition, consult your peers — this is extremely useful when trying to grasp new concepts.

Lectures

Whilst the back-to-back lectures on Monday from 3.15pm–5.15pm proved to be inconvenient at times, I thoroughly enjoyed attending lectures and listening to Daniel's explanations. It is argued that reading the textbook is not essential if lectures are attended, but it does not hurt to see concepts in another perspective. There were a few instances that lectures were not recorded due to technical difficulties, but other than that all lectures were recorded. Nonetheless, I attended all lectures.

Lectures follow the slides, where the theory is explained followed by an example. Daniel used the document camera to better explain certain concepts that were sometimes found difficult to grasp, such as discount rates. Lecture slides are made available on the LMS, and sometimes Daniel made minor changes to these slides during lectures. Again, do not worry, as these changes are made available on the LMS following the lecture.

Early on students may fall into the temptation that this subject is merely an extension of ACTL10001 *Introduction to Actuarial Studies*. Whilst this may be true for concepts such as simple interest, compound interest, and aspects of loan contracts, this subject does contain new concepts such as discount rates, cash flows with linear variations, and much more as you will see through your study of this subject, so do not become complacent!

Tutorials

Some students will argue that they could skip lectures and get by through reading the textbook. However, I do believe attending the tutorials is most beneficial in this subject.

The content in lectures wasn't always new, as mentioned earlier, due to the concepts taught in ACTL10001 *Introduction to Actuarial Studies*. However, I felt the tutorials took a more "investigative turn" where tutorial questions required me to really think before answering questions, which was a very stimulating challenge.

There are the standard questions which involve finding the present value or accumulation given an interest rate. Nonetheless, there were often questions which required one to find recursive relationships or proving algebraic relationships, which could be done in numerous ways. This aspect of this subject really appealed to me. Whilst I found it challenging, the satisfaction of solving such problem was most rewarding.

The tutor will work through the problems on the board or ask students to work collaboratively and share solutions to the class; this really depends on the tutor. I was very fortunate to have a brilliant tutor who recapped lecture content and also taught us tips and tricks to answer questions more efficiently. Again, like lectures, I attended every tutorial and found it most useful in understanding concepts of this subject.

Assignments

In 2016 Semester 1, there were two assignments which were completed in a group of four or five students. Assignments were handed in at the end of the lecture on the due date. Our first assignment was marked out of 40 marks whilst the second was marked out of 30 marks, with each contributing 10% towards the final grade.

I personally found the assignments to be quite interesting. Some questions were straightforward, requiring one to calculate present values or perhaps a monthly loan repayment. Whilst it may sound simple, it is important to show full working out to obtain full marks, which is good practice for exam situations. Other questions required a lot more thinking such as finding simplified expressions or proving algebraic expressions. I found that these questions were generally more difficult and required a lot of group discussion before reaching an answer.

Whilst these assignments are completed as a group, I do believe that it is worthwhile for all members to individually answer the questions before discussing solutions. In doing so, this allows each member an attempt at the questions, enabling each student a learning experience from completing the assignment. Furthermore, it generally ensures that the final answer is correct if everyone in your group obtains the same answer!

Daniel does allow students to type assignment answers using TEX and to draw graphs using Excel or Mathematica, which is also good exposure to the abundance of software that exists.

Mid-semester test

5 minutes of reading time and 45 minutes of writing time are given.

In 2016 Semester 1, the mid-semester test covered up to, but not including, the valuation of continuous cash flows.

Make sure you are well prepared. One can never really know how difficult these exams can be. In 2016 Semester 1, the test was doable. However, from general consensus, students made mistakes purely due to misreading the questions; I was

also guilty for this. Make sure to read questions word for word, and underline key parts if needed to ensure you understand what the question is asking of you. Other than that, our test had nothing obscure.

It is also important to improve timing. All the questions can be completed by students but the time factor in these assessments add the extra bit of pressure. The best way to combat this is by constantly practising the art of answering questions. We were given one specimen mid-semester test and a past mid-semester test as practice. Do these questions under timed conditions to see where you can improve and endeavour to double-check answers to avoid making silly mistakes.

The mid-semester test was accompanied by a formula sheet. However I do not think students will need this, because with practice the notation and formulae become second nature to you.

End-of-semester exam

The difficulty of the exam will be erratic. In 2015 Semester 1, the year before my semester, the exam was overly simple and resulted in downward scaling in the subject. On the contrary, in my semester, those I spoke with, including myself, did not find the exam as straightforward but instead found it quite difficult.

The exam is largely computational in nature with less than 10% of the marks based on the theory that is covered in the final lectures. Overall, I believe the exam tests one's ability and comfort with interest rates and cash flows.

As I mentioned earlier, without time constraints these questions are doable. However, time pressure can cause the inability to finish the exam on time, while exam stress can really throw students off track to make small errors that lead to incorrect final answers.

Again, as mentioned earlier, my tip to combat the stress and to improve timing is by practice. Complete the textbook questions, and complete the tutorial questions. Then complete the specimen exam and past exam that is provided under timed conditions. If you have time, search online, and there will be abundance of questions related to this subject. In doing so, one exposes themselves to the wide variety of questions that could be asked and the style in which they could be asked.

Improving one's timing is vital in this subject. This isn't about writing your answers quickly; it is about being able to find little tricks to simplify a problem or recognising algebraic identities that make the computations that less time-consuming. For example, it might be recognising the relationship between discount rates and interest rates that simplifies the problem immediately. These little tips and techniques are crucial in successfully completing this subject. You will come across many of these during tutorials, lectures, and your private study. I do believe that these observations will one day become useful under the time constraints of an exam, so always practise and be alert.

Wishing you all the very best!

ACTL20002 Financial Mathematics II

Exemption status	CT1 *Financial Mathematics*, in conjunction with ACTL20001 *Financial Mathematics I*. Satisfactory performance in both subjects' end-of-semester exams is needed.
Lecturer(s)	Professor Mark Joshi
Weekly contact hours	2 × 1-hour lectures 1 × 1-hour tutorial
Assessments	Microsoft Excel individual assignments 2 × 10% 45-minute mid-semester test 10% 2-hour end-of-semester exam 70%
Textbook recommendation	Fitzherbert, R., & Pitt, D. (2012). *Compound Interest and its applications*. Melbourne, AU: University of Melbourne Custom Book Centre. This textbook is the same as the one used in FM1. It is an excellent resource for the most part; however, it does not cover all the subject material. ✓ It is highly recommended that you acquire a physical copy of this text as it often provides a different explanation of concepts to what lectures would include. Furthermore, there are many supplementary questions that will help solidify the basic knowledge you need to succeed. It is important to note that the textbook questions are quite trivial in relation to tutorial problem sets and exam questions. They are not representational of anything you can expect to be tested on, and should be viewed as a mechanical exercise.
Lecture capture	Full (both audio and video).
Year and semester reviewed	2016 Semester 2

Comments

ACTL20002 Financial Maths 2 is a subject to be wary of. If you truly love applications of mathematics in finance (as you should), this will be the most interesting, challenging and rewarding subject you will complete in your first two years of the degree. Overall, the subject is extremely useful. In terms of technical skill, it extends upon content covered in ACTL20001 *Financial Mathematics I*, while teaching new content that is all broadly applicable in the actuarial industry. From a more abstract perspective, the assessments and examinations are not all different versions of the same paper, and help to develop problem solving skills more than any other subject.

Subject Content

- Discount Securities & Coupon Bonds (Price and Yield Calculations) — Weeks 1–2
- Measures of Investment Performance — Week 3
- Interest Rate Risk, Bond Market Structure — Weeks 4–5
- Derivative Securities (No Arbitrage Pricing, Put-Call Parity) — Week 6
- Valuing with Default — Week 7
- Non-Deterministic Interest Rates, Valuation w/ Stochastic Rate of Return, Moments — Week 8

- Life Insurance Applications, The Lognormal — Weeks 9–10
- Simulation, Time Series Models — Weeks 11–12

The first half of the subject (Weeks 1–6) has been appropriately termed "Financial Arithmetic" by some. This half of the subject goes further into detail for concepts covered in FM1.

The first week covers no new concepts, revisiting discounting using i and d. Week 2 increases slightly in difficulty, with the main point of interest being floating rate notes and their valuation. Nothing in the first 4 lectures should cause any problems. Whilst the theory and basic valuations here are relatively simple, Professor Joshi has been known to write variations on these simple questions that prove to be extremely challenging on exams. Thus, it is important to take advantage of the fact that this area of study is relatively easy by making sure you understand it beyond the basic level.

Following on from this, week 3 covers measures of investment performance, namely Time-Weighted Rate of Return vs. Money-Weighted Rate of Return. There are a few formulas and approximations here, but once you understand the fundamental difference between the two you won't have to memorise much at all.

Week 4 introduces concepts such as the duration and convexity of assets and liabilities in the context of portfolio insurance, and is quite interesting when considering real-world applications. There are even more formulae here, but they all have very intuitive derivations, and should prove no problem once understood and applied a few times. What is important here is to understand the mathematical relationship between duration, convexity and delta, which will help save time should you need to compute multiple values.

Week 5 covers bond market structure. This topic is tricky for different reasons. It is not at all mechanically tedious or hard to understand conceptually. However, there are many important distinctions to make with spot rates vs. forward rates vs. yield vs. one-period implicit forward rates. Each has its own use, and confusion will lead to your answers appearing to be **very** close to the correct answer, but entirely wrong. For this reason, covering a broad array of questions will help you recognise which rate to use when. **N.B** If you skim over yield curves because they are boring and you can't think of how they could possibly be examinable you **will** regret it.

Week 6 will seem new to many, unless you are simultaneously taking FNCE30007 *Derivative Securities* (which is frowned upon). Concepts of forward price and put-call parity are covered very briefly, and is likely to be easier to understand if you haven't taken DS because it can be quite confusing to learn the same topic 2 different ways concurrently.

Week 7 will likely have only 1 lecture, covering valuation with default. It is the first time you will be exposed to valuing a stream of payments which is uncertain, and is very interesting to learn. The method of valuation taught here is basically your intuitive interpretation of what you think it would be, and is not very difficult. However, this is another topic which can manifest in a variety of different forms on an exam paper, and you should thus make sure you do not take it lightly.

Weeks 8–12 are when things go downhill quickly for most people. The finance seems to disappear in a sea of maths, and you may wonder whether this is actually a MAST##### subject. From lognormals to life insurance applications all the way to autoregressive time series, these topics are the true core of what actuarial studies is actually about. They are taught with a very practical approach, often including Excel in lectures and tutorials. From anecdotal evidence, this content has proven to be directly applicable to real life work at a certain actuarial firm.

Lectures

The lectures for this subject rank as the highest all-rounder for myself and some others. They are paced very well, meaning you can rewatch it at 1.0x without feeling the need to fast forward. The lectures are 1 hour each, and the slides have some of the lowest WPS (words per slide) I have encountered. Not having to read through slabs of text is certainly incentive to attend.

Lectures were recorded with video, but I found myself attending whenever possible for a few reasons. Firstly, they were quite interesting (subject content wise but also lots of relevant advice and the occasional joke). Secondly, I found (especially later on) that I was needing to watch each lecture upwards of 3 times to really understand so I'd might as well get one out of the way in person.

Possibly the best thing about attending the lectures is the feeling of achievement when Professor Joshi remarks on the notably smaller cohort who have survived thus far.

Tutorials

Tutorials for this subject are essential due to its difficulty.

Whilst there are no marks explicitly allocated to attendance, it would be unwise not to utilise the resources provided by tutorials. You would be hard pressed to find anybody apart from the tutors who would be able to help you with something you don't understand in this subject. It is also a great time to ask questions from the textbook which may be confusing.

If you do choose not to attend, the worked solutions for the tutorial problem sets are very comprehensive, and will be sufficient for tutorials 1–7.

Assignments

There are two assignments which are almost definitely going to be the development of a self-sufficient Excel model. In my many years of studying, I had never actually enjoyed doing an assignment before these two (no spoilers). There is a certain unique feeling of success that comes with building a working financial model for the first time.

The assignments will require you to build a spreadsheet from scratch, which is supposed to perform a certain valuation or task (there will be plenty of context in the instructions). It will be heavily emphasised that the whole point is for the model to work with **any** inputs, not just the preset ones. Thus, you must ensure your model is **robust**, and can survive whatever Professor Joshi decides to throw at it.

These assignments will drastically improve your Excel skills, and teach you to test and retest your models.

Each assignment contributed 10% towards the final grade.

Mid-Semester Test

The mid-semester is 45 minutes and you are permitted the usual scientific calculators.

It covers everything up to and including derivative securities (the easier half of the subject). Whilst the content covered is not as hard as the second half, the difficulty of the mid-semester is unfortunately not deterministic. Its difficulty function has random variables which depend on the difficulty of the previous year's exam and the number of students who survived FM1 amongst other things.

End-of-Semester Exam

The final exam is a 2 hour paper, with around 8–10 questions depending on difficulty. As this is an actuarial subject, you will not have the privilege of being asked any multiple choice questions.

The usual rules apply for subjects with a mid-semester — i.e. the topics which have already been examined will be less heavily focused upon in the final. Unfortunately for this subject, that means less easy questions and more hard ones.

Preparation: Professor Joshi is notorious for his challenging exams. The questions asked in his papers are **never** simple. There will always be some need for outside-the-box problem solving to do well in these exams. In certain subjects, you can just memorise the general form of a question and regurgitate it on the day. This method will be extremely ineffective in FM2. Past exams will prove to be a valuable resource, but only to serve as a test of how well you tackle seemingly impossible questions. The best way to prepare for (relative) success in this subject is to complete **all** the textbook and tutorial questions on time and consistently (increases speed and accuracy), before proceeding on to past papers (practice problem solving). For past papers, absolutely do not look at worked solutions until you have attempted the paper with 100% effort. They are your best resource and you would be wasting it by cheating and looking at the solutions.

As a final note, **do not** let yourself fall behind. As I said above, this is likely to be the hardest subject you will have to take in second year. It is absolutely **not crammable**! The latter topics take many more hours than just the 1-hour lectures to truly understand, and merely understanding it is nowhere near enough knowledge to tackle an exam question. If you try and cram, you will almost certainly fail. Source: I have lost many mathematically brilliant friends to this beautiful subject.

ECON20001 Intermediate Macroeconomics

Exemption status	CT7 *Business Economics*, in conjunction with ECON10004 *Introductory Microeconomics*. Satisfactory performance in both subjects' end-of-semester exams is needed.
Lecturer(s)	Dr Mei Dong
Weekly contact hours	2 × 1-hour lectures 1 × 1-hour tutorial
Assessments	Tutorial attendance and participation 10% Online multiple-choice test 5% Group assignment, due in Week 7/8 12.5% Group assignment, due in Week 10/11 12.5% 2-hour end-of-semester exam 60%
Textbook recommendation	Blanchard, O., & Sheen, J. R. (2013). *Macroeconomics Australasian Edition*. Frenchs Forest, AU: Pearson Education Australia.
Lecture capture	Full (both audio and video)
Year and semester reviewed	2016 Semester 2

Comments

This subject is very similar to ECON10003 *Introductory Macroeconomics* in terms of the big picture concepts covered. You will find some overlap between the two subjects especially in the graphs shown. This subject just contains more variables and there is a greater focus on manipulating these variables mathematically rather than just understanding how the graphs lead to real life economic changes.

As there is a greater emphasis on using maths to manipulate variables, actuarial students should have an advantage over other commerce students.

Subject content

For students who haven't started the subject, don't be worried if you don't recognise many terms below. The difficulty of the models taught will not exceed *Introductory Macroeconomics* (except for DAS/DAD model)

1. Short-run macroeconomics
   (a) Output, investment and savings
   (b) Financial markets, background on the financial crisis
   (c) IS/LM model
2. Labour markets and unemployment
   (a) Labour market dynamics
   (b) Natural rate of unemployment
3. Macroeconomic adjustment
   (a) Inflation, unemployment relation (Phillips curve)

   (b) AS/AD model
   (c) Dynamic AS/AD model
   (d) Rules vs discretion in policy making
4. Long-run macroeconomics
   (a) Solow–Swan model
   (b) Convergence and conditional convergence
   (c) Endogenous growth
   (d) Productivity and institutions
   (e) Productivity, wage and inequality
5. Open-economic macroeconomics
   (a) Interest rate, exchange rate, output
   (b) Exchange rate regimes

Lectures

The lectures were well structured and directly covered the content on the assessments. They were highly conceptual and mathematical. There is an emphasis on calculating values rather than just qualitatively explaining economic trends. Hence formulae are a lot more important in this subject than *Introductory Macroeconomics*. As these formulae are hard to memorise and there is no formula sheet, Mei often uses the projector to derive the formulae on the slides. It is highly recommended to learn these derivations as this adds meaning to the concepts taught and makes remembering formulae easier for the final exams.

Personally, the focus on algebra and mathematical derivations in the slides made the subject more tedious and less enjoyable. However, you are sometimes required to use graphs and models to justify your numerical solutions in the exams. The graphs used are very similar to those in *Introductory Macroeconomics*. For example, the Solow–Swan Model, AS/AD model, PAE diagram and the money demand/supply diagram is almost exactly the same as in *Introductory Macroeconomics* (except for a few more variables). You will only learn a few new diagrams in this course making it conceptually easy to understand.

Tutorials

Tutorials are just like every other ECON subject with blue and pink sheets. Blue sheet completion before every tutorial contributes to participation scores and personally, they were very simple to complete. The pink sheet questions in class are a lot harder (sometimes even harder than most exam questions). They test your knowledge of concepts as well as finding numerical solutions. There is a focus on finding general solutions before applying numbers. I found pink sheet questions hard to do straight away because it was very conceptual and the lectures didn't focus on this too much.

As pink sheet questions are harder than exam questions, it is not an issue if you struggle to do them by yourself. However if you understand pink sheet questions after someone has shown you the solution, you are ready for the exam.

Assessment

The assignments are very useful for actuarial students because they use Excel. In both assignments, the task was to create a graph of economic values over time using Excel iterations. There were pretty challenging because you needed to do derivations by hand first before coming up with the appropriate recursive formula. You were then required to use

economic models and graphs to explain trends in your solution. In the assignments, the questions are very structured so you don't really need to think creatively to come up with solutions.

The final exam was extremely methodical and based on manipulating variables by algebra; it reminded me of high school maths. Because the exam is very mechanical, you could get away with just memorising the derivations of the formulae and knowing the economic models to the same depth as in *Introductory Macroeconomics*. Unlike other subjects for second year actuarial students, the final exam was very similar to past exams. A few questions in the exams were very similar to past papers except for a few numbers and variables.

Tips for Success

My main tip is to learn the derivations of the formulae used rather than just memorising it. It adds a lot more value to this subject and also makes doing the exam easier as you will need to manipulate formulae to find general rather than specific solutions.

There is not a big focus on real life events so the textbook doesn't add any more value than the lectures. I recommend just reviewing the lectures continuously and drawing the models and graphs for yourself rather than just looking at them.

FNCE20001 Business Finance [SM1]

Exemption status	CT2 *Finance and Financial Reporting*, in conjunction with ACCT10002 *Introductory Financial Accounting*. An average of 73 across this subject and ACCT10002 *Introductory Financial Accounting* is needed, with no fails.		
Lecturer(s)	Varies. In 2016, the lecturers were Summer Semester: Professor Rob Brown Semesters 1 and 2: Dr Vincent Gregoire		
Weekly contact hours	Summer Semester: 2 × 2-hour lectures 2 × 1-hour lectures 2 × 1.5-hour tutorials		
	Semester 1 and 2: 2 × 1-hour lectures 1 × 1-hour tutorial		
Assessments	Summer Semester: 1-hour mid-semester test, after 2 weeks of class		20%
	3-hour end-of-semester exam		80%
	Semester 1 and 2: Tutorial assignments	15%	
	1-hour mid-semester test	25%	
	2-hour end-of-semester exam	60%	
Textbook recommendation	Peirson, G., Brown, R., Easton, S., Howard, P., & Pinder, S. (2015). *Business Finance* (12th ed.). North Ryde, AU: McGraw-Hill. The textbook is a good complement to the slides to gain further understanding of the concepts that are discussed. The textbook is quite detailed so it does help solidify the understanding of those areas students may have trouble with. However, it is quite expensive and I do not believe it is essential to achieve high marks. Nevertheless, if students want to take a look, there are cheap second hand copies available.		
Lecture capture	Full (both audio and video).		
Year and semester reviewed	2016 Semester 1		

Comments

Subject content

Relative to the actuarial subjects, Business Finance was a nice change of pace in terms of the speed in which it was taught and difficulty. I felt that for the most part of the semester, there was plentiful time to grasp concepts as well as the level of difficulty being quite manageable. Some of the content was already touched on in *Introduction to Actuarial Studies* as well as *Financial Mathematics I* which made Business Finance less difficult earlier on. Having said that, new concepts are taught, especially towards the latter end of semester where there is much more theory.

- Introduction to Financial Mathematics
- Valuation of Debt Securities

- Valuation of Equity Securities
- Risk and Return
- Modern Portfolio Theory
- Asset Pricing Models
- Capital Market Efficiency
- Capital Budgeting
- Debts, Dividends and Taxes
- Introduction to Derivative Securities

Lectures

In my semester of completing Business Finance, my lecturer was Vincent who taught the subject at a very nice pace. Vincent talks through the lecture slides and explains each concept by providing an example. I thought the lecture slides were very comprehensive. Whilst examples were on the simplistic side, this really helped me grasp new concepts quite quickly.

Whilst lectures were fully recorded throughout the semester, I endeavoured to attend all lectures as I find this more engaging. In my semester, there were several lecture streams which made it convenient for students in case they missed their usual stream. Nevertheless, the recordings were a great way to revise concepts which were a little more tedious to grasp. This was very useful towards the latter end of semester where I thought the content was rushed and was much more theoretical compared to the first half of lectures.

Vincent also uploaded all of the semester's lecture material onto the LMS at the start of the semester. This was quite useful if you wanted to read ahead. This is something I made the most of during the mid-semester break where I endeavoured to learn a few concepts upfront so I could have a bit more time to focus on relatively harder subjects. Again, this is not a must but just something to consider if you are super keen!

Tutorials

Tutorial attendance was not necessary as there were no attendance marks contributed towards the final grade. However I do recommend attending tutorials as it forces you to not only stay on top of the subject but tutors help solidify understanding concepts taught in lectures as well as making you aware of any short cuts or tips in answering exam questions.

Vincent uploaded tutorial questions in the week prior to the tutorial which contained a series of multiple choice questions, short answer questions and the odd extended response question. I believe some of these questions are extracted from past exams so these tutorial sheets serve to be great practice as revision for the exam. Compared to most other subjects, I felt that these tutorial sheets were quite comprehensive as they covered most, if not all the concepts that Vincent taught in the week prior to the tutorial and attempted to expose students to different styles of questions.

Students are expected to attempt all questions prior to the tutorial before answers are discussed in class. However, this may change from tutor to tutor. Some tutors will allow students to answer tutorial questions in class before discussion takes place. Personally, I think it is always good to attempt these questions by oneself to the best of one's abilities before any sort of discussion.

Like lectures, whilst no attendance was taken, I attended each and every tutorial for Business Finance. I thoroughly enjoyed my tutor's explanations and weekly recaps of lecture material, which only further helped my understanding of concepts that were new to me.

Assignments

In my semester of this subject, there were two assignments which were to be completed individually. Both assignments were worth 7.5% each and consisted of multiple choice questions only. The vast majority of the questions were calculation based questions with the odd question being theoretical.

Vincent allowed one to two weeks to attempt these questions before submitting answers online at any time during the one to two week time period. I found that these assignments were not of great difficulty and could be completed under an hour, therefore time being plentiful. However, Vincent can be a little sneaky, so do not get complacent; read questions carefully or you will lose easy marks!

If students stay on top of the work and are up-to-date with the syllabus, they should reap the rewards and gain full marks in these assignments. As Vincent says, these assignments aren't designed to be of immense difficulty or to trick students but are a way of seeing if concepts are being understood properly.

Mid-semester test

The mid-semester is (again) purely multiple choice with a time limit of one hour. This contributed 25% towards the final grade. A practice test is provided in preparation for the mid-semester test. Assignments are good practice for the mid-semester test. I found that the assignments and the practice test were relatively easier than the mid-semester test. Having said that, the mid-semester test in my semester was still rather straight forward.

I personally thought that the mid-semester test tried to catch out students through the wording of questions. The content itself was not of great difficulty, however students need to take time in reading questions and understanding what is being asked prior to answering the question. I felt that my mid-semester test was heavier on calculations with a few questions being theoretical based.

Again, students who are studying consistently, on top of lecture material and tutorial questions should not find this test of great difficulty. In the case it is difficult, Vincent scales the marks which generally works out in your favour.

End-of-Semester Exam

The exam consisted of multiple choice questions and a series of short answer/extended response questions. The multiple choice questions were much like the assignment questions and the mid-semester test questions, so there is plentiful practice for this section of the exam.

Vincent uploads a few practice exams which is a great preparation tool. The tutorial questions also served as a great way of revising for the exam as there was an abundance of questions accumulated by the end of semester. On top of this, I recommend revising the theoretical sections of the course as the odd question asks for definitions or explanations of theoretical concepts which often finds students off-guard. As a result, easy marks are lost. So do not just get caught up in the calculations, make sure to read up on the theory.

Like most other subjects, the difficulty of the final exam will change from semester to semester. I found the difficulty of my exam being in the middle of the spectrum; not too easy but not too hard. If anything, the race against the clock is what I found difficult. So my tip for students is to complete the practice papers in timed conditions. It will give you a good indication of whether you need to work at a faster pace.

With Business Finance looking at concepts that actuarial students touch upon in other subjects of our major, I really enjoyed taking this subject. I thought all the facets of this subject were great which only gave me extra motivation to do well. I believe that if students dedicate the time to this subject, the rewards of such dedication will be reaped come results day!

MAST20004 Probability

Exemption status	CT3 *Probability and Mathematical Statistics*, in conjunction with MAST20005 *Statistics*. An average of 73 across this subject and MAST20005 *Statistics* is needed, with no fails.
Lecturer(s)	Dr Nathan Ross Dr Mark Fackrell
Weekly contact hours	3 × 1-hour lectures 1 × 1-hour tutorial 1 × 1-hour computer lab session
Assessments	4 individual assignments 4 × 5% 3-hour end-of-semester exam 80% The individual assignments are given in Weeks 2, 5, 8, and 11 and are due in the following week.
Textbook recommendation	Ghahramani, S. (2005). *Fundamentals of Probability, with Stochastic Processes* (3rd ed.). Upper Saddle River, US: Pearson Education. Each week, there will be supplementary problems selected from Ghahramani chapters, and these will very often be the most pertinent questions. Excerpts will be provided on the LMS, so you don't have to find them in the text yourself. That being said, the textbook will be a virtually inexhaustible resource with copious amounts of challenging questions to broaden your knowledge and exposure to questions (more on that later), so, in short, ✓ GET IT.
Lecture capture	Full (both audio and video). However, being a maths subject, only the document camera will be captured. While this IS the more important screen, watching lectures at home without the slides for reference makes it unnecessarily challenging to follow. I would recommend attending in person whenever possible.
Year and semester reviewed	2016 Semester 1

Comments

Disclaimer: I watched Nathan Ross' lectures (for the pleasant American accent) but will note differences wherever relevant.

In terms of structure and content, this is in many aspects a classic maths department subject. In it, you will get off to an easy start, with content getting challenging around Weeks 4 and 5 and potentially spiralling out of control if you let yourself get behind. Don't let the straightforward first assignment fool you, as it is not representative of the difficulty of this subject (IT'S A TRAP!).

This review was previously published in the 2016 mid-year edition of the *Actuarial Students' Society Subject Review*.

History of MAST20004 Probability (2009–present era)

This subject used to be much less frightening due to the fact that each cohort would notice the 'similarities' between the preceding exams, essentially being able to prepare for a certain set of questions that they knew would be examined. However, it was not only students that picked up on this, and recently it changed such that this is no longer possible (c. 2015). Hence, you will note that the 2014–16 exams are exponentially[1] more challenging.

Subject content (learn EVERYTHING)

- Axioms of probability — defining probability, set theory, De Morgan's laws
- Conditional probability, Bayes' theorem, independence, and the law of total probability
- Random variables and their distributions (discrete and continuous), properties of the distribution, mass, and density functions
- Special probability distributions
- Expectation and variance
- Transformations of univariate random variables
- Bivariate random variables, joint and marginal distributions, transformations, and the bivariate bormal distribution
- Mean and variance of sums and products of random variables
- Covariance and correlation
- Conditional expectation and variance (feat. the rather beautiful formula)
- Generating functions: probability-generating functions and moment-generating functions
- Limiting distributions: the law of large numbers and the central limit theorem
- Branching processes, stochastic processes, and Markov chains

This subject, while taught at different speeds depending on the lecturer (Dr Fackrell proceeds faster than Dr Ross), is taught well overall. It covers all the material at a reasonable pace while going into sufficient detail most of the time. However, once again, both lecturers do occasionally go off on tangents, proving certain theories in great detail. These proof are often complicated and not at all intuitive and do not always add value to your learning. It is more important to try and understand the techniques that are used in proofs rather than memorising the proofs themselves. Many recurring techniques, such as using the relationship between $1/(1-x)$ and its Taylor series expansion or factorising sums to pull out a factor such that you are left with a binomial expansion that sums to 1, are extremely 'neat' tricks that will help you immensely when working on your own proofs or questions.

Generally, each new topic will be started on a slide with its corresponding Ghahramani chapter. If you are finding the topic hard to understand, reading the chapter in the text will almost always help, as it often approaches the topic from a different perspective.

Lectures (attend them)

Nathan Ross' lectures are relatively slow compared to the pace of Mark Fackrell's. You should consider your own aptitude and preference when deciding which stream of lectures you wish to attend. As I am a slow learner, I chose Dr Ross.

As with all maths subjects, if you are finding it hard to keep up with the pace of the working out during the lecture, put your pen down and listen, and let those neurons form their connections, rather than mindlessly copying down working. There

[1] Not really, maybe geometrically.

will be plenty of time to copy somebody else's notes or re-watch the lecture online.

Both lecturers essentially follow the printed slides provided. However, Ross is known to digress more often than Fackrell. This is not necessarily bad, as you will note that he still finishes on time. The digressions often provide value in another form, be it an interesting proof or an interesting example.

Overall, the lectures for this subject should not be skipped at all.

Tutorials (use them well)

Maths tutorials are maths tutorials. They are only as good as you want them to be. If you put in the effort, do all the assigned (and more) questions, and ask the tutors for help when necessary, you will learn incredibly more than other students. It is only too easy to skip the tutorials with the excuse of "but there are solutions though".

The assigned questions for this subject are not nearly as challenging as problem sets in MAST10009 *Accelerated Mathematics 2* but are a good test to make sure that you at least understand the theory. Whenever possible, endeavour to complete the Ghahramani questions as well, and ask your tutor or consult the solutions manual if necessary. It is strongly advised that you cover as broad a range of questions as humanly possible.

The computer labs give a practical application of the theory learnt in the exam and, while not exactly crucial, are a valuable resource. There have been years where the lecturer has said that there will be a question on theory covered in the labs on the exam, though it rarely ever happens (touch wood). After all, they are most often straight after the tutorial, so don't be lazy.

Assignments (have fun!)

The assignments (bar the first one) are wonderful. They are extremely interesting, challenging, and just overall great fun to do. The questions in assignments are more "out of the box" than usual and will often require a lot of thinking or trial and error to find the method to solve them. After that, the arithmetic will follow without a problem. These are the best types of problems you will do in that they are satisfying to complete.

After completion of each assignment, the past years' assignments will become accessible. You should use these as refreshers, as they are very often the same standard as questions you will encounter on the exam.

End-of-semester exam (do questions from everywhere)

The end-of-semester exam will be a mess. It will be a random variable with mean difficulty 70 and variance 10000 which is positively skewed. As I said before, the past few years have had exams which were increasing in difficulty, culminating in the disaster that was 2016 Semester 1.

Why was it difficult? The exam covered a vast range of content, barely adhering to the structure that was provided to us for preparation, and did not in any way resemble any of the past exams. The topics examined included some obscure ones, and solutions were not immediately obvious. Thus, it was easy to become scared and lose focus. Though the exam was almost impossible to finish, it was a test of how well you performed under pressure and how well you tackled questions you hadn't seen before. It is important in exams like these to get as many easy marks as you can, and I would advise you to ALWAYS start on Questions 1 and 2. These will be free marks, and you can then move on to complete whatever you

are most comfortable with. Usually, the question on Markov chains or branching processes will be fairly straightforward. Getting as many marks down while not worrying about not being able to complete questions will ensure you get a decent mark.

Scaling for this subject was unfortunate. If you are hoping to scrape an exemption by riding on the scaling wave, you are in for disappointment. The brightest of mathematical minds could leave two questions unanswered on the exam and score above 90, but for the many that only answered about 60% of the exam, you will find that your score will approximately equal that of which you answered. This is the maths department, and they do not care whether you get your exemptions.

MAST20005 Statistics

Exemption status	CT3 *Probability and Mathematical Statistics*, in conjunction with MAST20004 *Probability*. An average of 73 across this subject and MAST20004 *Probability* is needed, with no fails.
Lecturer(s)	Dr Davide Ferrari
Weekly contact hours	3 × 1-hour lectures 1 × 1-hour tutorial 1 × 1-hour computer lab session
Assessments	3 individual assignments 20% 45-minute computer laboratory test 10% 3-hour end-of-semester exam 70%
Textbook recommendation	Hogg, R. V., & Tanis, E. A. (2014). *Probability and Statistical Inference* (9th ed.). Harlow, United Kingdom: Pearson Education Limited. 7th and 8th editions are also acceptable. Lecture notes and examples seem to be based quite closely on the book and hence will suffice. If you want additional questions (beyond tutorial sets and past examination papers), ✓ I would recommend investing in the textbook.
Lecture capture	Full (both audio and video).
Year and semester reviewed	2016 Semester 2

Comments

Subject content

MAST20005 Statistics begins with some basic revision of probability then quickly proceeds to cover methods of estimation, descriptive statistics and linear regression (these are all covered quite quickly but a solid understanding is very important in the following weeks). The majority of the 12 week course covers hypothesis testing and finishes with order statistics and a basic introduction to Bayesian methods.

As with MAST20004 *Probability*, the content in this subject is relatively easy to start with, however, it rapidly becomes more difficult as the semester progresses. Be prepared to work hard throughout the year, however a very high score is certainly not unattainable with the appropriate level of effort.

Lectures

Dr Davide Ferrari is a reasonably entertaining lecturer and is always looking to improve his lecturing style in order to help facilitate the learning for his students. One fantastic aspect of this subject is his use of the lecture capture — he changes the screen between the slides and the document camera effectively making home viewing no different from lecture attendance (an invaluable resource, especially for those who experienced Dr Barry Hughes' use of the lecture capture during MAST10009 *Accelerated Mathematics 2*).

Course content is divided into several sections (of very uneven length) which are effectively independent of one-another. You will find that between topics there is a fair bit of overlap. It is still possible to complete one section without having studied a previous section, though it will be considerably more challenging. Within a single topic it is very easy to get lost if you don't understand everything that has gone on throughout the rest of topic. For this reason, even if you are watching them online, I would recommend keeping up to date with lectures from week to week.

One downside of the lecture notes in this subject is the number of errors in the slides. It is not uncommon to come across one or more typos in any given lecture, despite Davide usually picking up on it, he makes little effort to fix the mistakes from year to year. This is especially problematic if you're reading through slides without the lecture recording.

Tutorials

As with *Probability*, a set of questions is released at the beginning of the tutorial week. During the tutorial, you will break into smaller groups and complete the questions on the whiteboard. Usually they are not too challenging, but from time to time there are some very tough ones that you will struggle to complete by yourself.

One great aspect of this subject is that Davide releases the solutions at the same time as the questions. This means that if you're a stickler like me who needs to get one question correct before you move onto the next, you won't be stuck on one question for a week (which then leads to you never actually doing the tutorial questions).

If you are able to complete and understand all the questions at home, there is little need to attend tutorials.

Computer Labs

Each week there is a one-hour computer lab using R, a programming language which provides invaluable resources for analysing data. You only use inbuilt commands with no understanding of the programming behind what is happening.

Personally, I found these labs to be quite dull and uninteresting. I found that learning MATLAB was far more stimulating as lab-sheets gave you a set of tasks to complete which required the understanding of code and simulations. R, on the other hand, requires simplistic copying from lab sheets to get results which are already printed for you. Beyond the muscle memory of typing in commands, there is really no difference between reading through the lab sheet and actually using a computer.

R software is free to download on your computer at home, that's to say you can complete the computer labs in your own time without too much difficulty.

Assignments

Personally, I found the assignments to be long and tedious. Admittedly, I always seemed to be behind on coursework which made things a little more challenging, however I was able to do all the questions given enough time.

It is worthwhile having a good understanding of R as many of the assignment questions can be easily solved using the computer software. Whilst it can be completed by hand, you will find it takes considerably longer.

Assignment questions are a very good reflection of what you will get in the exam (in fact many of the questions are taken from past papers) so it's worthwhile understanding the theory behind all the questions.

Laboratory Test

Not much to say. You get to take all your lab sheets as well as several pages of hand-written notes. Davide also provides you with a practice test so there's no reason you shouldn't get a good mark with some effort.

End-of-Semester Exam

The exam is three hours long with 15 minutes of reading time.

You will be allowed to take in a number of handwritten cheat sheets (2016 Semester 2 allowed three double-sided sheets, although there seems to be changes between years, so ask Davide yourself!!). Since there are so many formulas in this subject these cheat sheets are an invaluable resource, so make sure you leave enough time to make them legible and detailed. The process of making the cheat sheets is good revision in itself so I'd recommend doing this before you start completing practice exams.

You are provided with a number of past exams. The only problem is that solutions are not only very brief, but seem to be littered with errors. This makes it very difficult to accurately correct your work. However, be content that you have something as many other lecturers won't provide you with solutions (@barrydhughes #takeahint). On the up side, exams tend to be quite repetitive so a proper understanding of previous years' examination papers will lay the foundations for a great score.

Davide likes to include R output on his exams to save you from doing tedious calculations yourself. This can be very daunting at first (especially for ANOVA tables) so it is vital that you complete some past papers so you know what you're up against.

All the best ☺

MGMT20001 Organisational Behaviour [SUM]

Exemption status	None.
Lecturer(s)	Ms Victoria Roberts
Weekly contact hours	2 × 1-hour lectures 2 × 1-hour tutorials 2 × 1-hour online tutorials
Assessments	Tutorial attendance and participation 10% Individual assignment, due in Week 3 10% Group assignment, due in Week 5 30% 2-hour end-of-semester exam 50%
Textbook recommendation	Department of Management and Marketing. (2011). *Organisational Behaviour* (5th ed.). Sydney, AU: Pearson Choices. The lecture notes are sufficient. The textbook for the subject is available from the university bookshop. It is a custom compiled edition by Pearson Education and contains readings from a range of textbooks which have been specially selected for this subject. The textbook is not essential and can be borrowed from the high-use section of the Giblin Eunson library, so you can have a look if you wish. The textbook was useful for filling in gaps of information and extending knowledge for the first half of the course — for the second half, it began to lose relevance.
Lecture capture	Full (both audio and video). Yes, since there is no writing or live editing in this subject, it is possible to watch them online. However if you don't go, you probably won't watch them online anyway, so you might as well go and experience OB. It really depends on how much effort you want to put in the subject, and how well you want to do, as it is not an exemption subject.
Year and semester reviewed	2016 Summer Term

Comments

For many, this subject will be where one's WAM drops. However, this correlates entirely with how much effort you put in and how you redirect your energy to study efficiently and effectively. As a hardcore writing subject for many Actuarial students, you may initially find it daunting.

Don't be put off by the naysayers of this subject — it is a lot of fun if you try and enjoy it.

This review was previously published in the 2016 mid-year edition of the *Actuarial Students' Society Subject Review*.

Subject content

The subject is broken down into a micro and macro section of management. Each week in Summer Semester, you will cover two new topics, so content builds up quite fast.

The first section, micro, consists of:

1. Perception, Attribution, and Decision-Making

   Actually interesting and fun if you see how they relate to you personally. You will find yourself realising you can relate to a lot of these perceptual biases.

2. Values, Attitudes, and Behaviour

   Difficult subsection; it is easy to understand the basics of this topic, as it is simply following a process of how values lead to attitudes, resulting in behaviour. The second aspect of this topic is where things begin to get confusing.

3. Leadership and Teams

   Fun subsection. If you really get into it, you will start joking with your friends about what stages of team development you are currently in. The teamwork aspect I found more enjoyable personally compared to the leadership aspect.

4. Motivation

   Not a hard topic, but definitely need to get your head around how it works.

5. Conflict and Negotiation

   Probably the most difficult and content-heavy topic of the micro section.

Note that the macro topics generally have a lot more content in them than the micro topics, as it comprises of 75% of the exam.

The second section, macro, consists of combinations of a topic and a case study on a company:

1. Organisational Change/Sanrizz

   Fun and easy to apply; hope that you get this for the exam.

2. Organisational Communication/Enron

   This was difficult to write about, and while the content isn't hard, try writing 1500 words on it in an exam.

3. Organisational Culture/Solaris and Supernova

   Fun topic. A lot of content, but not difficult.

4. Organisational Power/Automakers Australia

   Easy topic to apply. There are three dimensions of power, and once you know them, things are smooth sailing from there.

5. Organisational Strategy and Structure/Apple

   If this appears on the exam, writing about everything will probably mean you will run out of time. This has the most content and the most information to process.

Note that while these are the combinations you will learn in class, these combinations will not appear on the exam. You will have to learn how to apply each topic to each different case study.

Lectures

As I did it in the Summer Semester, I can only speak about it for that course. However, I assume the content will be similar in normal semesters.

In terms of the lecturer, Victoria was great, and I believe it was her first time lecturing. She was enthusiastic and excited — very passionate about what she was doing. Sometimes she would give her own examples of how the management topics were applicable, which was very insightful. Overall, she was a very fun lecturer and really tried to make sure her lectures were simply crammed with content. I remember watching *The Simpsons* and *Big Bang Theory* in her lectures — great times!

As Summer Semester was twice as fast as normal semesters, we had two lectures a week. This meant the lecture content did build up quite quickly. Management concepts are quite straightforward to understand but take some thought and preparation to apply; as long as you understand it and give it some creative thinking, you will be on the right track.

The micro lectures were definitely more fun than the macro lectures, as it was more personalised and you could apply a lot of the concepts to yourself and your friends. Trust me — you're going to be cracking OB jokes early in the semester.

Online tutorials

Online tutorials basically involve doing the online pre-tutorial work before you come into the following week's tutorial. It's quite straightforward; there are online questions to answer. Make sure you save a copy before you finish up; otherwise you have to redo the entire set of questions again.

The questions are simply based on whatever you covered in the lectures that week, and they don't take very long. I tried to put a lot of effort into it and made sure I had at least three lines of writing per answer, but I know some people just came in with dot points, and that was fine too.

Readings

There is a lot of reading to do in OB. There is no hiding from this. I know individuals who did well who read the readings, and I know individuals who did well who didn't read the readings. Do whatever you want, but personally, I read the readings, and I found them very interesting.

Basically, the micro readings are journal articles, which some people may find quite dry, but I found reading them really helped with understanding how OB as a subject works.

The macro readings are a must-read as they are examinable and consist of case studies which you may have to analyse on the exam.

Tutorials

Tutorials are a lot of fun if you put your heart and soul into it. You pretty much get to discuss what you wrote in the online tutorials in your group assignment groups.

If you answer a lot of questions creatively with pre-thought, you will definitely score highly on the tutorial participation side of things.

My advice: do the online tutes and actively participate in class.

However, don't breathe a sigh of relief even if you obtain full marks for your tutorial participation marks. This is only just the beginning…

Individual assignment

How's your writing? Good? Well it turns out OB markers can be quite harsh, so you have to lift your writing game. No, there's no shortcut to writing well, so you will need consistent practice on your end, and generally consulting your tutor will be a benefit to ensure that you're on track and that you won't lose marks for being off-topic.

The assignment is generally based off a micro topic and is a 1000-word academic essay, which means using academic references and citations! Yay! The best place for this is Google Scholar; you have to do something with linking it to your university account, but that isn't hard.

My trick to finding references was… there is no trick. You have to put in the hard yards — don't expect that the first search on Google Scholar will give you enough to last you the entire essay.

Trawl through Google Scholar, and ensure your references are properly cited and sourced. You don't want to lose marks on citations, because you're already going to lose enough marks…

Group assignment

Everyone's favourite part of OB. It brings students from different backgrounds and degrees together and creates long-lasting friendships and strong bonds. It is 5000 words of goodness and excitement.

What? You think I'm joking? Well, to be fair, that was actually my personal experience with our group. We all put in effort, had regular meet-ups, and really gave it an all-round effort. We ended up with a great score and had a lot of fun in the process (such as playing board games as a reward).

Teams are generally 4–5 people and are formed based on tutorial groups as well as through an 'online group test'. It is currently not known how the 'online group test' functions, so trying to put false information or trying to get friends to have different personalities may or may not work. Proceed at your own risk!

No, but seriously, not everyone will have a group as successful as this. It is a hit-or-miss draw, and it really depends on how much work you put in. Sometimes, you just don't get along with the people in your group. My advice? Get on with it; complaining doesn't get you marks. If you really believe things have escalated to a point of no return, you might actually have to solo the assignment (if your writing is good enough)!

I've heard nightmarish stories about OB groups, where things fall out so badly that no one talks to each other by the end of it, but then you have stories like mine. Is there a way to avoid it? Well, there is, but it doesn't guarantee you a good mark

either. As the selection of groups is based on the individuals in your tutorial, you can try and get a group of individuals that are friends and register for the same tutorial. However, I haven't seen a lot of groups that perform well using this strategy. Your friends may be your friends, but that doesn't mean they love writing either, especially when everyone is an aspiring actuary.

Usually, the group assignment is also based on a micro topic, is 5000 words (with 10% leeway), and is supposed to be evenly divided between the group. From personal experience, while this sounds fair logically and ethically, having different people write different sections will result in a mess of different writing styles and will probably detract from the overall consistency of your assignment. Have the best writer either do the final write-up or a thorough edit at the very end.

The group assignment will basically be a case analysis where you are given a scenario and you must analyse it with your group by using the specific topic of micro you are asked to use. The split is 3000 words towards the analysis section, and 2000 words towards the recommendations section. Don't forget: your recommendations aren't perfect, so do highlight the weaknesses in your recommendation, but not to the point of humiliating yourself.

You will need to divide up the workload into finding academic journals online, compiling these into useful examples, and actually writing the essay. You will find the latter part the hardest in a team environment.

Also, doing well in the group assignment does not guarantee a great subject score, so don't sigh a breath of relief either, as it only gets worse…

End-of-semester exam

The make or break of OB, where even getting 90+ in the group assignment does not make you immune towards getting H2A or less.

The exam is 2 hours long and contains four extended response questions: three of them on a single case and macro topic combination and the other on a micro topic. As such, micro is worth 25% and macro is worth 75%.

The micro section focusses on applying a single micro topic on your group assignment experience. This can rapidly turn into a 30-minute rant about why your group assignment team didn't get along well and why you guys did badly. While it may make an amusing read for the examiners, just remember that good writing seldom mixes well with extreme emotions about how your team worked. Also make sure that you don't spend too long on the micro section, as it is definitely not the most important part of the exam.

The macro section consists of writing extended responses to three questions based on a single case and topic combination. The case–topic combination will definitely not be one that was covered in tutorials or asked in previous exams. While this does narrow down the number of combinations, you should still practise all the combinations, rather than study a few and hope for the best.

My advice is to [hand]write a lot of practice essays in order to get accustomed to the format. Also, if you want to get a good score, just remember that memorising notes and ideas will not get you very far, especially as it is probable other individuals will memorise the same ideas, meaning that you can't stand out from the crowd for your essay. You also don't know the questions that will appear, and it is therefore impossible to prepare or memorise applicable ideas beforehand.

Really, the best way to tackle the exam is to be creative in your approach; by having a thorough understanding of each topic and case and being able to come up with your own unique ideas, you will be able to increase your chances of doing well.

The practice exams given are pretty useless, as you know those topic–case combinations will definitely not appear on the

exam. It really comes down to how much effort you want to put into self-study — this is not a subject for memorising ideas and taking them in.

However, no matter the topic, the last macro question will always ask for recommendations, which requires you to think outside the box and apply the topic to the case in order to make improvements.

Concluding remarks

Prepare to see your WAM drop (or barely stay level). There's no secret to success in this subject. There's no way you're going to get through it like a bludge subject, but at least if you try, you might actually enjoy it and have a lot of fun while you go through possibly the last writing subject in your life!

MGMT20001 Organisational Behaviour [SM2]

Exemption status	None.
Lecturer(s)	Professor Graham Sewell Dr Angela McCabe
Weekly contact hours	1 × 1-hour lecture 1 × 1-hour tutorial 1 × (approximately) 1-hour online tutorial
Assessments	Tutorial attendance and participation 10% Individual assignment of 1000 words, due in Week 4 10% Group assignment of 5000 words, due in Week 9 30% 2-hour end-of-semester exam 50%
Textbook recommendation	Department of Management and Marketing. (2011). *Organisational Behaviour* (5th ed.). Sydney, AU: Pearson Choices. All of the assessable material in this unit will be covered in lectures and tutorials, so the textbook serves mainly as an enrichment tool.
Lecture capture	Full (both audio and video).
Year and semester reviewed	2015 Semester 2

Comments

Subject content

- Weeks 1–6: Micro Theories

  We look at studies on the impact of individuals and small groups on the behaviour within organisations, taking a psychological perspective on analyses.

  The theories covered in the first six weeks are

  - principles of management;
  - perception, attribution, and decision-making;
  - group dynamics, teams, and team leadership;
  - values, attitudes, and work behaviour;
  - motivation in organisations; and
  - understanding conflict in organisations.

- Weeks 7–12: Macro Theories

  These theories take a more sociological, political, and cultural perspective on organisational structures as a whole and how they affect the behaviour within organisations.

This review was previously published in the 2016 start-of-year edition of the *Actuarial Students' Society Subject Review*.

The theories covered in the latter six weeks are

- Change
- Communication
- Culture
- Power
- Strategy
- Structure

Lectures

The OB staff ran 1-hour lectures in 2015 Semester 2 instead of their usual 2-hour lectures (as in Semester 1) for the first time. As a result, lectures were easier to sit through but were very content-dense and rushed. A few slides had to be skipped here and there in order to finish on time. Regardless of the drawbacks, the lectures were well delivered by Graham and Angela.

Tutorials

The online pre-tutorial work is great for applying the ideas you have learnt in lectures and allow you to partake in richer and more involved discussions in class.

Tutorials are very helpful for learning and understanding the unit material. You're given a brief review of the previous week's lecture before going into either class or small group discussions about the pre-tutorial and tutorial work. The in-class exercises enable very detailed and comprehensive discussions to take place and are a great opportunity to fill in any gaps in understanding you may have had and also to deepen your OB proficiency.

You will form your groups for the group assignment early on from the students in your tutorial class. Subsequent tutorials offer you ample opportunity to get to know your team and smooth out any rough patches you may have, which will prove to be vital, should you desire to be a part of a high functioning and collaborative team. Tutors give out handy assignment and exam tips in class but, however, do not provide any answers to the answers you must answer in your assignments. Both online pre-tutorial work and in-class tutorial participation are graded. Tutors will consider your attendance as well as the quantity and quality of your answers provided online and in-class.

Assignments

The individual assignment is a 1000-word essay that tests your knowledge of a micro topic (has generally been scientific management vs human relations) and requires you to apply it to a case study through analysing the scenario and then providing recommendations on improvements.

This is a fairly easy assignment, since very little content is required for its completion. The task requires you to support your answers with reference to peer-reviewed journals, which seems like a daunting task; however you will be guided through the referencing requirements and be given advice by the OB teaching team in a workshop. If you're unable to attend the workshop, a comprehensive set of slides will be uploaded to the LMS for you to download.

The group assignment is a 5000-word essay that requires you to analyse a case study using models within the micro topics. Your team is selected by a program that aims to diversify your team as much as possible. The assignment requires a lot

of time to be invested into researching peer-reviewed articles to support your arguments. The key to a successful result is to maintain a flow of communication between team members and to manage your time well in order to avoid pulling late nights come submission due date.

End-of-semester exam

The end-of-semester 2-hour exam is worth half your final grade. The exam marks are divided uniformly between four questions. You will not be allowed to bring in any extra materials into the exam; however, you are allowed to annotate the question booklet during reading time.

The first question will require you to reflect on your group work experiences from your tutorials and team assignments and analyse them using one of the micro topics. Your reflection journal will come in handy here. The following three questions will be based on a combination of one case study and one macro topic, which will not be a pair you have already studied in your tutorial classes.

Overall, it will be a straightforward exam, provided that you put in the time and effort to study your topics and cases properly. You will have less to cram during SWOTVAC if you read the cases during the teaching period of the semester.

Third-Year Subjects

ACTL30001 Actuarial Modelling I (1)

Exemption status	CT4 *Models*, in conjunction with ACTL30002 *Actuarial Modelling II*. Satisfactory performance in both subjects' end-of-semester exams is needed.
Lecturer(s)	Professor David Dickson
Weekly contact hours	2 × 1-hour lectures 1 × 1-hour tutorial There is an additional lecture scheduled every three weeks. However this was only used one or two times during 2016 Semester 1.
Assessments	Group assignment, due in Week 6 10% Group assignment, due in Week 10 10% 2-hour end-of-semester exam 80%
Textbook recommendation	Dickson, D. C. M., Hardy, M. R., & Waters, H. R. (2013). *Actuarial Mathematics for Life Contingent Risks* (2nd ed.). Cambridge, UK: Cambridge University Press. Apparently three chapters of this is used, ✗ but the book is not necessary at all. All required content is provided in lecture slides. The book is, however, used for ACTL30003 *Contingencies*.
Lecture capture	Full (both audio and video).
Year and semester reviewed	2016 Semester 1

Comments

Subject content

Actuarial work in life insurance involves calibrating models to estimate the probability that policyholders die or become terminally sick. ACTL30001 Actuarial Modelling I covers, **rigorously**, the mathematical underpinnings of different types of models. The course is split into six main sections, each one building on (in one way or another) concepts learnt in previous sections.

1. Introduction to basic concepts in mortality models such as: survival functions, force of mortality, life tables, and their associated notation. Mainly work with known probability functions.
2. Building non-parametric models for mortality using Kaplan–Meier, Nelson–Aalen, and Cox proportional hazards estimates. Involves maximum likelihood estimation.
3. Deriving two-state (alive–dead) models under various assumptions. Involves parameter estimation by method of moments and maximum likelihood estimation.

This review was previously published in the 2016 mid-year edition of the *Actuarial Students' Society Subject Review*.

4. Deriving multiple-state models as continuous-time stochastic processes. Using models with more than 2 states (e.g. healthy–sick–dead) to estimate transition probabilities. Involves solving linear ordinary differential equations (first-rder and sometimes second-order).
5. Deriving the mathematical properties of a Poisson process (a continuous-time counting process) and solving simple problems using this model.
6. Theory behind simulation of all models taught in the course, including compound models.

Lectures

Notes for each of the six sections are provided progressively, and lectures follow these notes exactly. The lectures are one of the strong points of this subject: David Dickson speaks clearly and slowly, covering every single step of a proof or sample exercise, and draws diagrams (timelines) that help with the interpretation of loaded mathematical results. Despite this, the content of the lectures can become somewhat boring, so it is easy to lose concentration during long proofs, which could lead to missing key steps or ideas. As proofs are an emphasized and regularly assessed part of this subject, do make sure to reproduce each proof in your own time. My word of advice is to not leave all of them until SWOTVAC, because the exercises you will have to revise on top of the proofs will make this task overwhelming.

After finishing the section notes, David Dickson will use the last few lectures as exam revision lectures, going through (possibly new) exam-style problems as well as exam techniques. However, he will not record these lectures, so attendance is highly recommended. Also, it is likely that at least one concept/question covered in these lectures will be on the exam! (Don't make my mistake and find this out the hard way).

Tutorials

Overall, I found the tutorials to be very worthwhile. Questions aiming to build on concepts learnt in lectures come in two forms — problem sheets and tutorial sheets. Problem sheets are for personal revision, with solutions released every two weeks, whilst tutorial sheets are provided and completed (in groups) in the tutorials.

To help students improve their teamwork and communication skills, David Dickson requires groups to present their solutions to the class. This involves explaining your methodology for solving the question in words, which will most likely be very beneficial to your understanding of key concepts. Nevertheless, if you are struggling, the tutors (in 2016 Semester 1 at least) are always willing to help.

Apart from collecting tutorial question sheets, another reason to attend tutorials is the extra insight you will obtain from your tutor, whether it be intuitive explanations for mathematical results or mathematical proofs for given results that seem to come out of the blue. Also, the steps to solving each question are explained in much more detail by the tutors compared to what is given in the uploaded tutorial solutions.

Assignments

Unlike the end-of-semester exam, there seems to be no set style or structure to either of the two group assignments, and David Dickson does not appear to re-use past assignments. Assignments can vary from extremely open-ended tasks such as "Create an exam question" (2015 Assignment 1), open-ended tasks requiring mathematical judgement such as "Create an approximation to the density of the mortality function using this data set" (2016 Assignment 1), or purely computational

questions that only require usage of results derived in lectures, e.g. "Calculate this estimate given this model and the following data" (2016 Assignment 2). One thing that is certain about assignments is that they will be marked harshly, to the point where you could lose marks for having too many decimal places in your answers, even though the required number of decimal places is never specified. If you wish to avoid this (although most people do not mind because they are only worth 20% of your final score), carefully study the formatting of David Dickson's lecture slides, tutorial solutions, and Excel spreadsheets, and replicate that for your assignment.

On a more serious note, my tip for tackling open-ended assignment tasks is to not be afraid to think outside the "box" of the subject and be able to fully justify your method and results. A technique you've learnt in a past subject and/or one that was briefly mentioned in tutorial questions may be much more justifiable compared to another concept recently covered in lectures.

Usually, assignment submissions will include a written explanation along with an Excel file. The explanation is restricted to a page (or even less) most of the time, so being clear and concise is extremely important.

End-of-semester exam

You are given one specimen exam and the mid-semester test used for the graduate equivalent of this subject, ACTL90006 *Life Insurance Models I*, as revision material. The actual exam is of a similar difficulty and length to these two papers.

The style of questions in the actual exam follows that of lecture examples (some of which are from past CT4 papers from the Institute and Faculty of Actuaries) and/or tutorial problems. There may also be a few difficult questions you haven't seen before, but completing the sample exams and revising all tutorial sheets, problem sheets, and the ideas behind the important proofs will ensure that the majority of the exam is manageable. The revision itself is a lot of work, so you should, as mentioned before, be diligent and spread this work across the semester. If you are able to do this, you should be confident in scoring above the exemption threshold for the exam.

If you also want to score highly in this subject, you will still need to be careful in the exam as it is only out of 60 marks but is worth 80% — each mark lost will have quite a big impact on your final score.

Concluding remarks

This subject is one of the more mathematical/analytical subjects in third-year. If you enjoy rigour and proving everything mathematically, even the most intuitive results, you will probably love this subject. On the other hand, the knowledge gained from this subject will most likely be redundant when one is in the workforce, making the subject a bore for those keen to see the practicality of actuarial models. My final suggestion to make the mathematics in this subject easier to follow is to revise the concepts of moment-generating functions, inferential statistics, and important calculus results (all of which are needed to complete Problem Sheet 0).

ACTL30001 Actuarial Modelling I (2)

Exemption status	CT4 *Models*, in conjunction with ACTL30002 *Actuarial Modelling II*. Satisfactory performance in both subjects' end-of-semester exams is needed.
Lecturer(s)	Professor David Dickson
Weekly contact hours	2 × 1-hour lectures 1 × 1-hour tutorial There is an additional lecture scheduled every three weeks. However this was only used one or two times during 2016 Semester 1.
Assessments	Group assignment, due in Week 6 10% Group assignment, due in Week 10 10% 2-hour end-of-semester exam 80%
Textbook recommendation	Dickson, D. C. M., Hardy, M. R., & Waters, H. R. (2013). *Actuarial Mathematics for Life Contingent Risks* (2nd ed.). Cambridge, UK: Cambridge University Press. This is recommended ✗ but not necessary at all. However, it is recommended to purchase the textbook as it will be used for ACTL30003 *Contingencies*.
Lecture capture	Full (both audio and video).
Year and semester reviewed	2016 Semester 1

Comments

Subject content

This subject covers different models that may be used in actuarial work to estimate the chances that policyholders will die or become permanently/temporarily disabled or ill. This is a very important part of life insurance. The course has six units, and each unit is linked to each other.

1. Explain the concept of a survival model;
2. Describe estimation procedures for future lifetimes;
3. Define a Markov process, and apply Markov models in actuarial problems;
4. Describe models of transfer between multiple states, including processes with single or multiple decrements, and derive relationships between probabilities of transfer and transition intensities;
5. Derive maximum likelihood estimators for the transition intensities in models of transfers between states with piece-wise constant transition intensities;
6. Describe the binomial model of mortality, a maximum likelihood estimator for the probability of death and compare the binomial model with the multiple state models.

This review was previously published in the 2016 mid-year edition of the *Actuarial Students' Society Subject Review*.

Lectures

David Dickson provides detailed lecture notes, and the lecture notes are released on the LMS progressively. David Dickson uses the projector to deliver lectures. He always writes notes and draws timelines to explain the concepts. For each topic, he will go through examples (either a past university exam question or a CT4 exam question) in detailed steps. It is very important to fully understand the examples in order to understand the concepts. Apart from applying models and formulae, another important area of the subject is proofs. There could be questions on the exam that ask you to prove a theorem or derive an equation. Some proofs can be long, tedious, and hard to understand the first time. Therefore you should read it over a few more times after the lecture to really understand it. Lecture attendance is highly recommended.

The last few lectures are used as exam revision lectures and are not recorded. David Dickson will go over more exam-style questions and any questions that are asked by the students.

Lastly, David Dickson is very strict on using mobile phones in lectures, so switch them OFF.

Tutorials

Problem sheets are posted on the LMS, and students are expected to attempt them before each tutorial. You will also be given the tutorial question sheet for that week in tutorials. Students will usually be asked to attempt them in groups and to present your answers afterwards as a group. Tutors will also go through each question and help you out with the questions.

It is a very good chance to ask any questions you may have. Some tutors will go over lecture concepts again in the tutorials. They may also give other intuitive explanations that will help you understand the concepts. Solutions will be provided on the LMS; however, solutions given in the tutorials are more detailed.

Assignments

Assignments are done in groups as assigned by the lecturer. Assignments are very different each year. For Assignment 1 in 2016, we were asked to create an approximation to the density of a lifetime distribution using the data provided. For Assignment 2, we were asked to calculate estimates using the model and data given. The assignments are supposed to be open-ended questions, and so they can be difficult to answer. Students are expected to submit a spreadsheet that contains all the working and a PDF file that explains the techniques used and the results obtained.

End-of-semester exam

You will be given one specimen exam and the mid-semester test for ACTL90006 *Life Insurance Models I* (the graduate equivalent of this subject) for exam revision. However, solutions will not be provided. The specimen exam is a good indication of the length and difficulty of the actual exam. However, the questions can be quite different.

To study for the exam, I recommend first going through all the exam-style examples and making sure you comprehend them. Then, go through all the problem sheets and tutorial questions. Again, it is essential to understand the proofs and derivations presented in lectures. I recommend leaving the specimen exams to the end of your revision and studying everything else first. It is also a good idea to study with friends and compare your answers for the specimen exams with your friends as solutions are not provided. However, revision is a very long process so don't leave everything until SWOTVAC.

As the exam is only 2 hours long, some students may find it difficult to finish all the questions. Therefore it is recommended that you practise your efficiency and maybe time yourself when doing the specimen exam to make sure you at least complete the exam within time constraints.

Tips

This subject focusses more on mathematics and less on theory. This is neither good nor bad. It also uses some knowledge that you've gained in past studies in first-year and second-year maths subjects. Make sure you understand the lectures thoroughly. Do not just memorise the proofs and derivations, but actually understand the logic behind each proof and derivation. If problem sheets and tutorial questions are not enough, you can find more practice questions in the textbook to help you prepare for the exam.

ACTL30002 Actuarial Modelling II (1)

Exemption status	CT4 *Models*, in conjunction with ACTL30001 *Actuarial Modelling I*. Satisfactory performance in both subjects' end-of-semester exams is needed.
Lecturer(s)	Dr Enrique Calderin
Weekly contact hours	2 × 1-hour lectures 1 × 1-hour tutorial There was occasionally an additional lecture during the rotational lecture time.
Assessments	Group assignment, due start of Week 7 10% Group assignment, due start of Week 12 10% 2-hour end-of-semester exam 80%
Textbook recommendation	Enrique compiles a workbook that is also the lecture slides. This is available for purchase at Co-op.
Lecture capture	Full (both audio and video).
Year and semester reviewed	2016 Semester 1

Comments

This subject and ACTL30001 *Actuarial Modelling I* both focus on modelling mortality and together form the exemption for CT4 *Models*.

Subject content

Subject content in this subject is split into four units:

- Unit 1 — Exposed to Risk Methods
- Unit 2 — Hypothesis Testing
- Unit 3 — Methods of Graduation
- Unit 4 — Markov Chains

Unit 1, for many people, was hard to understand and very confusing initially. The unit focusses on how to count the exposure of lives based on different rate intervals (or ways to classify a person's age) in order to calculate mortality rates. However, while it is quite confusing, there is ample time to master this section as Unit 2 and Unit 3 are relatively simpler. Unit 2 is similar to the hypothesis testing topic in MAST20005 *Statistics*, with a few new tests. It is important that students understand how the tests work and are able to apply the ideas to new, slightly modified tests. Unit 3 is about graduation, that is, how we can smooth out data but still ensure sufficient adherence to the original data. As with Unit 2, the material in this unit is quite methodical and routine. The difficulty of the subject returns in Unit 4 of the subject, as questions are mostly of a problem-solving nature. However, the lecturer provides lots of worked examples, so, with practice, the unit is definitely understandable.

This review was previously published in the 2016 mid-year edition of the *Actuarial Students' Society Subject Review*.

Lectures

During lectures, the lecturer goes through the subject content. The lecture slides are not uploaded until after the lecture, and the order of the material presented may differ at times to the official subject workbook. There is space in the subject workbook to fill in the worked examples, and while the examples are usually recorded, the lecturer sometimes writes on the whiteboard.

There is also a class test during one of the lectures. It is not formal assessment, but it is recommended that students attempt the test before attending the lecture, where Enrique will discuss the solutions to the questions.

Tutorials

Tutorial attendance is not compulsory but highly recommended. During tutorials, the tutor discusses the answers to the tutorial questions (which are included in the subject workbook). It is a good idea to attempt the tutorial questions before going to the tutorial (especially for Units 1 and 4); otherwise it can be difficult to follow the questions discussed, as these units are relatively more confusing.

NB: Answers to the tutorial questions are not released on the LMS, so that is another incentive to go to your tutorials.

Assignments

There are two assignments in the subject and both require students to work at a high level. The first assignment was on Unit 1 and Unit 2, and students were able to put into practice the principle of correspondence as well as some of the hypothesis testing procedures. The second assignment was on Unit 2 and Unit 3. The assignments are generally quite long, as they test material that is unsuitable to test in an exam due to time constraints. My advice on the assignment would be to include everything: for example, reasons for the choice of graduation formulae, diagrams, and assumptions made. Usually the assignments are expected to be written as if it were a formal report.

End-of-semester exam

The exam is generally quite long, with some students (including myself) finding it difficult to complete in the 2 hours of writing time. One specimen exam is included in the subject workbook and is quite indicative of the style and difficulty of the actual exam. For other exam practice, reworking through the lecture examples and tutorial questions is very helpful. Questions are fairly routine, so understanding the lecture material and practising the available questions throughout semester will guarantee success. For Unit 1 questions, it is imperative that assumptions are clearly stated. If no assumptions are required, this should also be stated. During the exam, work through the questions you are comfortable with first. The first question could be to count days, and with exam panic it is surprisingly easy to miscount the number of days in a period of time!

ACTL30002 Actuarial Modelling II (2)

Exemption status	CT4 *Models*, in conjunction with ACTL30001 *Actuarial Modelling I*. Satisfactory performance in both subjects' end-of-semester exams is needed.
Lecturer(s)	Dr Enrique Calderin
Weekly contact hours	2 × 1-hour lectures 1 × 1-hour tutorial There was occasionally an additional lecture during the rotational lecture time.
Assessments	Group assignment, due start of Week 7 10% Group assignment, due start of Week 12 10% 2-hour end-of-semester exam 80%
Textbook recommendation	ACTL30002 Actuarial Modelling II workbook ✓ It is essential that you get the workbook. Lectures are taught through the workbook — you are not given the lecture slides prior to each lecture. Additionally, all tutorial problems and a specimen exam are located in your workbook. The workbook is also available on the LMS should you choose to print it instead of purchasing it from Co-op.
Lecture capture	Full (both audio and video).
Year and semester reviewed	2016 Semester 1

Comments

This subject, along with ACTL30001 *Actuarial Modelling I*, will be your first subjects that deal with mortality (along with other topics). This subject covers content that is a bit more practical than its sibling.

Subject content

This subject is about the estimation of mortality rates and the process of making them appropriate for use (e.g. pricing insurance instruments). The subject's content is categorised as follows:

- Unit 1 — Exposed to Risk Methods

  This unit sets the foundation for Units 2 and 3. Given a set of people's lifetimes, as well as their times of death (if it occurred), how do we estimate the probability of death for specific ages (i.e. the crude death rates)? How do we go about defining their ages? It's not as simple as their "age last birthday". Homogeneity/heterogeneity, central and initial exposed to risks, rate intervals, and the principle of correspondence are covered here. This is without a doubt the hardest part of the course.

- Unit 2 — Hypothesis Testing

  Suppose we have our crude rates, how closely do they adhere to some other set of rates (e.g. those in a standard table)? We use hypothesis testing to answer this question.

This review was previously published in the 2016 mid-year edition of the *Actuarial Students' Society Subject Review*.

- Unit 3 — Methods of Graduation

  Using crude mortality rates leaves an insurance company open to sampling errors. Additionally, there is evidence to suggest that mortality rates have to have a number of features (most notably smoothness). How can we alter our crude rates to fix this?

- Unit 4 — Markov Chains

  We then take a step away from mortality rates to explore a subset of stochastic processes: Markov chains — a stochastic process where, given the present, the past and future are independent of each other.

You will want to briefly revise row reduction (for Unit 4) as well as content covered in your second-year mathematics subjects (for Units 2 and 3).

In addition to the content covered in lectures, you will also be required to memorise conventions that apply in many of these topics (e.g. adjustments for tests to a set of graduated rates or the conventions that apply to counting days). These are common pitfalls for students come exam time, so you should become familiar with them as soon as possible.

Lectures

Lecture slides for this subject are unavailable before the lecture — students are expected to follow along with Enrique in their workbooks (that they either printed or bought from Co-op). This is not much of an issue, as the lecture slides are really just a re-formatted version of the workbook. That said, sometimes it is hard to follow along with Enrique, as we were (occasionally) required to jump to different sections of the workbook with no indication. Completed lecture slides were provided after the lecture, providing solutions to lecture exercises. Feel free to use either these slides or your workbook for revision during SWOTVAC.

Enrique regularly utilised diagrams to help us absorb some of the more challenging concepts in the subject (in particular, rate intervals and the principle of correspondence). These helped immensely with absorbing the challenging content of the course.

Occasionally, there would be an extra lecture in the week (during the rotational lecture slot) to either catch up on content or go through some advanced exercises. The exercises presented in these lectures were a very good indication of what would be on the exam, so I would highly recommend attempting the problems beforehand (under timed conditions) and attending these lectures.

Tutorials

Tutorials generally consisted of a brief recap of the content covered in the previous week followed by time to work on the problems set for that tutorial.

The problems for the tutorial are provided in the workbook. Given the nature of the content in this course, a few of the problems required the use of software (mostly Excel). Solutions for the tutorials are unavailable outside of tutorials, so I highly recommend you attend them, especially for the first unit.

Your tutorial experience will ultimately depend on your tutor. Tutorials start in Week 2.

Assessments

You will be placed into groups of four (or three for those leftover). In 2016 these groups were the same as the groups in ACTL30001 *Actuarial Modelling I*.

Both assignments require students to produce a report. The first assignment covered Units 1 and 2, while the second assignment covered Units 2 and 3 (Unit 4 was not assessed outside of the exam). Tasks included applying the principle of correspondence and estimating the age at which a mortality rate applies to, testing and/or graduating a set of crude rates, and even conducting a new hypothesis test that is not covered in lecture slides.

Marking for the assignments was strict — no marking criteria was provided, but students were expected to be incredibly thorough with their report. If you think you have to do something in the assignment, you probably have to do it. Sometimes, the requirements were not so obvious. As an example, students were required to (numerically) find parameters a and b such that some function of a and b was minimised. This was done using software in Excel. However, students were expected to show that the solution found was indeed a minimum and not another type of critical point (i.e. a saddle or a maximum), which required the use of the Hessian matrix.

Enrique loves when groups use LaTeX for their report. The average for the cohort hovered at around 34 out of 40 for both assignments.

As the content may not be as technically challenging as the other subjects taken at the same time, it is quite easy to become complacent with the end-of-semester exam. Many were surprised when the exam was more challenging than expected. The specimen exam provided in the workbook, whilst providing good practice for the actual exam, was not very indicative of its length. My advice (which is not exclusive to this subject and, in all honesty, is fairly obvious) is to have a solid understanding of the content to allow you to deal with unfamiliar scenarios. Given the limited number of practice problems available to students, this is essential for success in the end-of-semester exam. Tutorial problems were generally much easier in difficulty than the exam.

A list of expectations is presented in the back of the workbook. This checklist provides a good summary of the subject and will be an excellent guide for your studies. Also, if you look online, you may find professional exams for CT4. These questions may provide extra practice for both this subject and ACTL30001 *Actuarial Modelling I*. If you have time left to kill before your exam and you are desperate for more practice material, it might help to look at these.

The final exam was tough but fair (despite a bit of clumsy wording for one of the questions).

Tips for success

Whilst it may be easy to become complacent with this subject after Unit 1, don't. Some of the more challenging questions on the exam related to Unit 3.

MAST20004 *Probability* and MAST20005 *Statistics* are arguably the most important subjects in your second year of Actuarial Studies. Having a strong foundation in these subjects will be a boon for you in (pretty much) every subject from third year onwards. This is especially the case in this subject, where Units 2 and 3 of the course is pretty much content covered in MAST20005 *Statistics*, but applied in an actuarial context. Part of 2016's exam required students to derive the formula for a 95% confidence interval, something which is covered in your second-year mathematics subjects.

Also, learn LaTeX. Your lecturers will thank you for it.

ACTL30003 Contingencies (1)

Exemption status	CT5 *Contingencies*. Satisfactory performance in this subject's end-of-semester exam is needed.
Lecturer(s)	Dr Ping Chen Dr Kevin Fergusson
Weekly contact hours	2 × 2-hour lectures 2 × 1-hour tutorials There are 2 extra hours of lectures in the first week.
Assessments	Group assignment 30% 3-hour end-of-semester exam 70%
Textbook recommendation	Subject notes are available for purchase from Co-op. ✓ It is recommended because the tutorial exercises are in these notes.
Lecture capture	Full (both audio and video).
Year and semester reviewed	2016 Semester 2

Comments

Double subject, hooray! Before taking the subject, people warned of the intense workload and difficulty of the subject. After taking it, it was already apparent from the first week of lectures that staying on top of lectures and the material was going to be very important. However, as the semester went on, it was quite difficult to be completely on top of the course given the speed and amount of content (and the time it takes to complete exercises).

Nevertheless, the subject is manageable if time is taken to understand how formulas come about. In doing so, you will find that many other formulas follow the same pattern, and are tweaked versions of one another. Having said that, there are still many formulas, and abundant practise is highly recommended. This is not a subject that you can cram for.

Subject Content

Life Insurance – 4 weeks

This part takes up most of the Contingencies course, covering topics like annuities, death benefits, provisions and premium calculations. Whilst there are many different formulas, trying to understand the derivations of the formulas will help you realise that many formulas follow the same idea.

Joint Life Theory – 2 weeks

This topic extends what is learnt in the first four weeks to insurance contracts covering two lives. Whilst the first part of the course is more tedious and computational, this part of the course is quite challenging.

Multiple Decrement Models – 1 week

The idea behind the content here is very similar to the multiple state models topic in ACTL30001 *Actuarial Modelling I*. It is important to understand the difference between the independent state case, and the multiple state case to avoid confusion when tackling questions. You should be able to understand and convert between independent rates and dependent rates.

Pension Funds – 1 week

This topic combines multiple state models and life insurance, exploring how to calculate the expected present value under different pension schemes. Again, the expressions for the EPVs can be very long, so understanding is key.

Demography – 1 week

Very similar to the demography section learnt way back in ACTL10001 *Introduction to Actuarial Studies*. Relatively straightforward content if you try to understand the formulas instead of memorising them.

Discounted Emerging Cost Techniques – 1 week

This topic explores how insurance offices would assess and design products that meet certain profit criterion. The nature of the exercises is similar to those done in financial accounting. Again, it is imperative that you try to understand which cash flow goes where and when because the scenario can be slightly different, causing issues if you just memorise the procedure.

Lectures

The first few weeks covering Life Insurance and Joint Life Theory are taken by Dr Ping Chen. Ping has a lot of experience teaching this subject, and is very good at delivering the material at a suitable pace. Initially some people may have found the lectures a little slow, however, this is done to make students comfortable with the material (and not feel overwhelmed). Later on, the lectures move a little faster. At the start, or end (or sometimes both), Ping would give summaries of the concepts or formulas taught thus far, allowing students to see how everything fits together.

The second half of the semester is taken by Dr Kevin Fergusson. Kevin's pace is much faster than Ping's, but this may be because the material in the second half is not as difficult to process as what is covered in the first half of semester. Kevin is also good at drawing connections between the material and real life work scenarios.

Overall, attending lectures is highly recommended as there is a lot of information in this subject. For those who prefer watching lectures online, it is imperative to be disciplined and not fall behind lectures because you can be overwhelmed by the number of formulas very quickly.

The lecture material can be quite dry at times making it hard to stay focussed for two hours straight. Lecturers are very aware of this, and do give us a break in between, so bringing snacks and water (or coffee) to rejuvenate yourselves may be a good idea!

Tutorials

There are two one-hour tutorials every week. At the start of semester, the tutorial questions are distributed (they are just a select few questions from the exercises in the subject notes). During tutorials, the tutors go through how to tackle these. Questions do not seem long, but can take a long time to work out if attempting them for the first time. Two hours of work is often required per set of tutorial questions. Handouts (lecture summaries, tutorial answers) were distributed at the end of tutorials, but this may vary from year to year.

Group Assignment

This year's assignment focused on valuing reverse mortgages using hypothetical data provided. The assignment was split into three parts. The first part of the assignment involved research into the actual reverse mortgage product so we all understood what it was. The second part required us to fit the data we were given to the Lee–Carter Model to project mortality rates. For the final part of the assignment, we derived a formula for the EPV of a reverse mortgage portfolio, and proceeded to use it to calculate the EPV for the hypothetical data. We were then required to submit a written report, and make a presentation on our findings.

Overall, this assignment was very challenging, but allowed students to learn a lot. Kevin was very understanding of the difficulty of the assignment, and gave us many hints along the way.

End-of-Semester Exam

The exam is 3 hours, and advice given to us by tutors and students who had taken the subject revolved around 'practise practise practise' because the exam was generally tight for time. Unfortunately, the exam was extremely difficult in our year, and time really was not the problem. It felt as if the lecturers pooled together the hardest concepts from each topic, and made that our exam (*cry*). Having done all the textbook questions and the specimen exam, none of what I had done to practise made me feel ready for that particular exam. The pensions section was particularly worrying because there were few tutorial questions on that topic to begin with. Nevertheless, students who took time to understand the material were somewhat successful at making decent attempts at certain questions. It is also important to work carefully as questions are often consequential.

Good luck, and may your exam be not-as-intense!

ACTL30003 Contingencies (2)

Exemption status	CT5 *Contingencies*. Satisfactory performance in this subject's end-of-semester exam is needed.
Lecturer(s)	Dr Ping Chen Dr Kevin Fergusson
Weekly contact hours	2 × 2-hour lectures 2 × 1-hour tutorials There are 2 extra hours of lectures in the first week.
Assessments	Group assignment 30% 3-hour end-of-semester exam 70%
Textbook recommendation	*ACTL30003 Contingencies* workbook ✓ The workbook is essential. All tutorials problems, and the specimen exam are available in the workbook.
Lecture capture	Full (both audio and video).
Year and semester reviewed	2016 Semester 2

Comments

It's the big scary capstone subject of the degree — Contingencies! This subject can be seen as the fusion between ACTL20001 *Financial Mathematics I* and ACTL30001 *Actuarial Modelling I*. Be prepared for one of the most challenging subjects (for various reasons) of the entire degree.

For students who have decided they do not want to become an actuary but still want the actuarial major, I strongly recommend that you forgo this subject in favor of other actuarial subjects like ACTL30004 *Actuarial Statistics* or ACTL30006 *Financial Mathematics III*, as the content in this course is highly specialised for the actuarial profession, and I imagine it would be of little use outside the profession.

Subject content

Contingencies is mainly about pricing insurance products, taking into account the present value of cash flow (FM1) and the probability that the payment actually occurs (AMI). The content is categorised as follows:

- Life Insurance Mathematics

  Combining knowledge from probability and financial mathematics, how does one find the "expected present value" (EPV) of the cash flows from a life insurance product? How does one calculate a "fair premium" for this product? This was briefly touched upon in ACTL10001 *Introduction to Actuarial Studies*. A life insurance company must also set aside a certain amount of money (provisions) to pay out to policy holders if a benefit must be paid out. How much should they set aside? Calculating profit is a bit more complicated for a life insurance company. How do we go about calculating that?

- Joint Life Theory

  The first part of the course focusses solely on policies that are contingent on the life of a single person. However, some contracts are dependent on two lives. How does one answer the questions laid out above when two lives are involved? This is easily the hardest part of the course.

- Multiple Decrement Models

  Above, we only consider the decrement of 'death'. However, sometimes a benefit is paid out for multiple reasons (e.g. death and disability). How do we calculate the probability of a person dying when they also have the risk of becoming disabled? The content here is similar to Multiple State Models from AMI.

- Pension Funds

  Here, you apply your knowledge in life insurance mathematics and multiple decrement models. The 'EPV' of various superannuation benefits are explored here.

- Demography

  A nice breather after all of the complicated content. Remember the 'crude death rate' and 'crude birth rate' stuff from *Introduction to Actuarial Studies*? Those things make a return here. This unit also contains the only 'theory' part of the entire course, where a number of different factors for mortality and different types of selection are explained in detail.

- Discounted Emerging Costs Techniques (DECT)

  The DECT is another way of calculating the EPV of a number of insurance products. In this subject, the technique is mainly applied to 'Unit-Linked' products (where the benefit paid out is dependent on some other investment).

Overall, the content for Contingencies is extremely dry. Students are expected to work with life tables the entire semester, which can become very tedious to work with. Unfortunately, there is no substitute until electronic exams become feasible, so you will just have to make do. If you love memorising and working with formulae, you may enjoy this subject.

Lectures

The first 6 weeks cover Life Insurance Mathematics and Joint Life Theory, and was taught by Ping Chen. Weeks 7 to 10 cover the rest of the course, and was taught by Kevin Fergusson. There are no lectures for the last two weeks. Group presentations are held in the last two lectures of the semester. More details regarding these presentations can be found later in the review.

Ping goes through each lecture slowly and meticulously, carefully explaining each step of the derivations of formulae and the solutions to each lecture example. Such a teaching style is incredibly helpful for the earlier parts of the course and some of the harder concepts in Joint Life Theory. The vast majority of students found this approach to teaching the subject incredibly helpful for absorbing the content. I personally wished it went a bit quicker, but going too slow is not necessarily a bad thing.

The change of lecturers was very jarring. Kevin sped through the content, and rarely went into detail for any of the concepts. Most of his comments provided context to the content learnt in lectures which, while interesting, did not suit the quantitative nature of the subject — perhaps he is better suited for a more qualitative subject. Fortunately, the content Kevin taught was not nearly as difficult as the content in the earlier half of the semester.

The slides for Life Insurance Mathematics are much better than the workbook (for example, some important details regarding the calculation of mortality profit are missing from the workbook). Apart from Life Insurance Mathematics, lecture slides are essentially a copy of the workbook. While I strongly recommend using the slides for Life Insurance Mathematics, feel free to use either the workbook or slides to revise the course content during SWOTVAC.

Tutorials

There were two tutorials per stream during the semester, and a different tutor took each of them. Each tutorial stream had the same two tutors.

Tutorials consisted of a very brief summary of the content covered in the previous class, followed by discussion of a few selected questions for the week. The list of questions to be discussed is sent out at the start of semester. Worked solutions for the questions discussed are handed out at the end of each tutorial, which may help in understanding the methods used to answer each problem. Solutions to each chunk of exercises in the workbook (not just the questions discussed) are uploaded to the LMS at the end of each week.

Compared to other subjects, I personally found this subject's tutorials to be the least helpful. Whether that was because I was too brain-dead to follow along with the tutor, or whether it was because the content was uninteresting is a mystery.

Your tutorial experience will ultimately depend on your tutor. Tutorials commence in week 2, and finish in week 11 — there is no tutorial in week 12.

Exercises

There is an absolute mountain of exercises in the workbook — more than the average actuarial subject. The sheer number of questions each week makes it quite intimidating to begin, as well as a huge pain to catch up if you fall behind (even one week of exercises will take ages). It will be in your best interest to keep up each week to avoid spending an entire week catching up (like this reviewer did).

Exercises were a mixture of proof questions, standard calculation questions, more complex calculation questions, excel questions, as well as interesting theory questions. The overwhelming majority of questions required the use of the life tables located at the back of the workbook. Flipping back and forth between reading the question and grabbing the appropriate values from each table was a huge pain, so I decided to print off each life table (which are provided on the LMS) and create a separate binder at OfficeWorks. You should definitely do this ASAP to save yourself a lot of hassle.

Group Project

Being a capstone subject, this subject's group assignment is unlike any other group assignment in the major. Much like all the other group assignments in 3rd year, students are grouped together based on their "capabilities" (i.e. strong students tend to get grouped with other strong students). The group project is worth 30% of the overall subject score.

In 2016, the group project dealt with reverse mortgage contracts — a type of product which, while not explicitly taught in the course, can be priced using the concepts from Life Insurance Mathematics and Joint Life Theory. Groups were expected to produce a report, presentation slides, and an excel spreadsheet showing any calculations. The report was to cover the background of the product, an explanation of the models used and numerical figures showing the portfolio value and the

profit made over the financial year. In addition to this, groups were to give a 10 minute presentation about the project. The 10 minute time limit is very strict, with penalties for groups going over this time limit.

The project was a large source of stress for many students in the latter half of the semester due to the open ended nature of the project. The project also introduced a large number of new concepts that extended on what was taught in lectures. For example, the use of the Lee–Carter model of mortality (i.e. stochastic mortality rates) instead of the usual "static" mortality rates. However, the project was designed to give students a taste of what it was like in an actual job (e.g. ambiguity and open-endedness) rather than working with artificial scenarios, and the project succeeded in doing just that. Any experience in VBA for Excel will be very helpful for the project (and was somewhat necessary).

I recommend that you start as soon as possible. The deadline might seem like a long way away from the time the assignment is actually released, but trust me on this one. Do not be afraid to ask questions to the lecturer(s) if your group needs any clarification on the project.

Kevin spent a large amount of time during lectures giving hints for the assignment. Summary statistics for the project were not provided, and your mark is not given to you unless you ask for it personally (e.g. e-mail). Unfortunately, as interesting as the project was, it did not offer much in terms of revision for the exam.

End-of-Semester Exam

In the past, the exam was usually quite predictable, being similar in style and difficulty to tutorial problems. However, the 2016 exam was arguably the hardest exam in the entire degree (at least, for the cohort of 2016).

The first half of the exam (life insurance mathematics and joint life theory) surprised the vast majority of students. You had to work extremely hard for every single mark. I felt that the exam really tested one's attention to detail, as the types of annuities used required a lot of manipulations of normal annuity numbers. If I were to compare the questions on the exam to the workbook questions, the exam questions would probably be in line with the most difficult questions in the book.

Other parts of the exam were relatively okay. The superannuation question was a huge curveball, as many of the workbook exercises and in-lecture exercises primarily used Excel. However, as the entire superannuation unit is essentially an application of life insurance mathematics and multiple decrement models, the question itself was do-able.

The specimen exam was vastly different to the actual exam in both length and difficulty. Fortunately, the exam was scaled appropriately.

There is also no formula sheet.

Tips for Success

I can not offer you any tips for success, but I can offer you tips to avoid failure. The one thing you do not want to do in the subject is fall behind in your exercises, as it will be almost impossible to catch up without sacrificing your study time in other subjects, as well as your sanity. Like most other subjects, understanding what each term in each formula does will greatly reduce the burden of memorisation. Luckily this is relatively easy to do for the first two topics due to Ping's teaching style.

Honestly, there is no secret to success in Contingencies. Just grind out question after question and it should eventually become second nature (...hopefully). Best of luck!

ACTL30004 Actuarial Statistics

Exemption status	CT6 *Statistical Methods*, in conjunction with ACTL40002 *Risk Theory I*. Satisfactory performance in this subject's end-of-semester exam and a satisfactory final grade in ACTL40002 *Risk Theory I* are required.
Lecturer(s)	Dr Enrique Calderin
Weekly contact hours	2 × 1-hour lectures 1 × 1-hour tutorial
Assessments	2 group assignments 2 × 10% 2-hour end-of-semester exam 80%
Textbook recommendation	ACTL30004 Actuarial Statistics workbook Much like in ACTL30002 *Actuarial Modelling II*, ✓ getting the workbook is essential. All tutorial problems, and the specimen exam are available in the workbook. The workbook is available on the LMS if you choose to print it instead of purchasing it from Co-op.
Lecture capture	Full (both audio and video)
Year and semester reviewed	2016 Semester 2

Comments

This subject predictably extends on the content covered in MAST20005 *Statistics*. Though it has 'Actuarial' in front of its name, this subject covers content that is very applicable in all fields outside of just actuarial studies. Therefore, it is probably the most useful subject in third year. Whether or not you intend to be an actuary at this point of your degree, be prepared to learn a lot of useful skills for any quantitative work.

Subject content

This subject introduces a number of different models and tools to aid in statistical analysis. The subject's content is categorised as follows:

- Unit 1 — Introduction to R

  In order to effectively study the following units, the subject starts with a brief introduction to the programming language of R.

- Unit 2 — Likelihood Theory

  In order to fit a set of data to a probabilistic model, one must find the correct parameters. Using Maximum Likelihood Theory, the parameters are chosen by assuming that the outcome that has occurred is the most likely outcome. Different properties of Maximum Likelihood Estimators (MLEs) are covered in detail. The content covered here is just enough to study the next unit.

- Unit 3 — Generalised Linear Models (GLMs)

A normal regression model assumes that the response variable is normally distributed, and that the mean is a linear combination of a set of explanatory variables. What if the response variable was not normally distributed, or the mean is a **function of the linear combination** of explanatory variables? Then you have a GLM.

- Unit 4 — Simulation

  Some of the more complicated models are unable to be analytically examined. In these situations, simulation (using a computer to perform a large number of experiments) is used. This extends upon knowledge from second year mathematics subjects and ACTL30001 *Actuarial Modelling I*.

- Unit 5 — Outstanding Claims Provisions

  In order to calculate the amount of money that should be held for future claims payments, run-off triangles are used. This unit covers a number of different methods that utilise these run-off triangles.

- Unit 6 — Experience Rating Systems

  A very short unit that applies markov chains to a 'No Claim Discount' system — a system where policyholders with no claims in a year have a lower premium in the following year.

- Unit 7 — Time Series Analysis

  There are situations where the 'residuals' of a variable observed over time follow some sort of pattern. This unit explores these patterns, with a focus on stationary processes. The autoregressive and moving average processes from ACTL20002 *Financial Mathematics II* makes a return, as well as a new process — ARMA(p,q): the autoregressive and moving average process.

While it may look like there are a lot of units, the majority of the semester will be spent covering Units 2, 3, 4 and 7. Unit 3 is far and away the hardest unit of the subject, so bring your A-game for that.

Lectures

As the lecturer for this subject returns from ACTL30002 *Actuarial Modelling II*, the style of lectures between the two subjects are very similar. However, given the more challenging course content, I felt that there was a greater need to attend lectures in this subject.

Students are expected to follow along with Enrique in their workbooks. Sometimes lecture slides were released before the lecture time, but the workbook is more than enough. Unfortunately, this subject suffers from the same problem that often there is not enough time to copy down worked solutions for the in-lecture exercises. However, slides are posted as soon as lectures finish, allowing you to copy what you have missed afterwards. Like before, feel free to use either the workbook or the complete set of slides for revision during SWOTVAC.

Enrique is very clear in explaining the statistical concepts, and is a much more effective lecturer for this subject than for AMII. He regularly asked questions to keep us on our toes and helped us understand some of the more complicated concepts relating to GLMs and R output. If *Statistics* left a sour taste in your mouth due to the lectures, be comforted with the fact that this subject has an amazing statistics lecturer.

Tutorials

Tutorials generally consisted of a brief recap of the previous week's lectures, followed by the solutions for tutorial problems.

Unfortunately, there were times during the semester where the tutorial problems used content that had not been covered in lectures yet. Tutors were generally aware of this, so it was not really much of an issue. My tutor saved these questions for the following week.

Solutions for the tutorials are unavailable outside of tutorials, where a printed copy is handed to you.

Your tutorial experience will ultimately depend on your tutor. Tutorials start in Week 2.

Assessments

Much like in the first semester modelling subjects, students are placed into groups of four (or three for leftover students). Both assignments require groups to produce a report. The first assignment covered Unit 2, while the second assignment covered Units 3 and 4. Tasks included applying the Fisher–Scoring algorithm, calculating maximum likelihood estimates, and using simulation to perform a statistical test.

While you were able to get through past assignments using Excel, it will be a huge struggle to get through these assignments without the use of R, so it will be in your best interests to familiarise yourself with the programming tool well before the assignments are released. The average for the cohort was roughly 34 for the first assignment, and 38 for the second assignment.

For this subject's exam, marks are typically lost for silly mistakes rather than a lack of understanding due to the number of small things that must be considered. For example, you might forget a negative sign, or glance over a small detail in the question that changes the numerical solution ever so slightly (e.g. expected *failures* vs. expected *trials*).

For practice, the specimen exam is a very good indication of the difficulty of the questions for the exam. However, the specimen exam does not cover every unit that is taught in the subject (in particular, there was no question on Unit 6). Like always, it is best to save the specimen exam until after re-attempting all the tutorial problems. It might also be wise to save a question in Unit 6 to add to the specimen exam when you attempt it. There is a checklist at the end of the workbook, listing the expectations related to each unit, which will aid your revision immensely.

In 2016, all of the units were assessed (unlike the specimen exam). Surprisingly, there was no question requiring students to interpret R code. Overall the exam was very fair and doable.

Tips for Success

It goes without saying that your knowledge from *Statistics* will be a huge boon for this subject — there is a large amount of overlap between the two subjects, particularly in Unit 2.

A bit of background knowledge in programming will definitely help a lot with assignments and the occasional tutorial problem. Take the time during the first week to familiarise yourself with R, whether that is through the notes in the workbook or your notes from second year mathematics subjects (though, the notes in the workbook are sufficient for the subject).

ACTL30005 Models for Insurance and Finance

Exemption status	Not an exemption subject, but is a prerequisite for ACTL40004 *Advanced Financial Mathematics I* (CT8 *Financial Economics* subject).
Lecturer(s)	Professor Daniel Dufresne
Weekly contact hours	3 × 1-hour lectures The third lecture each week is a discussion of the provided exercises.
Assessments	2 group assignments 2 × 10% 2-hour end-of-semester exam 80%
Textbook recommendation	No external texts required. An electronic set of lecture notes (formatted more like a textbook) is provided by Daniel and is all you will need.
Lecture capture	Full (both audio and video).
Year and semester reviewed	2016 Semester 2

Comments

Do all of the following apply to you?

- You are not considering Honours.
- You are not considering the MC-COMACTS *Master of Commerce (Actuarial Science)*.
- You do not like abstract theory.
- There is another subject which you would rather study in Semester 2, and you believe it is worth submitting an enrolment variation form to change your study plan.

If yes, I would highly recommend withdrawing from ACTL30005 Models for Insurance and Finance.

Otherwise, this subject might be for you!

MIF is different from all other actuarial subjects because of its style. First of all, you are not going to find simple practical applications of the theory in this subject (there are practical applications, but they are beyond the undergraduate student). Moreover, the structure of this subject is more like a pure maths subject: there are several results and techniques shown throughout MIF, all of which may be useful in solving a problem. Is it obvious which one will be useful? Maybe. But probably not.

When you are presented with a problem in MIF, it is a joint question of

- Can you recognise that there is a result or technique which might be of use?
- Can you identify which result or technique might be of use?
- Can you use the result or technique and solve the question?

In a subject which covers a variety of general results, the hardest part is ostensibly the first.

In other actuarial subjects, the first question is essentially moot, because there are not many mathematical results covered, and the ones that are covered are normally very specific in their area of use, to the point that in students' minds they become directly associated with problems in that area.

That is not the case for MIF. Despite the mentions of *insurance* and *finance* in its name, both of which sound fairly practical, MIF can be likened to MAST10009 *Accelerated Mathematics 2*. There was a variety of results in AM2, and hardly any were highly obvious in their utility for solving problems.

MIF studies some basic measure-theoretic probability theory and proceeds to explore basic concepts in stochastic calculus (calculus for dealing with stochastic processes) and some new concepts regarding stochastic processes. A good result in MAST20004 *Probability* should inspire some confidence, because many of the computational tools make a reappearance, although do be prepared to be awakened to the measure-theoretic perspective of probability theory, of which you probably have been unaware unless you studied MAST30020 *Probability for Inference* (on a personal note, fantastic subject, would highly recommend for the abstract-minded).

The role MIF plays in the tertiary education of an aspiring Honours or MCom student is preparation for ACTL40004 *Advanced Financial Mathematics I*, which is required for exemption from CT8 *Financial Economics*. The theory in MIF provides a foundation for studying derivative pricing in AFM1.

MIF lacks some of the rigour which you might expect from such a mathematical subject, particularly in the introduction of stochastic calculus — it is far less rigorous than the introduction to calculus in AM2. To be fair, the rigour of the theory in MIF is largely far beyond a third-year actuarial student, and if the rigour were examinable I would simply have told everyone to withdraw from this subject immediately.

On the other hand, MIF holds the status of being the only undergraduate subject in the entire university to discuss Brownian motion (in the mathematical sense) and stochastic differential equations (i.e. differential equations with randomness). Neither is mentioned in *Statistics and Stochastic Processes* subjects taught by the School of Mathematics and Statistics, because Brownian motion has sadly been removed from the syllabus of MAST30001 *Stochastic Modelling* (apparently, as of 2016 Semester 2), where it was formerly taught.

A minor note: From 2017 onwards, MIF will no longer be delivered by Professor Daniel Dufresne. Please keep this in mind when reading this review.

Subject content

There are six topics in MIF:

1. an introduction to measure-theoretic probability theory
2. conditional expectations (in particular those conditional on σ-fields)
3. random walks and Brownian motion
4. a new type of integral for stochastic processes called *Itô's integral*
5. stochastic differential equations
6. martingales (a type of stochastic process with special properties)

Introduction to measure-theoretic probability theory You have finally made it: the ultimate semester of your BCom. Having survived the merciless slaughter that was the FM3 exam, you are honestly just glad you still have a chance of graduating on time.

You look at the name of the first topic: *Probability Spaces, Random Variables, Simulation, Expectations*. All are familiar terms, except for maybe *spaces*. Vector spaces maybe? Covered in AM1, although you may be a bit rusty. Everything else sounds like a revision of *Probability*. You kick back and prepare for a cruisy first few lectures. Maybe you should have stayed at home.

You kick back a bit too far, and the sensation of falling wakes you abruptly. You are met with a barrage of jargon which you have never heard of before. Did you misread the timetable? What are measures? What are fields doing indoors? Who is Lebesgue and why is he measuring things? Where did all the probability densities go? Is this a Greek class?

You awaken to the reality that this was not revision at all. Your concept of probability is being completely rewired.

What a grand welcome to the final semester of your BCom.

This first topic serves to set up the theoretical environment in which you will study probability theory in MIF, and, accordingly, there is a lot of new terminology. Fortunately a decent amount of time is spent on stabilising your foundation here. You are introduced to many new concepts along the way which are clear signs that there must have been ridiculous advances in probability theory over the last two semesters, surely.

Not really. This has been the true face of probability theory all along.

In this first topic, your knowledge of random variables, events, and expectations will completely change (for the better). Events with a probability of 0 are actually made distinct from impossible events, and you even have a completely new type of integral, the *Lebesgue integral*. The Lebesgue (pronounced something like *leh-bek*) integral is different from the Riemann integral, but the exact distinction is not made clear in MIF.

The main takeaways from this first topic are that

- the σ-field contains subsets of the sample space to which we can sensibly assign probabilities (the subtlety being that not all subsets of the sample space can be sensibly assigned a probability);
- a random variable is a function whose domain is the sample space; and
- the expectation of a random variable is the Lebesgue integral of the random variable over the entire sample space.

Close to the end of the topic are two seemingly arbitrarily placed theorems: the dominated convergence theorem and Fubini's theorem (which may have been given a passing mention in AM1). These theorems deal with the finiteness of Lebesgue integrals, and you need them because the distinction between finite and infinite is now relevant again!

Conditional expectations Your expectations adjusted, you are now ready to accept that MIF is going to be hard. In the wry humour of Daniel, even a broken clock is right twice a day, and this time you are right. (And how many times is a functional, accurate clock right in a day? This is the sort of question present at the beginning of MIF.)

Conditional expectations in this subject are random variables just like they were in *Probability*, but the conditional part is now different — it is now a σ-field instead of a single random variable.

At this point it must be stressed that the intuition behind σ-fields is that they represent information or information potential. The conditional expectation is a random variable whose value depends on exactly what information is present (i.e. a function of an element in the sample space).

This new take on conditional expectations is introduced with a very basic example of a σ-field (one that is generated by a partition of the sample space). For the rest of MIF, the σ-field is usually one that is generated by a collection of random variables, in which case the conditional expectation is just like it was in *Probability*, but be aware that all of the results for conditional expectations do in fact hold for general σ-fields.

Three properties of conditional expectations are discussed (one more is given later). You will use these somewhat frequently in solving problems in MIF, and they will also be important in understanding lecture content.

From a computational perspective, conditioning on a collection of random variables is all you will need to handle in MIF (think "find the expression for the conditional expectation"), ergo you are well prepared from *Probability* to handle computations involving conditional expectations.

In terms of conditioning on generic σ-fields, again, what is most important is an understanding that you are essentially conditioning on information [potential]. You will not really deal with computations for conditional expectations given general σ-fields.

Random walks and Brownian motion With a corrected perspective on probability theory, the next topic in MIF begins your journey through stochastic processes and an associated calculus.

Random walks are defined with some small properties shown, including an application of the newfangled conditional expectation. Long-term behaviour of random walks is discussed, with a short application to risk theory, validating the use of "insurance" in the subject's name.

The discussion on random walk ends rather quickly in favour of introducing Brownian motion. Make sure you take in this moment, because Brownian motion truly is something to behold (and something that will be everywhere from this point onwards).

Standard Brownian motion is a continuous-time stochastic process and is introduced as the limit of a random walk (by scaling the frequency and size of the steps appropriately). It is (almost surely) continuous when graphed, but has some very peculiar properties. If your position along a straight line were described by the value of a standard Brownian motion, then the ways in which these peculiar properties manifest (almost surely) include that

- over any time period you have travelled an infinite distance; and
- you have transcended the concept of velocity (your velocity does not exist).

Indeed, standard Brownian motion is very complex.

There are some other properties regarding how to construct new standard Brownian motions from existing standard Brownian motions (which you will need to know), but the most important property which is fundamental to stochastic calculus is that the quadratic variation of standard Brownian motion (a way of measuring the amount of change) is equal to the length of the time period over which you measure. This may come in use when computing basic limits involving standard Brownian motion, so you will have uses for it outside of understanding what is discussed in the next few topics.

Regarding the *standard* descriptor in *standard Brownian motion*: There are other types of Brownian motion (arithmetic, geometric), but they are all based on standard Brownian motion.

Itô integrals Things certainly do not get any less weird with the introduction of a type of random integral. What about the integral is random? The differential. This is probably difficult to grasp, but you will be led slowly through the (heuristic) construction of the Itô integral.

The Itô integral, like the Riemann integral, is the limit of a sequence of sums. Of course, this limit is not the same one you encountered in AM2, because the sums are all random too! The sums all involve a single standard Brownian motion, which is the reason you studied them before this topic. Taking the limit (in a special sense) you will arrive at the Itô integral, which is naturally also a random variable.

The Itô integral possesses some familiar properties associated with normal Riemann integrals, such as linearity, but gains some new ones from its proud status as a random variable, many of which hold analogously with the random sums of which the Itô integral is the limit.

Unfortunately, its proud status as a random variable also means you often cannot find closed expressions for Itô integrals. Your normal methods for integrating deterministic functions like polynomials or exponentials in Riemann integrals sadly hold no weight in this newer stochastic world.

The Itô integral leads to the introduction of a type of stochastic process called *Itô processes*, and these can be differentiated (in a sense). There are even analogues of the much-loved product rule and chain rule, but the expressions are slightly more complicated. You will need to be able to use these, and fortunately they will appear on a formula sheet in the exam.

I recommend practising these new rules for differentiation quite heavily, because they are difficult to become accustomed to (yes, these new rules are that much more complicated). Relatively speaking (compared to the rest of the content in MIF), they are just as mechanical as the product and chain rules in normal differentiation, so it would be a shame to make mistakes when using them.

Stochastic differential equations Having infused integration (and differentiation) with randomness, we now proceed to do the same to differential equations. Stochastic differential equations are equations relating the change of an Itô process to itself (what you are solving for is a particular Itô process). There are far fewer techniques to solve these equations compared to those available for solving deterministic differential equations.

Pay special attention to the two types of stochastic differential equations which are shown in this subject to have analytical solutions. The solution to one is geometric Brownian motion, while the solution to the other is something called the *Ornstein–Uhlenbeck process*. The method of obtaining these solutions is shown in lectures but effectively amounts to trial and error.

The expressions for the analytical solutions are fairly horrendous. In 2016, many students did not memorise the expressions, which unfortunately was required for a question on the exam.

At the end of the topic you are shown how to obtain deterministic differential equations for the moments of the solution to a stochastic differential equation. These you are expected to be able to solve analytically, as they are first-order linear ODEs. (Use integrating factors to solve them.)

Martingales The final topic is martingales. The origin for the name lies within a type of betting strategy whereupon one continually doubles his bets after a loss to eventually make a profit. For this to be feasible, however, you must be infinitely rich and somehow care about becoming more rich. Anyway please gamble responsibly.

Martingales are a type of stochastic process which is the mathematical model of a fair game; that is, it is impossible to form strategies based on historical outcomes of the game which will result in profits on average. The classic example in finance is the price of a stock in a market which exhibits weak information efficiency.

The definition of a martingale is essentially all that is examined in this topic. The discrete-time martingale transform is also introduced (barely) as well as an associated theorem, but I would say that they are highly insignificant in MIF. (Over five years of exams the theorem has not been necessary, but there has been potential to use it.)

The way this topic is assessed is usually by providing several stochastic processes and asking which (if any) are martingales. They can all be done by testing the parts of the martingale definition, but often there are faster ways, such as testing whether certain properties of martingales hold.

Fun fact: Did you know the Society of Actuaries in the USA has a main office located on North Martingale Road?

Lectures

Keep in mind that the following comments are specific to the lectures delivered by Daniel.

Lecture notes were made completely available at the beginning of the semester. They were formatted more like a textbook and would be on display on a projector screen in lectures. Daniel also mentioned he was in the process of making them available as a series of web pages (currently the first topic is located at http://www.ozdaniel.com/IntroStochCalc/Chapter1.php).

Lectures followed the sequencing of the notes, although in 2016 there was occasionally some skipping or backtracking. However, not everything delivered in lectures was part of the notes. Often Daniel would spend time verifying that all conditions were satisfied when applying a result, even the auxiliary ones (usually involving finiteness of certain quantities). Daniel would also expand on some aspects which were only given passing mentions in the notes or begin explaining areas which were related to the topics in MIF (but nevertheless outside the scope of the subject).

In 2016 we were mostly ahead in the lecture schedule, so nothing was rushed. In MIF, despite the foreign nature of the content, there is not a lot of it, which gave Daniel flexibility to discuss other related topics. Of note were the several times the focus of a lecture temporarily became the history behind some of the results (there was sufficient time to do this and not hinder the content delivery).

Lectures were recorded, with the video feed being the document camera that was displayed next to the lecture notes in lectures. Daniel would occasionally show more working or details for some of the steps in examples through the document camera.

There were three lectures each week, but the third lecture was dedicated to discussing solutions to the exercises.

Exercises

The full set of exercises and all the solutions were made available on the LMS at the beginning of the semester.

As is characteristic of Daniel, the exercises supplemented the lecture notes with extra insights and results. Aside from these were simple applications of definitions and results in lectures, some problems investigating the results in lectures, and some more involved problems which required some ingenuity or acute observations. The more involved problems were not always directly relevant to the content discussed in lectures, however. Nevertheless, the solutions to these were always rather interesting.

The extra material introduced in the exercises, such as some inequalities (Markov, Chebyshev, Cauchy–Schwarz), was considered examinable, and various novel techniques were showcased in solutions, such as the use of moment-generating functions and characteristic functions (these in particular made few appearances in the lecture notes). Some of the problems were explicitly marked as not examinable.

Daniel discussed the solutions in the third lecture each week. The solutions themselves were fairly comprehensive, often including multiple different approaches. Daniel mostly presented the solutions as-is during the third lecture while commenting on subtleties along the way.

Assignments

The two assignments are worth 10% each. Both are done in groups of three to five of your choice.

In 2016, the first assignment was more difficult, requiring some ingenuity. The second was more straightforward but discussed some new concepts and required some programming for simulating random walks and standard Brownian motion (R code was acceptable).

Like the exercises, the assignments were not always directly related to the lecture content, and the difficulty of the problems was overall quite similar to those in the exercises.

Bonus marks for solutions to bonus questions were available in the first assignment. These could be used for insurance in the second assignment, but total marks from assignments could not result in a contribution of more than 20 to the final grade.

End-of-semester exam

Historically, in contrast to other actuarial subjects, the exam for MIF has been of a fairly consistent length (perhaps to compensate for the more abstract nature of MIF). Problems on the exam usually test some creative or critical thinking in using the definitions and results discussed over the course of the subject; this immediately distinguishes it from the exams in other actuarial subjects.

As mentioned at the very beginning of the review, a good performance in the MIF exam will require a competent memory of the variety of definitions and results in the subject as well as an ability to discern which of them are useful in solving a problem. Problems in MIF often can be solved in various ways, and some will use far less precious writing time than others will.

The best way to prepare for the exam would be completing past exams in timed conditions. In 2016, Daniel provided past exams from 2012 to 2015 accompanied with short answers (not really full solutions). The style of the exam questions was largely similar to those of the exercises, but the exam questions were of course all related to the lecture content. Comparing specifically to the problems in the exercises which are directly related to the lecture content, I would say the exams are generally more difficult.

I would advise attempting all the exercises to grasp the variety of techniques that can be used for problem solving in probability theory. In a subject like MIF, you can never have too many techniques at your disposal.

Be mindful of the auxiliary conditions for results and more obscure parts of definitions, such as those involving finiteness of certain quantities. It is easy to overlook these aspects since they are clearly not the primary concern of the result or definition. In the exam it is of course your responsibility to carefully examine them; indeed it is quite possible that they may not be satisfied, which can substantially change your approach to the question. For placing upper bounds on expectations, you will probably use the dominated convergence theorem or the Cauchy–Schwarz inequality.

The 2016 exam was slightly more computational than the past exams were; I certainly used my scientific calculator far more than I had for the past exams. The exam required the analytical solution to one of the types of stochastic differential equations shown in lectures — this was the first exam in five years that had done so. The exam also made use of the inequalities introduced in exercises. The MIF exam clearly has potential for some surprises, so preparation is key.

Concluding remarks

Free from the reins of an Institute syllabus, MIF has the rare privilege of focussing slightly more on critical thinking in mathematical problem solving. Tractable actuarial subjects have their place, but MIF is, in my opinion, a very welcome departure.

ACTL30006 Financial Mathematics III (1)

Exemption status	CT8 *Financial Economics*, in conjunction with ACTL40004 *Advanced Financial Mathematics I*. Satisfactory performance in the end-of-semester exam of this subject and satisfactory performance in the mid-semester test and end-of-semester exam of ACTL40004 *Advanced Financial Mathematics I* are required.
Lecturer(s)	Dr Jane Paterson
Weekly contact hours	2 × 1-hour lectures 1 × 1-hour tutorial There is a rotational lecture every third week (i.e. Weeks 3, 6, 9, 12).
Assessments	Individual assignment, due in the mid-semester break 10% Individual assignment, due in Week 9 10% 2-hour end-of-semester exam 80%
Textbook recommendation	Joshi, M. S., & Paterson, J. M. (2013). *Introduction to Mathematical Portfolio Theory*. Cambridge, UK: Cambridge University Press. While the lectures follow the content in the book (almost exactly), it explains some of the concepts in different ways, which may help with your understanding. Additionally, almost all the tutorial problems are from the textbook, ✓ so it is essential that you own a copy (or have access to one).
Lecture capture	Full (both audio and video).
Year and semester reviewed	2016 Semester 1

Comments

True to its name, this subject has a lot of mathematics. That said, it arguably has the most theory out of all the third-year subjects. ACTL30006 Financial Mathematics III is one of the more challenging, but also rewarding, subjects of third year.

Subject content

This subject is all about different models for comparing investments. The course covers the derivations and/or motivations of each model through to their limitations. The topics can loosely be categorised as follows.

1. Modern Portfolio Theory (MPT) (Mean–Variance Analysis) — Lectures 1–9

   MPT from FNCE20001 *Business Finance* makes its return, but now with linear algebra. Given a covariance matrix of returns and the expected return vector, how would we find an efficient portfolio in the market? How about if we add a risk-free bond? These are the types of questions you will be expected to answer. This topic finishes with single- and multi-factor models as well as the Gram–Schmidt algorithm (which you may remember from your past studies).

2. Utility Theory — Lectures 10–15

This review was previously published in the 2016 mid-year edition of the *Actuarial Students' Society Subject Review*.

This is familiar territory for those who have studied ECON20002 *Intermediate Microeconomics*. Mean–variance analysis only tells us which portfolios are worth investing in, not which ones we should invest in. Utility theory attempts to address that issue. You will cover risk aversion, quadratic utility, and the rational expectations theorem. Geometric mean and stochastic dominance closes the topic out, both of which are applications of utility theory.

3. CAPM — Lectures 16–17

   The capital asset pricing model says that the expected return of an asset is determined by its covariance with the market. Two-factor CAPM is covered shortly afterwards — a form of CAPM where there is no risk-free asset.

4. Arbitrage Pricing Theory — Lectures 18–19

   This portion of the subject attempts to price assets based on the principle of no arbitrage — the idea that there is no opportunity to make riskless profits.

5. Market Efficiency and Rationality — Lecture 20

   Up until now, assets have been assumed to be priced correctly (i.e. the market is efficient), but are they actually? This topic explores this idea.

6. VAR,and Stochastic Models for Stock Prices — Lectures 21–23

   The risk measure VAR (Value-at-Risk) is covered in the final part of the semester. The subject goes into its uses as well as some of its limitations. The subject concludes by jumping into some stochastic processes. A log-normal model for stock prices is touched upon before moving into AR(1), ARCH(1) and GARCH(1) processes, all of which contribute to the Wilkie model for investment returns.

It is important that you keep up each week, as the content in ACTL30006 Financial Mathematics III is immense.

Lectures

Jane delivers the content in an easy-to-understand way. The lectures follow the textbook almost exactly, though some topics are omitted. Slides are available in 3-week chunks (similar to its predecessor ACTL20002 *Financial Mathematics II*) throughout the semester. Whilst the slides do have some typos (especially towards the end), it is nothing too detrimental to your studies.

Every third week there was an additional lecture, which was used to address questions sent in to Jane or to cover some topics on a deeper level. For that reason, I recommend you attend these lectures. For example, Jane's notes and diagrams for weight spaces in particular was the turning point where everything about MPT clicked and made sense (to me at least), but your experience may vary.

The final lecture is used to go through exam problems. Additionally, Jane held a Q&A lecture during SWOTVAC, addressing any questions students had about the subject content. Some exam problems and explanations of challenging concepts were covered.

Tutorials

Tutorials covered select questions in the textbook. Your tutorial experience will ultimately depend on your tutor.

Occasionally, some additional exam-style problems are released, giving you a taste for the difficulty of the end-of-semester exam. These additional exam style problems were a leap above most questions in the book and really tested understanding rather than performing computations. Solutions for the additional problems are only provided in tutorials, so I highly recommend attending them.

Tutorials start in Week 2.

Assessments

The two individual assignments in this subject are very similar in style to those of ACTL20002 *Financial Mathematics II* — you are given a scenario in a firm and you are asked to produce an Excel model for said scenario. These assignments are one of the more practical assignments you will receive in the course and really help you develop your Excel skills. You are also given a second chance if you did not receive full marks for the assignment. However, your mark is then capped at 8 instead of 10 so you will still want to do well on your first attempt.

The exam is quite daunting, especially when listening to war stories from seniors. Jane likes to repeat that the questions on the exam will be very different to those in lectures and tutorials. This stresses the importance of understanding the concepts rather than relying on rote memorisation of formulae, as breaking one or two assumptions may make the standard algorithm fall apart. Generally, the exam consists of eight questions worth 10 marks each, regardless of how long they would take (i.e. one question might take 5 minutes with some clever thinking, while another question might take 20 minutes even though they are both worth 10 marks). You are given a myriad of past exams, but the style of each exam varies (only two of the four provided exams follow the eight-question format).

The 2016 paper was extremely long — no student (to my knowledge) finished all eight questions. Additionally, the exam was extremely computational in nature, requiring us to find the inverse of many matrices and compute tedious integrals. You may find that the questions cover cases you likely have not dealt with before (e.g. 2015 — finding the minimum-variance portfolio for a singular covariance matrix — or 2016 — choosing from a set of investments with a decreasing utility function). You should expect roughly 25% of the exam to be theory questions (e.g. explain the concept of such and such). You may or may not be expected to write an essay during your exam.

Tips for success

Before stepping into the subject, it will definitely be worth your time going through your notes for linear algebra from first-year mathematics. That way, you can focus more on applying those concepts rather than relearning them during the semester. Try to come up with ways to shorten your calculations through matrix multiplication instead (e.g. finding the returns and covariances of assets in a multi-factor model).

Overall, the subject is incredibly rewarding, albeit extremely tough and stressful. Just try to ignore the incredibly daunting exam (scaling also helps alleviate your worries).

ACTL30006 Financial Mathematics III (2)

Exemption status	CT8 *Financial Economics*, in conjunction with ACTL40004 *Advanced Financial Mathematics I*. Satisfactory performance in the end-of-semester exam of this subject and satisfactory performance in the mid-semester test and end-of-semester exam of ACTL40004 *Advanced Financial Mathematics I* are required.
Lecturer(s)	Dr Jane Paterson
Weekly contact hours	2 × 1-hour lectures 1 × 1-hour tutorial There is an additional lecture scheduled every three weeks.
Assessments	Individual assignment, due in the mid-semester break 10% Individual assignment, due in Week 9 10% 2-hour end-of-semester exam 80%
Textbook recommendation	Joshi, M. S., & Paterson, J. M. (2013). *Introduction to Mathematical Portfolio Theory*. Cambridge, UK: Cambridge University Press. This is very useful as it contains a healthy amount of exercises, some of which will be set as tutorial exercises. ✓ This textbook also contains useful derivations and explanations of mathematical concepts covered in lectures and is highly recommended.
Lecture capture	Full (both audio and video).
Year and semester reviewed	2016 Semester 1

Comments

Subject content

The main focus of this subject is modern portfolio theory: exploring different models, their assumptions, how they can describe how investors make their decisions, as well as critically evaluating the models. Some of the topics covered in this unit include the derivation and critique of the capital asset pricing model, expected utility theory, and using arbitrage pricing theory to find expected returns of portfolios, just to name a few. A full list of learning outcomes can be found in the University of Melbourne subject handbook entry for ACTL30006 Financial Mathematics III.

Lectures

Lecture slides are released in blocks of six lectures, which is a plus for those who want to have a quick read ahead just to have an idea of what topic is upcoming. Similar to the structure of ACTL20002 *Financial Mathematics II*, the slides themselves are skeletal, as the lectures are interactive by design. All of the missing proofs, derivations, and example exercises will be filled out in the lectures, with Dr Paterson providing very insightful and meticulous explanations with each step, as well as passing comments which can potentially be very helpful for the assignments and exams — so pay attention!

This review was previously published in the 2016 mid-year edition of the *Actuarial Students' Society Subject Review*.

The content of FM3 is quite vast, with strong focus on both the theory and the computations, so it is important not to miss too many classes. Otherwise, catching up will be quite the challenge with so much to take in.

The extra lecture every three weeks is reserved for re-visiting topics which students are having trouble with. Make sure to request a topic to be covered via email if you are having any troubles, as Dr Paterson provides extremely good explanations and this is an opportunity you do not want to miss.

Some exam questions from past exams are thoroughly covered in the final lecture, providing students with invaluable exam skills and tips on how to perform well, so attendance is highly recommended, even if you do not want your practice exams to be spoiler-free.

Tutorials

Often set problems can be very computational and not mathematically challenging. However, the additional problems and the exploration of boundary conditions will certainly raise the difficulty and challenge of tutorials. Furthermore, tutorials are a great way to consolidate your understanding of the content you learnt in lectures, and they are the only time you will be able to get solutions to the challenging additional problems.

Assignments

Both assignments were individual spreadsheet projects which really test your understanding of the topics at an in-depth level. The topics covered in 2016 Semester 1 were the efficient frontier and expected utility theory. They are of a similar style to FM2 assignments, focussing on creating functional spreadsheets that can produce correct output for any acceptable inputs. These assignments combine the understanding of the content with application and are quite straightforward. However, you are usually required to also consider boundary conditions for full marks.

End-of-semester exam

A quarter of the exam will be theoretical, so it is important to take in everything during lectures and tutorials. One of the factors that contribute to FM3's difficulty is the vast amount of content that has to be learnt, as anything could appear in the two-hour exam. For two hours, it is generally considered a very lengthy exam too. However, with the right level of understanding, there is normally a succinct solution for each question, so it is by no means unfinishable.

Concluding remarks

Overall, FM3 provides a challenging but satisfying experience. Retaining knowledge from MAST10008 *Accelerated Mathematics 1*, MAST10009 *Accelerated Mathematics 2*, MAST20004 *Probability*, and MAST20005 *Statistics* will certainly be a big help. For a third-year actuarial subject, FM3 might seem relatively more theory-oriented, but despite this, it can still be just as, if not more difficult.

Honours-Year Subjects

ACTL40002 Risk Theory I

Exemption status	Completion of this subject and ACTL30004 *Actuarial Statistics* with satisfactory performance across both will lead to exemption from professional exam CT6 *Statistical Methods*. **NB:** Unlike previously, the mid-semester exam for ACTL40002 Risk Theory I will form part of the contribution to the exemption.
Lecturer(s)	Weeks 1–6 Professor David Dickson Weeks 7–12 Associate Professor Shuanming Li
Weekly contact hours	3 × 1-hour lectures
Assessments	50-minute mid-semester exam 20% 2-hour end-of-semester exam 80%
Textbook recommendation	Dickson, D. C. M. (2005). *Insurance Risk and Ruin*. Cambridge, UK: Cambridge University Press. Offers, alongside six tutorials and eleven problem sets, additional practice problems for the first three topics.
Lecture capture	None.
Year and semester reviewed	2015 Semester 1

Comments

Colloquially referred to as RT1, this subject will in almost every instance form part of the standard course of an Actuarial student. In essence, most, if not all, of RT1 focusses on applications of probability and statistics to actuarial science: in particular, claim distributions and claim frequencies. Previous success in the second-year mathematics subjects will be an advantage I think but the overall strength of one's mathematical ability might dictate how one performs here. It isn't spectacularly mathematical, in the sense that the concepts are not astronomically difficult to grasp, but it might be commonly regarded as such. An observation supporting this view is that proofs are, quite literally, scattered everywhere throughout the course.

Subject content

Six main topics are studied in RT1, to varying degrees of length. David will take the first two in the first six weeks and Shuanming will take the final four in the final six weeks.

- Probability distributions
- Collective risk model
- Individual risk model

This review was previously published in the 2016 start-of-year edition of the *Actuarial Students' Society Subject Review*.

- Bayesian statistics
- Credibility theory
- Ruin theory

Probability distributions First topic of the subject is essentially revision of basic probability. We revisit moment generating functions, probability generating functions, expectations, as well as important discrete and continuous distributions (all but the Weibull will be familiar). Overall, the new material really begins with the convolution distribution of identically distributed random variables, where we study (pardon the incoming jargon) the recursive method of deriving the probability mass function of the n-fold convolution of a discrete random variable with support on the non-negative integers with itself. Perhaps more important than the result itself is the proof; it will make **numerous** appearances in the subject (taking various forms) and it is crucial that you learn and become familiar with the reasoning behind the proof (it could be said that it amounts somewhat to algebraic manipulation of products of infinite sums). Methods of estimation are then briefly covered, adding a statistical element, but I would still argue that the majority of the topic is dedicated to the convolution recursion.

Collective risk model Following an extension of the above, we look at compound distributions; the n-fold convolution is the sum of n independent and identically distributed (IID in the sequel) random variables. In the case of compound distributions, n is not a fixed integer but is in itself also a random variable, usually denoted by N; this generalisation serves as a mathematical abstraction of general insurance where the number of claims over a period (say, a year) is a random variable and the size of each claim are IID copies of some random variable. (Strictly speaking, the n-fold convolution is a compound distribution, with the counting distribution, that is N, being the degenerate random variable at n, also known as the Dirac mass concentrated at n, but this is the trivial case.)

Having made that introduction into the basic idea at hand, I'll continue. Basic results of general compound distributions with arbitrary counting distributions are shown before we study the compound Poisson distribution, i.e. one in which the counting distribution is Poisson. It is studied rather heavily because it possesses some nice properties (e.g. convolutions of compound Poisson distributions are compound Poisson also). Moreover, recursion makes another appearance here (called the Panjer recursion), giving the probability mass function by way of recursion and allowing higher moments (you might have realised immediately that the first two moments are trivial by way of the law of iterated expectations and law of total variance) to be written down.

In the next and final subtopic, we look at certain classes of probability distributions with particular properties. Proofs dominate, and the number you will have to digest and memorise will be, I think, overwhelming. Recursions for these specific classes also exist and will be examined deeply; they all rely on the same concept, simply applied differently. From memory, you will be examined on material covered up to here for the mid-semester exam, but don't quote me on this! Next will be a brief discussion on approximations and parameter variability, the latter of which might be described as an application of the law of iterated expectations and law of total variance, conditioned on the (Poisson) parameter (hence its namesake). Overall, this topic is very interesting, in that it is somewhat surprising that such neat results exist for such a complex random variable.

Individual risk model It is possible to regard this as an extension of the previous topic, as it examines in detail the convolution of compound Bernoulli (not Binomial) distributions. Its namesake is therefore derived from the fact that the compound Bernoulli distribution can be thought of as the claim amount, if any, arising from an individual risk (with the Bernoulli distribution being an indicator random variable for the claim arising or not; different to the collective risk model where an individual risk may make multiple claims). Our formulation will therefore look at properties of this convolution (namely its expectation, variance, and moment-generating function, which is trivial) as well as a rather involved recursion

(with its associated proof). Thankfully, the coverage on the individual risk model is rather short-lived with the majority being dedicated to the development of the recursion and the final part being a brief discussion of approximation methods.

Bayesian statistics Conditional probability is obviously the focus here, as Bayesian statistics should have already been covered (from memory, if the syllabus has not changed) in one or both of the second-year mathematics subjects or ACTL30004 *Actuarial Statistics*. We review some of the basic concepts and introduce numerous definitions, some of which may be familiar already. I think personally this topic serves as a reasonably in-depth review of Bayesian statistics, as it cites several examples throughout the topic and overall prepares you well for the upcoming topic. Something that would help here is understanding well the fundamental definitions, as the notation used in conditional probability and statistical estimation might be somewhat foreign after an extended break. Loss functions round up this topic, but it is comparatively gentle content — all it really says is that the point estimate using Bayesian statistics can vary depending on the loss function. That is to say, it is not always $\mathbf{E}[\theta|x]$, with θ the parameter.

Credibility theory Fifth in the semester, this topic is perhaps the second 'large' topic, after the collective risk model. In short, we learn to adjust a future premium or a parameter based on the claim experience. From this definition, the reasoning behind a review into the underlying principles of Bayesian statistics should be obvious. Personally, I think that in approaching this topic, one should be aware of the overlapping terminology; the word 'credibility' is thrown around a lot and it appears in a number of definitions, so you should be critically aware of how to identify the differences in the definitions (for instance, of the Bayesian and credibility premiums, or of the Bayesian premium and the Bayesian estimate). I would imagine that, for most, the algebra behind the mathematics is reasonably doable and should not be too onerous; however, the same cannot be said for the notation and the definitions. Before the topic delves into a serious exploration of what is known as the Empirical Bayesian Credibility Theory (referred to as EBCT hereafter) models, it looks at a particular application of the initial development of the theory and gives some propositions and theorems, but this should not prove too difficult to grasp.

Perhaps the most frustrating topic in the second half of the semester is the first EBCT model; it has numerous assumptions and the notation can be really quite complex (some definitions are expectations and variances of particular functions of or conditional on some unknown parameter. Such issues are complicated by the fact that the notation plays an important role in the first EBCT model and it will be crucial in order to manipulate the algebra coherently and to perform computations for your own practice and the end-of-semester exam. Essentially, the EBCT models are a formulation that generates a credibility premium (as distinct from the Bayesian premium) given a sequence of random variables representing past claims. Several results are presented including the main result — the credibility premium itself — with their accompanying proofs (which should be memorised if not for the off-chance it appears in the exam but at the very least to understand methods of proof in this topic). More results are presented that I cannot possibly begin to list, but hopefully the practice problems that will be given to you should help consolidate some of the concepts encountered.

Unfortunately, the onslaught does not stop here. Occasionally you will be given a model and therefore be able to determine several important quantities analytically, but in the cases where such information is unavailable, you will be tasked with estimating these quantities. I think, however, the cases in which one or the other method is required is quite obvious from the information presented, so there should not be too much sleep lost over that. However, just as estimation of the variance of a sequence of Gaussian observations requires memorising the appropriate formula, the estimation here also is accompanied not only by notation, but formulae that are derived using the notation. Two of the estimators will be 'obvious', but one will require making a slight bias correction. Be prepared to perform computations, in memorising proof or otherwise. For instance, some of the proofs are reminiscent of proving that the previously mentioned variance estimator with denominator N is biased, albeit of higher difficulty.

Finally, the topic looks at a second and thankfully final EBCT model, which relaxes a few assumptions but introduces a

weighting system and it is a generalisation of the first EBCT model. I think by now, while the proof will still be difficult to initially digest, the basic underlying theory of the second EBCT model should be very familiar, especially after immediately studying the first EBCT model. Indeed, most of the results are obvious analogues that have been adjusted for the weighting system, although I will admit that the way in which they change might not be regarded as obvious. I will not go into too much depth here because much of what needs to be discussed has already been said in examining the first EBCT model, but I will mention that you should be prepared to memorise more formulae and that the application of the model is slightly different due to the implementation of a weighting system. I will give my concluding thoughts; while the numerical complexity of the second EBCT model is far greater than that which could be reasonably expected in an end-of-semester exam, I think that this does not preclude the possible appearance of a question either demanding a certain proof or application of the model given summary quantities (by this, I mean for example being given the sum of a finite sequence so that you do not bear the time-consuming and tedious burden of manually computing the sum yourself) that can be used to answer questions.

Ruin theory Concluding the subject is a brief overview of ruin theory. I note that the discussion here is rather brief; at least in my year ruin theory only managed 3 or 4 lectures of discussion (actually, we might have been behind since a review lecture was scrapped). It takes a stochastic approach to the collective risk model; rather than have a counting random variable that counts the number of claims over a given period of time, say N, we have instead a counting **process**, say $N(t)$, that counts the number of claims over the time period $[0, t]$. Naturally, this extension allows us to generalise the collective risk model to be a stochastic process. Risk theory then takes the following approach: if this stochastic process, call it the aggregate claims process, is the total amount claimed over some time period, then we can introduce a surplus process, which describes the surplus of an insurer (with some initial surplus) as it evolves throughout time with the injection of premiums (theoretically a stochastic process per se, but usually simplified to be a constant rate per unit time) and the ejection of aggregate claims. Ultimately we are interested in, as the name suggests, the probability of ruin — i.e. the probability of the surplus of the insurer becoming negative.

From memory, there is a brief introduction into the (homogeneous) Poisson process, which should have been studied already in ACTL30001 *Actuarial Modelling I*; the enthusiastic might already remember all three constructions of the Poisson process and their associated proofs of mutual equivalence. We then formalise some definitions mentioned in the paragraph above in a general fashion, and in particular we give the ruin probability as well as numerous other interesting quantities. Possibly because ruin theory in academic circles is almost certainly more sophisticated than it is presented to us here, much of the material here will be definitions, remarks, and properties of the model.

Notably, there are two proofs: the first is an inequality relating the ruin probability to the initial surplus and some constant and the second is the existence of said constant as the unique positive solution to a particular equation. It is not all too complex (it involves induction, by the way), and the foray into ruin theory is overall quite brief and sparse. (Caveat: this may or may not depend on the amount of time that is available to this final topic; lecture slides beyond this proof existed but were not covered, ostensibly due to time constraints.)

Overall For those uninterested in reading the nitty gritty, I will give some summarising thoughts on the content covered in RT1 here. For most, this subject might give you the most trouble in your honours or masters year due to the mathematical nature of the problems. Multitudes of definitions and, more annoyingly, proofs are thrust upon you and for the most part you will necessarily remember these, as techniques present in the proofs occasionally recur throughout the subject (most noticeable in the proofs). Being comfortable with algebraic manipulation of certain expressions will be extremely helpful in this subject I think, since a number of proofs essentially amount to this. I think that, while the material will initially seem very dense, you should find respite in the fact that a comparatively large proportion of the material is dedicated to proofs.

From experience, the review (first and fourth) topics should not pose too much problems. However, the material present in the second and third topics is very closely interrelated and this lends itself to a vast variety of questions you might face,

while the material in the fifth and sixth topics is a bit more insular. I would imagine for most that there is a lot of memory work involved in the revision of this subject, and indeed there needs to not only be understanding of the preliminary and main results but also of their assumptions and proofs. As a caveat, the assumptions are important because you might be faced with a situation where you are unsure of the result(s) to draw upon. Some of the material should be familiar, which is why I mentioned earlier that strong foundations in the second-year mathematics subjects would be helpful (for instance, in the computation of integrals or point estimates). Nevertheless, the sheer amount of content covered in this subject should not be too daunting, given that it is an fourth-year exemption subject.

Lectures

Every week, there are 3×60-minute lectures with no tutorials, as per usual for a fourth-year actuarial subject. However, from memory, every second week will be dedicated to the giving of solutions to a tutorial set (there are 6 tutorials in all, with 11 additional problem sets that are not covered in class). From memory (again), said solutions to both tutorial sets and problem sets are posted on the LMS after some delay, so these classes are strictly speaking, unnecessary. If, however, you enjoy the structure of tutorials, then it obviously might be of benefit to you. As a precaution however, be prepared for a possibly abhorrent timetable for your fourth year; not only will you probably see obligatory 5–6-hour breaks due to RT1 and ACTL40004 *Advanced Financial Mathematics I* lectures usually scheduled before noon and ACTL40006 *Actuarial Practice and Control I* being scheduled on Tuesdays and Thursdays from 4:15–6:15pm, but you might also find yourself with a single RT1 class on some random day in between. I mention this only because while you might endeavour to attend every class, the possibility of your lecture being scheduled poorly (ahem, Wednesday 9am with nothing else) might be a significant deterrent.

Expect a reasonably small class size, ranging from 20–50 students, roughly speaking. From experience, you will probably become close with your classmates (and I strongly urge you to do so as it makes fourth year all that more tolerable), but this might not happen quickly enough for lectures to be a bit more interactive and for the atmosphere to soften. Nevertheless, you might find yourself more confident in responding to lecturer's prompts and asking questions during tutorial time, which you should do. I have the faint suspicion that, as an exemption subject and as by fourth year you are probably cognizant of mark scaling, people are more reserved in class, since they view others as competition which may affect the mark scaling. I hope for the most part that this does not deter people, because quite frankly the material is difficult enough and the burdens borne are so great in the first semester (subject revisions, projects, assignments, graduate program applications/interviews, and whatever social life you've managed to preserve up to now) that being able to mutually help one another is usually in your best interest (as they say, teaching is the best way of learning).

NB: the absence of lecture capture means that you should skip class at your own peril. While you might be able to mitigate some of the problems with truancy by relying on your friend's or friends' notes, this obviously is no substitute for actually being in class and, say, writing down the proof line by line with the lecturer guiding you and describing the rationale behind each step. I'm personally a bit biased on this issue because I think that you should practise attendance whenever possible, but in this particular case I recommend it highly simply because lecture capture is unavailable and you will not as easily understand the logic behind the results, proofs, nor examples, without the assistance of the lecturer.

Mid-semester exam

In 2015, the mid-semester exam covered material up to and including the fifth week and its date fell in the first class of the seventh week. While it is not overly difficult, as per most mid-semester exams, it will be stressful revision because of all the other responsibilities you will inevitably have. Use the available material — the recommended text, tutorial and problem sets — to your advantage, but do not rely on the mid-semester exam being similar. Indeed, while the questions that the

2015 cohort faced were not strictly speaking all that difficult, the variation in the style of questions was sufficient to pave way for an average below 40% and marks ranging from barely being above 0 to barely being a H1.

In defence of the mid-semester exam, there were a few textbook questions and it was for the most part quite accessible to the diligent student. Calculators played a minor role in that there was, I think, one question that mandated a numerical answer, which therefore implies that the majority of the exam demanded answers in analytic and symbolic form. Being familiar with the techniques you encounter in class will be **extremely helpful**; at least it was the case for the 2015 mid-semester exam. That said, I do not want to pigeonhole expectations of the mid-semester too much, as the vastness and richness of the content covered in the first five weeks lends itself to a wide variety of plausible questions.

End-of-semester exam

I will make a brief note of the scaling in 2015; it was upwards by a moderate amount, suggesting the exam was more difficult than average. If I recall, the calculator was used somewhat often, although thankfully analytic expressions dominated the exam. As with all exams, the scope of the exam was parallel to the coverage of the content throughout the semester. By this, I mean that all topics were covered to an extent proportional to the amount of time dedicated to their study.

To begin, there is a reasonable amount of proof throughout the exam (for instance, one question consisted entirely of proofs, although they were textbook) but overall with an emphasis (I feel) on analytic results. Overall, the exam performance was apparently poor (that's an understatement). Truthfully, however, I feel that six of the seven questions that appeared in the 2015 paper were slight variations of practice problems appearing elsewhere which, with proper thought and care, any well-prepared student could answer. If I may give any sentiments on the exam, the questions, except perhaps one, were **doable**. It might be own taste, but any question which is doable is, by my personal standards, fair game in the exam. Indeed, looking back, the questions — which covered pretty much everything from the second topic onwards — were not all that straightforward, but by no stretch of the imagination could one say that they were unreasonably hard. I would think that as an exemption and fourth-year subject, the questions were rightfully testing. I personally think, however, that there was a single question which should never see the light of day in another exam for posterity, only because the algebra was incredibly tedious. Going home and attempting it on Mathematica, I found that the problem involved a seventh order polynomial with two roots, one with multiplicity six and the other being the unique positive solution (assuming I did it right). I do not know what will become of the question in the future and whether my sentiments are objectively correct (i.e. whether the lecturer(s) agree that it was algebraically frustrating), but if anything I think it serves as a potent reminder for just how computational this subject can be. While I do not think it is the intention of the lecturers to test our understanding by asking us to sift through and manipulate lines upon lines of algebra or use the calculator excessively, it is inevitable that algebra and numerical computation appear in this exam. I think it is therefore prudent to prepare for both, whether the question is seeking for a result, a proof, a number, a verification, et cetera.

NB: In defence of the cohort, while the question which I felt was unreasonable could have been left to last with prudent use of reading time (which is obviously important), the methodology that would have been used to solve the question was comparatively simple and I do not think it possible for the typical student to have the foresight to see that the algebra would be devastatingly time-consuming.

Concluding thoughts

Despite the challenges that I personally faced in this subject, I certainly enjoyed it. Sure, there is increased pressure because it is an exemption subject, but it is also an exemplar of the mathematics that probably attracted many students

to the course. I think that the results are rather deep given that it is intended to serve as a foray into the applications of probability and statistics in insurance.

Admittedly, the material and the exams can be quite daunting. However, take comfort in the fact that you have great lecturers and a comparatively large number of practice problems to develop your skills and cement your understandings. Even though there is a large amount of memorisation that you should be prepared for, this is not advisable without the requisite understanding. After all, I would imagine it would be a godsend for questions in the exam to be carbon copies of those encountered in practice problems or request exact replicas of the proofs that appear in the lecture slides. Thus, if you are prepared for some variation in the questions you will encounter in your examinations and adapt your understanding to the problem appropriately, I think you should do fine.

Finally, I hope you enjoy this subject — it might be one of the last quantitative actuarial subject you study as you might find yourself in a second semester with, for better or worse, little to no mathematics. It is also a good time to make some friendships with the cohort whittled down to a smaller size; certainly this was the case for me. I think that, while it will be a difficult road to finish the final two exemptions, it will be a satisfying challenge. Good luck — for this fourth year and thereafter.

ACTL40003 Risk Theory II

Exemption status N/A; this subject does not constitute any exemption requirement but is instead an elective upon satisfactory completion of ACTL40002 *Risk Theory I* (which comprises part of the exemption requirement for CT6 *Statistical Methods*).

Lecturer(s) Shuanming Li

Contact hours 2 × 1.5-hour lectures

Assessments

	Honours	Masters
Mid-Semester Exam (Week 8)	20%	20%
Assignment	—	10%
3-hour Final Exam	80%	70%

Textbook recommendation Dickson, D. C. M. (2005). *Insurance Risk and Ruin*. Cambridge, UK: Cambridge University Press.

The same text as the one used in ACTL40002 *Risk Theory I*. It is referenced but ✗ not essential.

Lecture capture None

Year and semester reviewed 2016 Semester 2

Comments

Subject content

The subject covers 4 units relating to risk theory:

1. Utility Theory

   The utility theory concepts learnt in ACTL30006 *Financial Mathematics 3* are applied to the setting of insurance premiums by considering the maximum premium that individuals are willing to pay for insurance and the minimum premium insurers are willing to receive to offer insurance.

2. Principles of Premium Calculation

   We consider various principles for premium setting such as the Esscher premium or the P–H transform and the properties of various premium principles.

3. Reinsurance Problems and Optimal Reinsurance

   This unit goes through various theorems and proofs regarding optimal reinsurance types under different criteria.

4. Ruin Theory

   Finally, we examine the classical risk model, looking at Lundberg's inequality and the adjustment coefficient, reinsurance applications of the classical risk model and methods of solving for the ruin probability, including the use of

Laplace transforms.

Lectures

The lecture slides are very comprehensive and contain all the content that is required for the course. There are blanks in the slides which are filled in during lectures.

Shuanming provides very detailed annotations of slides in the lectures and goes through the content at a fairly steady pace. The slides are very dense though and the calculations aren't always the most obvious, so it is often necessary to review slides after lectures to get a proper understanding of the content.

Tutorials

Like all other honours year subjects, there are no weekly tutorial classes. Instead, the lecturer sets aside some lecture time to go through tutorial problems. In all, there were 5 tutorials during the semester. The questions in the tutorials tended to be quite difficult and solutions aren't the most straightforward.

A series of problem sheets with solutions are posted throughout the semester. The questions in these problem sheets tended to be more on the easier side.

Combined, the tutorial sheets and problem sheets provide ample exercises for the subject. There are of course questions from the textbook that can also be used as additional practice.

Mid-Semester Exam

The mid-semester exam covered Units 1, 2 and most of Unit 3. Shuanming is very generous in his supply of past mid semester exams and we received 6 past exams in the lead up to the mid-semester exam.

In 2016, our mid-semester exam was of a very reasonable level of difficulty with most students scoring very high marks. The exam covered fairly standard questions including determining an insurer's minimum acceptable premium under utility theory, applications of premium principles and proving a relationship between expectations of stop loss reinsurance.

Final Exam

The final exam was quite long and most students found themselves very pressed for time. The majority of the questions were of reasonable difficulty but there were a few questions in the exam that were a lot more difficult. Shuanming provides a specimen paper and a past paper in the lead up to the exam which I felt were a fair reflection of the difficulty of the final exam.

Concluding Comments

I would highly recommend taking Risk Theory II if you enjoy the maths side of actuarial studies. In particular, if your other two subjects are APC2 and APC3 (which are very qualitative in nature), having a subject with a familiar quantitative feel to

it was great — when my brain couldn't handle anymore of APC, doing risk theory calculations was almost like a comforting break. However, that is not to say Risk Theory II is an easy subject. The calculations and proofs require deep thought, but having made it this far in your actuarial degree, I'm sure you would already assume this of all actuarial subjects.

ACTL40004 Advanced Financial Mathematics I

Exemption status	CT8 *Financial Economics*, in conjunction with ACTL30006 *Financial Mathematics III*. Satisfactory performance in the mid-semester test and end-of-semester exam of this subject and satisfactory performance in the end-of-semester exam of ACTL30006 *Financial Mathematics III* are required.
Lecturer(s)	Dr Zhuo Jin
Weekly contact hours	2 × 1.5-hour lectures
Assessments	Individual assignment, due around Week 11 10% 1-hour mid-semester test in Week 7 20% 2-hour end-of-semester exam 70%
Textbook recommendation	The lecture notes are sufficient. Joshi, M. S. (2008). *The Concepts and Practice of Mathematical Finance* (2nd ed.). Cambridge, UK: Cambridge University Press. ✗ This is not essential at all. The lectures don't really follow the textbook exactly so it can be hard to match up the textbook with lecture content. However, if you really like financial maths and want some extra fun bedtime readings then feel free to buy. It is needed for ACTL40008 *Advanced Financial Mathematics II*, so if you know you will do AFM2 then buy it.
Lecture capture	Full (both audio and video). However, tutorial problems are often done on the whiteboards in class so don't get captured.
Year and semester reviewed	2016 Semester 1

Comments

Subject content

This subject focusses on the pricing of derivative securities and is very theoretical. The topics covered are roughly:

- binomial model (4 lectures)
- martingales, Brownian motion, and stochastic calculus (6 lectures)
- Black–Scholes model (6 lectures)
- interest rate and credit models (5 lectures)

Do not fear if you have not done FNCE30007 *Derivative Securities* for that subject is only really relevant for the first two lectures, the two easiest lectures of this subject. It would be better to pay greater attention to ACTL30005 *Models for Insurance and Finance*, for what is covered in MIF is essentially covered in six lectures in AFM1 in a lot less detail, so a solid prior understanding of the content will make AFM1 a lot less of a hectic experience (which it was for *Master of Actuarial Science* students who unfortunately do not get to take MIF).

This review was previously published in the 2016 mid-year edition of the *Actuarial Students' Society Subject Review*.

Lectures

The lecture slides in this subject tend to be long and dense, and lectures can often leave you very confused. However, personally, I find that every time I read the lecture slides, I pick up on something new that I didn't notice or fully understand the first time around, and I think a lot of the subject is like that. Everything always seems like just a blur to begin with, and you feel overwhelmed by the theoretical nature of most lectures, but when you start to revise your notes and slides, things gradually fall into place. AFM1 is really just a subject that takes a lot of time and patience.

The content of the subject tends to be very well ordered. The first few weeks shouldn't be too bad, but the subject content does tend to get more and more difficult as the semester progresses. The last few lectures on interest rate and credit models are quite long and difficult. Maybe it was because I was already tired by then, but the content in the last few lectures seemed to be a lot harder to process than the rest of the semester.

Tutorials

There are no more tutorials when you reach Honours. Instead, occasionally when some of the lectures aren't that long, some time at the end of a lecture will be dedicated towards working through tutorial problems.

At the end of each set of lecture slides, there is a slide for theory problems as well as usually two or three slides of more exam-like general problems.

The theory questions include things like "Define geometric Brownian motion" or "What does it mean for a model to be complete?" Personally, I found the theory problems quite useful in testing whether or not I had fully understood the content of the lecture, and for those who like to make notes, they give good prompts for key points to have in your notes.

The general problems vary greatly in difficulty. Some are nice and easy number-crunching exercises, which can be tedious but generally shouldn't present any major issues. On the other hand, there are some problems that really test your understanding of the subject and, as is always the case in actuarial subjects, the answer is always a lot simpler than you expect but you constantly question how anyone would be able to think of such a solution in an exam situation. Solutions to the problems are provided at the end of each week. However, the solutions for some questions can be quite brief and skip a lot of intermediate steps, so if you have any doubts about a solution, make sure you ask the lecturer or a friend.

Assignments

There was just one assignment for this subject and, as with all financial maths subjects, it was completed using Excel. For our assignment, we had to use Excel (and we were allowed to use VBA for once) to price European options, American options, and barrier options using both tree methods and the Black–Scholes equation.

If you aren't familiar with VBA, it might take a while to get familiar with how the coding works within Excel. However, overall, the assignment isn't overly difficult and most students scored well for the assignment.

Mid-semester test

The mid-semester test was held during the second lecture of Week 7 in 2016. It covered all content up until the end of Lecture 10 (binomial trees, martingales, Brownian motion, and stochastic calculus). In 2016, it happened to be in the same week as the ACTL40002 *Risk Theory I* mid-semester test as well as the due date of the draft report for ACTL40006

Actuarial Practice and Control I. Therefore, it was a very busy period and starting your preparations for the mid-semester test well in advance is definitely a good idea.

One specimen mid-semester test was provided in preparation for the mid-semester test, but looking at some CT8 papers may also be helpful for preparation. In general, CT8 papers and AFM1 papers are not very similar, the latter being far less predictable. However, for additional practice on some of the basic concepts like binomial tree pricing, then the CT8 papers can be quite a good resource.

Overall, the mid-semester exam in 2016 wasn't too bad, with the average mark being 15.8/20 and the median mark being 17/20. Questions ranged from pricing a barrier option, solving a stochastic differential equation using integrating factors, computing probabilities involving Brownian motion, and definition questions.

End-of-semester exam

In preparation for the final exam, two specimen exams were provided in 2016. However, as with all actuarial subjects, what you will end up getting in your final exam can be very unpredictable. Don't expect it to resemble the tutorial problems very much.

There was one nice straightforward question of pricing an American put in the 2016 exam, which you should be very familiar with. Otherwise, most of the other questions would be ones you have not seen asked in the exact same way at any point during the semester. This does not mean you should freak out. Whilst they may not seem familiar, they will obviously be questions that can be answered using the content you have studied during the semester. My personal advice for tackling seemingly unfamiliar problems is to think about what information they have given to you. For example, if they have given you volatility then that would suggest that Black's formula may need to come into play. Indeed, there was a question in the 2016 paper that involved the pricing of an option on a bond which was quite challenging, largely because you would never have seen a question like that during the semester.

Concluding remarks

People tend to say that AFM1 is the hardest of all the actuarial subjects and, indeed, I would probably agree with those people. The calculations themselves are usually not as tedious and difficult as they might be in subjects like *Risk Theory I*. However, fully grasping a theoretical understanding of the subject is definitely the biggest challenge in AFM1. Nevertheless, it is again another subject that nicely highlights how all the mathematical tools you have learnt along your actuarial journey can be applied in a practical sense.

ACTL40005 / ACTL90013 Actuarial Studies Projects

Exemption status	None.
Lecturer(s)	Daniel Dufresne Zhuo Jin Shane Wu
Contact hours	3 × 1-hour meeting (at time of project release) 2 × Optional Q&A sessions
Assessments	Project 1 25% Project 2 35% Project 3 40%
Year and semester reviewed	2016 All Year

Overview of Projects

Each project has an 8 week time frame. That is, Project 1 is issued in week 1 of semester 1, Project 2 is issued in week 9 of semester 1 and Project 3 is issued in week 5 of semester 2.

Project 1

The first project was written by Daniel Dufresne and involved simulating annuity payments with random rates of discount. The distribution of the present value of these payments was then approximated using lognormal and extended skew lognormal distributions. Comparisons between the accuracy of the various approximations were required to be discussed.

Overall, this project was probably the most structured out of the three, with clear steps in the project instructions outlining what was required and was a good way to ease into Honours.

Project 2

The second project was by Zhuo Jin and was financial maths based. It was in many ways applying ACTL30006 *Financial Mathematics 3* knowledge to real data. For the project, we were required to pick a selection of 10 stocks from the US stock market with stock symbols that were closest to our surnames. Using these stocks, we were required to apply a single factor and three factor model to determine expected returns and a covariance matrix for the stocks. Next, we had to plot the efficient frontier from these stocks both when short selling is allowed and when it is not. Finally, the last part of the project required us to use option market implied data to calibrate the covariance matrix and compare it with the original single factor and three factor models.

Personally, I found this project to be very broad in its scope and the most time consuming, which was fortunate, given that for the second project you get the extra winter holidays to complete it. Much of the project could be completed by digging up your *Financial Mathematics 3* notes. However, there were also parts of the project that required reading academic papers. There is also a lot of judgement required (e.g. choosing what factors to use in the three factor model) but remember, as is

often the case, there is no single right answer and it is more a matter of how well you explain and justify any choices you make.

Project 3

The final project by Shane Wu was *Risk Theory* based. It involved determining ruin probabilities in the classical continuous time risk model using discrete inter-observation times as well as randomised inter-observation times and studying the rate of convergence as the scale of discretisation was varied. There was also an optional bonus task of numerically verifying an identity shown in a paper by Albrecher and Ivanovs (2016). Concise explanations about simulation methodology as well as comparisons of outputs were required.

The running of simulations for this project was very time consuming, with some simulations taking hours to run (and then after all that waiting, you often end up realising you actually had an error in your code somewhere). Therefore, it would definitely be advisable to start a project like this very early. I found this project overall to be quite interesting and if you like coding, you might even find it fun.

Comments

The first thing to note with doing these projects is that you will need to decide on what software you wish to use for the projects. For all three projects, I used R. However, many peers successfully used Mathematica. Excel can also be alright. However, when large numbers of simulations are required as is the case for many of the projects, then Excel may get annoyingly slow. Other programs may also be used but it is best to first check with the lecturer if you want to use anything outside of the normal three. It is also possible to switch the program you use for each of the projects. However, I would recommend using one and getting yourself really familiar with it instead of having to relearn a new program for each project.

Secondly, I would say learning to use LaTeX makes your projects look cleaner (it is also easier to write equations). However, using LaTeX of course is not compulsory and many students did just fine using Word instead. However, the overall look of your report is one of the marking criteria.

Thirdly, the projects welcome you to use your own judgement and imagination to expand your analysis of the problem. However, the projects have strict word count restrictions so make sure this extra analysis does not mean you are sacrificing content that is required to meet the basic requirements of the project.

Finally, in terms of submission, all the projects require a report to be submitted as well as the code you used for the project. Make sure your code is neat and well commented and that your project is within the word limit. Note that the word count is sometimes different between Honours and Masters students, so don't just trust what your friend says if they aren't doing the same course as you.

I would say that doing these projects has been a valuable learning experience and in particular it has helped to develop my ability to write concise and structured reports. They have also helped to improve my R and general coding skills which no doubt will be useful in the future. However, since you don't have regular lectures, it is often easy to just forget about the project for a few weeks and then suddenly realise it is due in a few weeks, so I would say setting aside a certain amount of time each week for doing your project is a good way to avoid last minute stress that might reduce your life expectancy by a few years.

ACTL40006 Actuarial Practice and Control I

Exemption status	Part IIA *The Actuarial Control Cycle* and Part IIB *Investment and Asset Modelling*, in conjunction with ACTL40007 *Actuarial Practice and Control II* and ACTL40009 *Actuarial Practice and Control III*. Satisfactory performance in all three subjects' end-of-semester exams will lead to exemption from both Part IIA and Part IIB.
Lecturer(s)	Mr David Heath — Subject coordinator; general insurance Mr Andrew Brown — Life Insurance Mr Donald Campbell — Superannuation Mr Daniel Craine — Investments
Weekly contact hours	2 × 2-hour lectures
Assessments	Group assignment — 30% 3-hour open-book end-of-semester exam — 70%
Textbook recommendation	Bellis, C., Lyon, R., Klugman, S., & Shepherd, J. (Eds.). (2010). *Understanding Actuarial Management: the actuarial control cycle* (2nd ed.). Sydney, AU: The Institute of Actuaries of Australia. The textbook is used for ACTL40007 *Actuarial Practice and Control II* as well but ✗ is not really necessary.
Lecture capture	Full (both audio and video). It has to be recorded, because there are distance education students. However, often the lectures go over time, so the ends of some lectures get cut off.
Year and semester reviewed	2016 Semester 1

Comments

Subject content

Just in case you somehow haven't heard of it yet, ACTL40006 Actuarial Practice and Control I is very different to any other actuarial subject you have done. You can pretty much say farewell to your calculator, and Google will become your new best friend.

The topics covered can roughly be summarised as:

- the actuarial control cycle,
- professionalism,
- the need and impact of regulation,
- the impact of environment on commercial decisions,
- risks of financial products,
- enterprise risk management and risk assessment frameworks,
- product features and design, and
- appropriateness of models.

This review was previously published in the 2016 mid-year edition of the *Actuarial Students' Society Subject Review*.

Each of these topics will be considered in relation to general insurance, life insurance, and superannuation. In addition, there are two lectures that cover some of the basics of investments.

Lectures

The three main lecturers (David Heath, Andrew Brown, and Donald Campbell) rotate throughout the semester according to their own availabilities, so you will find that the order of the content will jump around quite a lot. However, each lecturer is a practising actuary, and together they bring a wealth of commercial knowledge and know all the nitty gritty details of the industry they work in.

Lectures are aimed to be discussion-like in nature, and certainly some of the lecturers encourage discussion a lot more than others. Therefore, it is a subject where question-asking is most welcomed. I think the risk of being picked on to answer a question during class scared some students away from attending lectures and lecture sizes did become very small (around seven students) at some point during the semester.

However, I would really encourage participation in lectures. The lecturers are all really friendly. Also, although the lecturers aim to repeat the comments and questions that students at the lecture make into the microphone so that people listening at home can hear them, there are inevitably still times when they forget to do so and you may miss out on some useful information if you don't rock up.

At the start of semester, David Heath will also emphasise repeatedly the importance of going through the information posted in the fundamentals documents that he uploads. As the semester progresses, you will come to realise just how little you actually do know about the insurance and superannuation industries, so I would recommend doing what he says. Also, at any point when the lecturer brings up some term or some concept you have never heard of, make a note somewhere to Google it or ask the lecturer directly. Knowing how the insurance and superannuation industries operate will greatly assist your understanding of the content in this subject.

Tutorials

There aren't really many tutorials in this subject. I think we had about two or three lectures where we went through some tutorial problems. However, these lectures are probably the most useful, especially if doing well in the exam is your main aim. In these tutorials, the lecturers often give a lot of exam tips and insight into how they mark exams and what sorts of answers are actually worth marks in the exam.

Indeed, for much of the semester, you will find yourself wondering how any of this content will ever be examined, because a lot of it will seem like common sense. The tutorials are very useful in giving you an idea of what sorts of questions you may be asked in the exam as well as what sorts of answers are appropriate. The lecturers usually upload brief outlines of solutions to these tutorial problems, but they are usually very sketchy and not in very much detail, so I would recommend making your own notes too.

Assignments

There is one large assignment for this subject. However, it will be submitted in three parts — a scope letter, a draft report, and a final report. The groups will be assigned and usually consist of around four or five people.

The aim of the assignment is to demonstrate the way that real consulting projects are carried out; that being first confirming the scope of the project, then providing a draft report, and then making amendments to the draft based on the feedback provided from the draft report.

Our assignment was on the financial planning industry and required us to explain to the company certain mortality phenomena and how they would impact the company's operations. As part of the assignment, we were also required to produce a newsletter that the company could send out to their clients.

In terms of doing well in the assignment, the most important thing to keep in mind would be who your audience is and in what tone or level of detail you should be writing your report. Also, for the marking of the final report, a lot of weight is placed on how comprehensively you responded to the feedback from the draft report in the final report, so make sure you address every piece of feedback.

End-of-semester exam

The exam is an open-book exam — a very strange feeling for an Actuarial student. The only thing you can't take into the exam is dictionaries, so you can go all out and bring in the textbook, lecture slides, your own personal notes, and, as David Heath jokingly mentioned, even a magazine in case you finish early and get bored. As such, I think one of the biggest challenges to the subject is working out how to study effectively since your studying no longer involves cramming information into your brain.

I would strongly recommend spending time making notes for the subject that you can take into the exam. It is a good way of revising the content from lectures, and it is always easier to find the information you need during the exam when you have made the notes yourself. You will find that for many of the lecturers, their lecture slides only have very brief dot points, so without annotations or other notes, looking at the slides won't be of much help. Therefore, if you see anything on any slides that you don't understand, then you should Google it or ask the lecturer for clarification.

At the end of semester, we were provided with one practice paper with solutions, which gave a very good indication of the style of questions to expect. Questions that will often be asked include:

- What are the risks of this product/situation?
- What are ways of dealing with the risks?
- What are the professional issues in this situation?
- What are some of the design issues with this product?

In many questions, you will also be asked to draft a response to someone, in which case it is always nice to format it like a letter. However, David Heath will also strongly emphasise that you should do dot points in almost all questions. This will help stop you from waffling on too much and also makes it easier for them to mark.

The one thing about the exam that was strange is the way the multiple-choice is done. For each multiple-choice question, there are five options. However, there could be 0, 1, 2, 3, 4 or even all 5 correct — it is essentially five true–false questions combined, and you will only get the mark for the question if you decide correctly for all five options. Therefore, if you circle one incorrect answer, you get 0. If you miss out on one correct answer, you get 0. I found many of the multiple-choice questions to be quite brutal, because they really test whether you fully understand the material.

Exemption procedure

For each of the Part II subjects (APC1, APC2, and APC3), an exemption list will be published online after the results are released (http://fbe.unimelb.edu.au/economics/ACT/courses/exemption_information).

For each exam, a certain mark will be deemed the appropriate "pass" mark. Each candidate is then given a score relative to this pass mark — a positive mark means you scored higher than the pass mark, and a negative score means you scored lower. After completing the three APC subjects, if your total score is positive, then you will receive the exemption for Part II.

Concluding remarks

David Heath will often tell you that when deciding whether or not to pass someone, they will often ask themselves, "Would I want to work with this person?" Indeed, the APC subjects are designed to help you to think in a more commercial and practical sense to prepare you for the big scary adult world. Whilst it won't be tested, I personally would recommend beginning to read any news related to the actuarial profession if you don't do so already, as it will make the knowledge learnt in this subject more meaningful and hopefully provide greater motivation to study.

ACTL40008 Advanced Financial Mathematics II

Exemption status	N/A; this subject does not constitute any exemption requirement but is instead an elective upon satisfactory completion of ACTL40004 *Advanced Financial Mathematics I* (which comprises part of the exemption requirement for CT8 *Financial Economics*).
Lecturer(s)	• Professor Mark Joshi • Professor Daniel Dufresne In 2015, the lecturer was Professor Mark Joshi. **NB:** I do not mean to say that both lecturers teach simultaneously, but rather that one of these two lecturers will teach the entire semester.
Weekly contact hours	2 × 1.5-hour lectures
Assessments	50-minute mid-semester exam 20% 2-hour end-of-semester exam 80%
Textbook recommendation	Joshi, M. S. (2008). *The Concepts and Practice of Mathematical Finance* (2nd ed.). Cambridge, UK: Cambridge University Press.
Lecture capture	Full (both audio and video).
Year and semester reviewed	2015 Semester 2

Comments

Before anything else, I firstly wish to make the remark that the recommended texts and the availability of lecture capture will presumably depend on the lecturer. Naturally, the same applies for the content and/or structure of the subject.

By now, you are most likely aware that this subject is the final subject in the *Financial Mathematics* pentalogy. Notably however, the material in ACTL40008 Advanced Financial Mathematics II (AFM2) is *very* different from that encountered in the first three subjects. Using the material taught in ACTL40004 *Advanced Financial Mathematics I* and ACTL30005 *Models for Insurance and Finance* (AFM1 and MIF, respectively), the focus of the subject is mathematical finance and, in my opinion, its purpose is to serve as a more mathematical foray into the material developed in AFM1.

Subject content

It is somewhat necessary to have a modicum of knowledge about the content that is covered in AFM1 before we can really discuss the material encountered in AFM2 as, surprise surprise, they are sister subjects. Broadly speaking, AFM1 covers:

- principle of no arbitrage (put simply, the idea that opportunities of making money must carry the risk of losing money)
- pricing of derivatives using hedging, replication, and risk-neutral techniques
- Brownian motion, continuous-time martingales, and stochastic calculus (in the latter case, there is some emphasis on stochastic differential equations)
- Black–Scholes model; its partial differential equation, associated Greeks and formulae, defects and extensions
- interest rate and credit risk derivatives and pricing models thereof

This review was previously published in the 2016 start-of-year edition of the *Actuarial Students' Society Subject Review*.

It should be immediate by now for those finishing third year that the focus of both AFM1 and AFM2 is quite different to that of all previous *Financial Mathematics* subjects. In any event, it is probably reasonable to say that the Institute standards of AFM1 mandate a reasonably deep discussion of some of the basic ideas underpinning quantitative finance.

Perhaps the best description of what the material taught in AFM2 comprises of is to say that it is an extension of all the topics encountered in AFM1. I have a personal belief that, as AFM2 is not an exemption requirement, the material is somewhat a bit more malleable and therefore admits extensions, most of which are mathematical. For instance, the concept of a risk-neutral measure is introduced in AFM1, but the way in which it is presented might give the impression that passing to the risk-neutral measure is the only pricing technique employed by practitioners. However, in AFM2, the more general notion of the *numeraire* grants access to a vastly superior pricing method. To illustrate this, the well-known Black–Scholes call option formula

$$C(S_0, 0) = S_0 N(d_1) - K e^{-rT} N(d_2)$$

can be obtained via brute force integration with respect to the (lognormal) probability density function of the stock price process in the risk-neutral measure (pardon the jargon). However, the methodology that is shown in AFM2 is far quicker, and indeed the call option formula may be written down as the linear combination of a (lognormal) survival probability computed in two different measures. Similarly, you will most likely be *told* that the Jarrow–Rudd tree in AFM1 has a risk-neutral probability that is very close to 0.5. However, you will not understand *why* that is the case until AFM2, where a mathematical examination of the asymptotic behaviour of the risk-neutral probability using Landau notation will show that this is the case.

I suspect that the connection between AFM2 and MIF is a little less tenable, but personally I find MIF to be a very suitable precursor to both AFM subjects. Indeed, MIF serves as good preparation for a more rigorous discussion of some fundamental concepts that arise in AFM1 and AFM2. Elements of probability spaces, conditional expectations with respect to a sigma algebra, continuous-time martingales and stochastic calculus are present in both AFM subjects, albeit to varying degrees — one very clear instance of this is the apparent absence of dedicated lectures to probability spaces, perhaps because they are rather theoretical and most computations can be performed without understanding, say, integration with respect to some measure. Nevertheless, I would recommend, be it for students only interested in studying AFM1 for the exemption requirement or those wanting to also study AFM2, taking MIF in third year.

Having digressed, I will now come back to the content in AFM2 specifically. In 2015, we looked at the following topics:

- principle of no arbitrage and pricing on binomial trees
- continuous-time martingales and stochastic calculus
- multiple sources of risk (extension of the above)
- vanilla interest rate derivatives

Immediately one might notice the similarities between these four topics and those listed for AFM1. Black–Scholes is apparently absent, but it instead comes back in different forms throughout the subject. For some time, I will discuss each of these topics in a bit more detail — for those uninterested in the minutiae, feel free to gloss over the next couple of paragraphs.

In the first topic, this is essentially a mathematical extension of the knowledge developed during study of AFM1. Further results include, for instance, the model independent property of call option prices being convex in the strike (proven by no arbitrage). Much of the overarching concepts will be familiar territory after AFM1, but it nevertheless goes into rather deep mathematical detail in some areas in the advancement of new ideas. To exemplify, there is a rather 'obvious' result — that a sequence of portfolios that replicate in the limit some derivative should also have the same price in the limit — which commands a proof spanning almost an entire lecture and demands also a stronger analogue of the principle of no arbitrage.

For the second and third topics, which I can perhaps summarise as 'applications of stochastic calculus', the content covered should be quite familiar but simply applied to different problems. Here, the numeraire is explored in more detail and several techniques that are useful in derivative pricing are shown; it would be a significant advantage for a student studying AFM2 to understand these well as they recur often. Some foreign content appears, such as the time-dependent volatility Black–Scholes model and the 2-dimensional Taylor's theorem, but most of the material here can be handled without losing much sleep. I should caution however that there is a particular lecture deemed by Mark himself to be one of, if not the, hardest lectures you will attend in all four years of your Actuarial tuition. Specifically, the lecture delves into the computational mechanism by which a change of measure is performed; students by the end of AFM1 will be aware that it is *possible* to arbitrarily add drift to Brownian motion by passing to another measure, but the precise details of *how* will form the crux of this lecture. Even though the context — barrier options — is quite a practical problem, the supporting mathematics, which involves finding a joint distribution involving Brownian motion, can be rather difficult. Following this is consideration of the natural extension of stochastic calculus to the case where either

- a single asset is driven by multiple, correlated Brownian motions or
- multiple assets are driven by correlated Brownian motions

Some theorems are given (the multidimensional Itô lemma and Black–Scholes partial differential equation), but apart from a lecture on the pricing of quanto options (where the pricing method can be quite confusing at times), I think it's safe to say that the content covered in these topics are, for the most part, manageable.

Last but not least is the fourth topic: vanilla interest rate derivatives. It will begin with a light refresher on the material encountered in AFM1, before delving into the mathematical aspects of the LIBOR market model. If you are worried by now however that the subject is primarily mathematical, this is certainly not true. Spread throughout the entire course there are discussions of varying lengths dealing with pragmatic issues such as the acceleration of pricing on binomial trees, methods of numerical integration, acceleration of Monte Carlo simulation, and methods of generating random variables (knowledge of first-year linear algebra is somewhat helpful here, as the Cholesky decomposition, eigendecomposition and diagonalisation make an appearance, albeit briefly). However, while the final topic may ostensibly be very mathematical, it is actually perhaps the most pragmatic topic of all.

First off, you will begin by learning how to perform computations of drift with different choices of the numeraire when the model of choice is the multidimensional Black–Scholes model. Mathematical symbols and convoluted equations may obfuscate the apparent usefulness of proven results, but it nevertheless serves as a potent reminder that model users need only an implementation algorithm and not mathematical elegance. Despite the general consensus in the Actuarial cohort being that theory is often more difficult than practice, I would argue the contrary here; without any practical experience in model implementation and appreciation for coding efficiency, I would imagine that much of the pragmatism to be gleaned is lost in translation. In spite of all this, the focus of this topic is practical implementation of the LIBOR market model, so methods of improving approximations to stochastic differential equations as well as a significant discourse spanning five to six lectures on methods of calibrating the model are also put forward. Indeed, it is rather beguiling when the mathematics appears to be sparse; we would expect it to be quite easy to rote-learn the qualitative aspects of the course, but I would imagine for most people that fully understanding a maximally time-homogeneous algorithm of solving a system of equations in n-fold space lying on the intersection of a sphere and cylinder is rather difficult. Thankfully, the subject concludes with a lighter, slightly more formulaic section on an extension to the LIBOR market model.

Of course, please bear in mind that this review was written with regards to the subject in 2015, so the content might differ in future years (although, perhaps, this review might be superseded by then). Having described now all the content (in perhaps too much detail!), I can probably say that the difficulty is **reasonably hard**; however, this should not be surprising, given that it is a fourth-year actuarial subject. Obviously, I cannot compare between the other possible electives, but with certainty I can say the subject is challenging and you might be confused immediately after a lecture on numerous occasions. However, with enough determination, it is certainly possible to overcome these issues with enough revision

and time. Some aspects of the difficulty will simply be attempting to memorise either formulae or theorems; others will be due to the apparently convoluted nature of the problem. I will speculate here and suggest that, as AFM2 is not bound to Institute standards as it is not an exemption requirement, there is more room for rigorous mathematical treatment of financial problems. It is still very accessible and taught very well, and indeed while MIF and AFM1 will prepare you well for the majority of the material encountered in this subject, having a modicum of knowledge in some of the entry subjects should be beneficial but not necessary. In short, the subject in my opinion coherently pieces together the theoretical framework underpinning quantitative finance, ignoring neither the mathematical rigour nor the issues of importance to practitioners. Problems faced will be primarily computational, but not of the numerical kind; most solutions can be written analytically.

Lectures

Being a fourth-year actuarial subject, there are no tutorials. However, you may see particular lectures set aside for discussion of practice problems. To this end, you will probably want to acquire the book and take it with you into said lectures, because Mark will discuss solutions to the practice problem(s) you wish to seek explanations for as well as any other queries surrounding the subject. Consequently, these lectures will constitute the closest thing to a tutorial you will have in this subject. Practice problems are available in the recommended text and additional questions are available on the LMS. Given that the amount of supporting material is quite sparse, you will probably want to finish all the relevant questions. Please note: such lectures are interactive. By now, you have undoubtedly discovered that some classrooms have this perpetual atmosphere of awkward silence, but hopefully with a reduced cohort the attitude of waiting until someone asks the first question slowly dissipates. For me at least, it certainly made the lecture more tolerable when someone — be it myself or someone else — asks a question, since I can tell you first hand that I would rather get a question answered and possibly feel like an idiot after than sit in a room where you can cut the tension with a knife.

For standard lectures, I would say this: absence should be practised at your own peril. If I can say anything that would encourage attendance, it is simply that the lectures are far more bearable than those in previous semesters; the size of the class for AFM2 is usually very small, which makes for a very relaxed closely-knit experience (for the past four years, enrolment has been in the single digits). From memory, lecture slides are intentionally empty in some regions to encourage attendance (so that you can fill them in with reference to the complete slides), but this is not strictly necessary given the availability of lecture capture (**NB:** I personally never used it, but I am fairly sure that there was both video and audio). Given that most students are probably going to be concurrently studying the *Actuarial Practice and Control Cycle* subjects (APC) which have lectures on Tuesday, Thursday, and Friday (at least, this was the case in 2015), you probably have nothing to worry about if you are concerned about wasting your time coming in for a single lecture since you can be productive during the breaks (they are unbelievably long, by the way). Given also that the size of the class is so small, it is possible for engaging discussions to be had even during standard lectures; my personal experience has been that there is an element of informality which makes lectures much more enjoyable. Moreover, both the lecturers have interesting idiosyncrasies — Mark often asks an interview problem (sometimes mathematical, physical, algorithmic, etc.), which is usually thought provoking and highly interesting. Likewise, if you are keen for Daniel's jokes and sense of humour (I'm a bit biased here), then that only gives one more reason to attend. Both lecturers are absolutely fantastic and very approachable which, combined with small class sizes, is particularly conducive to your learning. If not for the benefits to your understanding of the content, I strongly recommend you attend simply because it should make what is most likely your final semester of formal education all the more enjoyable.

Mid-semester exam

In 2015, the mid-semester exam covered content up to and including the fifth week. Normally, it is not overly difficult and is intended more to force one to study so that by the end of the semester, there is not this mad rush to cram everything. You can expect that the questions should test your understanding and not necessarily be computational; I believe that for my mid-semester exam, the scientific calculator was basically useless. I cannot really give any numerical indication of the exam difficulty since the sample size is rather small; if memory serves me right, the average was around the 65% mark or thereabouts.

Questions were of equal weighting and roughly of the same difficulty, although depending on how well you recall aspects of the subject, some questions will invariably appear easier or harder than others. Objectively, there was probably only one difficult question, since its suggested solution was far less obvious; the remainder could be described as 'textbook'. It should not be remarkably difficult, provided that you have understood the material covered so far and are capable of identifying and applying the appropriate techniques. Generally speaking, most mid-semester exams are quite gentle, at least in comparison to the final exam.

I also make a brief note of the fact that the assessment comprises only of exams; in my opinion, this is an advantage, since I'd personally much rather study for a single mid-semester exam than be constantly bombarded with assignments, as was the case with those who chose ECOM30004 *Time Series Analysis and Forecasting* (TS). Sure, it might make your SWOTVAC slightly more stressful as the content of a fourth-year actuarial subject is probably harder, but your in-semester workload is somewhat gentler when the proverbial hits the fan and you're looking down the barrel of approaching APC and TS assignment deadlines in conjunction with submission deadlines for the final project or research essay.

NB: THERE IS NO FORMULA SHEET FOR EITHER EXAM.

End-of-semester exam

You might have noticed by now that exams often carry an element of scaling should the situation mandate it; in 2015, scaling was upwards, suggesting immediately that the difficulty of the exam is above average. I have already mentioned this, but the first thing to note is that while you will inevitably use your scientific calculator, there is little emphasis on numerical computation. Hence, if you are able to devise some approach to the question, most of it will flow through quite naturally and without much time wasted on punching buttons.

If memory serves me right, what amounted to mathematical computation was essentially a question that required you to find an analytic expression; these questions will dominate the exam (or at least did in 2015). Questions draw on all four key topics to varying extents, usually dictated by the proportion of the subject dedicated to each topic. For instance, you might be asked to evaluate a particular probability or expectation and leave your answer as an analytic expression. By now however, you should already be fluent in symbolic evaluation, so this doesn't really pose any real issue (other than knowing how to find the relevant probability or expectation of course).

From a holistic perspective, the exam tests understanding of techniques and when to apply them. It may vary from testing your ability to create a replicating portfolio or to perform symbolic simplifications, for instance in pricing a derivative under the Black–Scholes model. Much of the exam will depend on your ability to do computations by applying the techniques you will have learnt appropriately. For instance, in the pricing of a derivative, it might be expected that you integrate; in showing that no arbitrage opportunities exist, a hedging or replication argument might be suitable; in approaching a question on stochastic calculus, applying the multidimensional Itô lemma might be a good starting point. **All the computational tools are taught to you** — but it is up to you to know when to apply it. Time, as with any exam, is always an issue, so there is a significant advantage to identifying efficiencies in solving questions. Take, for instance, the proof of the Black–Scholes call

option formula that I mentioned earlier; would you rather write down lines upon lines of tedious algebra (if you do not use elementary results, the risk-neutral integration requires a substitution that then requires completing the square) wherein mistakes can hide or would you rather write down a solution that could fit in the margin? In 2015, the exam was reasonable; there was ample time for the diligent student to finish, with some time to spare. I am not saying the exam is not hard: while there may be some questions that will make you laugh uncomfortably at your own distress, I would say that the questions in my year were **doable**, in the sense that they did not require insane mathematical working that goes significantly beyond what could be considered reasonable for an exam situation.

I have so far only discussed the quantitative aspects of the exam which mostly, as stated, requires application of several techniques refined throughout the course of the subject. In spite of its namesake, the AFM2 exam is home to some qualitative questions, which can range from requiring you to write a short sentence to a brief paragraph to an essay. If writing ability is an issue, this is certainly one that needs rectification as your written arguments need to be like any other piece of written literature — coherent, persuasive, and so on so forth. It will probably be somewhat self-evident as the subject unfolds where the qualitative aspects can be inserted into the exam; as a general observation, I would imagine that elements free of mathematical abstraction would be prime choices.

Even though there is a wide range of practice problems for you to play with, one thing I would advise against is to fall into the trap of believing that success in practice problems will translate to success in the exam. I am not saying you should not do them anyway; there are numerous cases of practice problems that actively test your ability to use specific mathematical techniques as well as test your understanding of qualitative considerations in mathematical finance. Indeed, it would be remiss of me to simply forget the benefits conferred by encountering various practice problems. However, I think it is wise to bear in mind that mathematics is a massive area and the potential for questions that may appear utterly foreign to you in the exam is very real. It is an advantage to be able to recognise similar questions and thus apply similar techniques, but when (not if) questions arise that are utterly foreign, a study methodology based solely on practice problems will do more harm than good as it will not only deceive you into a sense of false security but also fail to give you the understanding required to apply techniques generally. For this reason, I suggest that if you decide to embark on the AFM path, you should prioritise absorbing theory; an ability to do the exam will come as a byproduct of this, but the converse I do not believe to be true. I acknowledge that this view is my own, however, and that the reader might have very different methods of studying. I have no intention to dictate how you should study, but I would recommend studying theory simply because the sheer expanse of mathematics admits so many different types of plausible questions — preparing for each and every one is nigh impossible.

Concluding thoughts

Overall, I would say that the subject content is delivered well, and you will benefit from both the theoretical and practical aspects of the subject which are both broad and deep. It gives a very good discussion of some of the fundamental principles underlying modern mathematical finance without sacrificing both the elements of rigour and pragmatism. For those interested in the area, this is without a doubt the obvious elective.

I hope that you will not find yourself in the same situation, but I know some that shied away from the subject due to concern over their average breaching the passing benchmark of 65. Daunting as it may be, I think TS, a popular alternative, is far from the 'bludge' or 'free H1' that many may perceive it to be. Rather, it is much easier, having already done AFM1 and been introduced to the basic ideas, to enrol in AFM2 than it is to be thrown into the deep end (i.e. without the proper background) of a third-year econometrics subject. It will depend on personal preference, but I would also much prefer a single mid-semester exam than four assignments throughout the semester.

As with any subject, the difficulty will depend on how much of your time you intend to dedicate studying. Moreover, your study should emphasise understanding theory. Of course, there will be elements which you will inevitably rote-learn, such

as theorems, lemmas, corollaries, propositions, qualitative aspects and whatnot, but for the most part, success in this subject like in any other subject comes from comprehension, not memorisation. Objectively, the material taught is not spectacularly hard, nor is the exam relative to some others. It is certainly within the realms of what one can reasonably be expected to achieve, but that is not without hard work and steady resolve. Poetic aphorisms aside, this subject is definitely one to consider if you enjoyed the content in AFM1 or enjoy mathematics. In making your decision, bear in mind that this is, unless you are intent on postgraduate study, going to be your last semester of formal education — study what you want to study, since you might as well enjoy it. I hope you have enjoyed this review, and all the best for your fourth year of Actuarial Studies.

ACTL40009 Actuarial Practice and Control III [SM2]

Exemption status	Part IIA *The Actuarial Control Cycle* and Part IIB *Investment and Asset Modelling*, in conjunction with ACTL40006 *Actuarial Practice and Control I* and ACTL40007 *Actuarial Practice and Control II*. Satisfactory performance in all three subjects' end-of-semester exams will lead to exemption from both Part IIA and Part IIB.
Lecturer(s)	Richard Fitzherbert
Contact hours	1 × 2-hour workshop 1 × 1-hour lecture discussion
Assessments	Group Assignment 20% 3-hour end-of-semester exam 80%
Textbook recommendation	Investment Bridging Course Notes (IAAust) — made available online Course Texts and Extracts — available from Coop, contains extracts from BluePrint for Investment (Fitzherbert), Investment Principles for Actuaries (Fitzherbert) and Compound Interest and its Applications (Fitzerbert & Pitt) Course Notes — available from Coop, contains various readings and also the workshop problems for the course
Lecture capture	N/A
Year and semester reviewed	2016 Semester 2

Comments

Subject Content

The course is designed to cover all the investment foundations that the Institute deems necessary for actuaries in senior roles to be able to discharge statutory investment obligations.

The course starts off by examining some of the more philosophical aspects of investments. e.g. *"When is something a law rather than just a regularity?"* and *"Can speculative bubbles only be recognised in hindsight?"*

It then goes on to give an overview of the three major investment types — debt, property and equity — and a small discussion of derivatives.

Finally, the course goes on to critically evaluate various investment theories like CAPM and the efficient market hypothesis and discusses portfolio choice and investment forecasting.

There are also two case studies examined. The first is the collapse of Long Term Capital Management and the second looks at US mutual funds in the mid-1990s.

Overall, throughout the course, there is a strong emphasis on critical evaluation of various theories and understanding different arguments for different theories. For example, whether equity can really protect against inflation is a topic that is discussed several times throughout the course, but there is a strong focus on understanding the various arguments that exist and the supporting or contradictory empirical evidence for each argument.

Lectures

The lectures for this subject were all pre-recorded and online. There are two lectures per week and Richard would release these online on Monday mornings. It is then up to you to watch these lectures in your own time. Whilst the lectures are often very short (generally 20–35 minutes of recording time), unlike in live lectures where there are natural pauses, the online lectures are very densely packed with content and I found myself having to pause and re-watch bits of the lectures numerous times. Thus, in the end, watching a single lecture did end up taking the usual lecture time of around an hour.

Richard posts the slides for the whole semester at the start of the semester. However, these slides are in a very brief and concise form. Therefore, I would definitely recommend making notes for each lecture to supplement the notes from the slides.

Workshops

The workshop problems for the subject can be found in one of the course notes books that need to be purchased from Co-op at the start of the semester. Each week, the workshop has around 3–6 questions covering topics from the lectures from the week before.

After each workshop, Richard does upload a pre-recorded video of him talking through the workshop problems but the actual live workshops are not recorded. However, I personally found attending the workshops in person to be very valuable. Richard makes the workshops to be very much like a discussion and due to the small class sizes, he often goes around and chooses people to answer questions, so it's always wise to come prepared with answers.

The workshop questions are by no means straightforward and require quite a bit of thought — many of them require you to form your own opinion about a particular issue. Therefore, you will need to grow to love ambiguity as there are usually no strictly correct answers for most of the problems.

Discussions

In the one hour timetabled timeslot each week, Richard would hold a lecture discussion session. Again, these sessions are not recorded. During these sessions, Richard would provide a brief summary of the key points of that week's lectures and answer any questions anyone had about the lectures. In general, these discussions weren't that well attended. However, I personally found them useful as it gives you a better feel of which parts of that week's lectures were the most important. Also, if you're like me and often get distracted whilst watching online lectures and find it much easier to focus in an actual lecture theatre, attending the discussions can help the information sink in better.

Assignment

There was one group assignment for the semester and we were allowed to choose our own groups of three people. Our assignment was about a fictional company, Bob's bobcats. We had to project their cash flows and profit & loss figures for a number of years and examine the effects of changing certain variables such as changing inflation rates or changing the way inflation was applied to the company's return on shareholder's equity and some other financial metrics.

Part of the marks was based on explaining how our spreadsheet projections worked and how we derived our estimates of return on shareholder's equity. The assignment also required us to discuss whether our projections verified or contradicted

certain statements made by academics about the effects of inflation.

It was a pretty long assignment and very easy to make mistakes in the spreadsheet. However, upon reflection, it was a pretty useful assignment. Prior to doing the assignment, I don't think I properly understood some of the arguments about the effects of inflation on equity returns, but doing the assignment improved my understanding.

End-of-Semester Exam

The exam is a three hour closed book exam unlike the other two APC subjects. Richard uploaded one specimen in the lead up to the exam but without solutions. Also unlike the other two APCs, full sentence responses are encouraged and not just dot point responses.

As Richard puts it, the final exam is a "fair" test of the course. Some questions on the exam feel very familiar to workshop problems, but others are completely new and unseen and require a bit of extra thought. Just before the exam, Richard will mention a few figures you should have a rough idea of, such as the ASX 200 dividend yield. However, the final exam is still very much qualitative and more a matter of justifying your assumptions and choices rather than knowing the correct figures.

Concluding Comments

Overall, I found APC3 to be a much more enjoyable subject than I originally thought. I have never really found investments to be the most interesting topic, but I enjoyed the way APC3 was taught and the way it focussed more on critical evaluation of theories rather than just understanding how different investment types work. It is however probably the most different subject from standard actuarial subjects. In the first few weeks of the subject, it almost felt like I was sitting in a philosophy subject. But nonetheless, I can see the importance of the subject.

Breadths and Electives

AGRI20030 Australia in the Wine World [JUL]

Exemption status	None.
Lecturer(s)	Chris Barnes
Weekly contact hours	1 week intensive — 9 × lectures and 8 × practicals
Assessments	2 × 45-minute multiple choice online quiz 20% 1-hour practical exam 30% 2-hour theory exam 50%
Textbook recommendation	A combination of lecture notes, the prac book, the online readings, and note taking will be sufficient.
Lecture capture	None
Year and semester reviewed	2016 July Term

Comments

I took this course during the July Intensive over one week, so as expected it was of a very fast pace. To take this course during this time period you must travel to the Dookie campus. The cost of accommodation and catering was an additional $450. You get your own room with lock and shared bathrooms, and pretty good food; I had no complaints during my stay.

As a 5-day intensive I had lectures and practicals for the first 4 days, and exams on the Friday. On some days I had lectures and practicals from 8:30am–8:30pm with only breaks for lunch, afternoon tea and dinner. So IT IS truly of an intensive nature.

The knowledge taught is very practical in business, especially in Asia where business deals are ALWAYS discussed over wine.

Subject Content

The subject covers the process of wine making, viticulture (science of grapes) and how it relates to climate, and different soil characteristics etc. and how each of these affect the taste of the wine. You will learn about different wine regions in the world, namely France, Spain, Portugal and Italy, and you will also learn about the wine regions in Australia. There is a section on fortified wines and the commerce (marketing) of wine.

You also get to travel to one of the two nearby wineries, depending on which group you get assigned to.

You will be tasting wine everyday and learning to identify the different wine characteristics and how to describe them. The 30% practical exam is a blind tasting of 4 different wines.

Note: The level 1 version of the subject AGRI10039 is EXACTLY the same as the level 2 version, EXCEPT it doesn't cover the section regarding the marketing of wine. It is a very short section, so if you're not out of level 1 breadth slots, consider this one.

Lectures

Chris is a world renowned wine educator, and he teaches very well. Straight to the point, clear and concise, just the way you would want it during an intensive. Very friendly person one on one. 10/10.

Each lecture covers one topic, and given the how broad the topics are, are very brief. By the end of the week it might seem like a lot of knowledge, which it is, but you truly get a feel of the scale of the winemaking and wine retailing industry.

Tutorials & Exam

Due to the number of students undertaking the subject you will be split into 3 groups for the practicals. I was assigned to Sonia Needs who was the subject co-ordinator. Very friendly person who is always happy to spend some more time with individuals to help them get their senses right (literally).

Wine tasting might seem daunting to most people, but trust me it's not. When a normal person drinks wine, it might be once every few weeks or so, and by then the palate has lost the memory of how the wine tasted last time. During this intensive you will be tasting wine one after another, day after day, and you will be taught to identify characteristics starting with baby steps. It is not easy either but you do not need a highly-developed sense of taste and smell to do this. Taking lots of notes as you go along might help as you slowly lay the different wines across a scale of robustness and flavour.

Tip: Unless it's very good wine, spit. You do not want to be drunk in the middle of class.

The practical exam is a 1-hour semi-blind tasting. You are given 4 different wines, poured out in front of you with no knowledge of what wine it is. You are to give it a full breakdown based on how it looks, how it smells (nose), and how it tastes (palate, finish, length etc.), using the appropriate vocabulary you have been taught throughout the week. You will also be asked to name the variety of grape the wine is made with. My opinion of the practical exam is the same as my opinion of wine tasting in general. Not rocket science, just take baby steps and make notes.

The 2 hour theory exam covers all of the topics. There is a multiple choice section, a label-a-map section, a short answer section, and an extended response section. You are given the choice of 5 extended response questions from which you must choose one to answer. For this exam, since you really only have a week, having a good memory would really help. The English sections were much easier to remember, but I also had to spend a lot of time memorising a lot of very alien Spanish, Portuguese, Italian and French words. When it got to the exam, I actually found it easier than expected. I finished the exam with an hour to go. A bit of regurgitation yes, but if you have been learning it shouldn't be too hard.

Online Quiz

There are two more online quizzes after you come back to Melbourne during Semester 2. These are worth 10% each and you do them over assigned weekends with a time limit of 2 hours. They are open book, and consist of 10 multiple choice questions each. You will not run out of time, but some of those questions are seriously hard. I personally did worst in this section because I was not thorough enough with my search terms. Being outside of the intensive week, I got a feeling of wanting to just get it over and done with, and so I reap what I sow.

Concluding Comments

I took this subject because it was a personal interest of mine. I thought it was very insightful and practical. However, I DID NOT think it was bludge. You will have to learn A LOT in a short period of time. And if you have problems memorising foreign words this subject might be difficult for you. We had to memorise wine regions in France, Portugal, Italy and Spain, their different classification systems and grape varieties used, which is almost all in their own different languages. Like I said, a bit of regurgitation yes, but if you have been learning it shouldn't be too hard.

On the up side, for 5 days you get one of your subjects out of the way and you can 'enjoy' a semester of underloading.

And I should repeat — very practical in business. There have been many cases of people landing jobs, promotions, business deals etc. off knowing their wines.

For more information:

http://students.fvas.unimelb.edu.au/breadth/australia-in-the-wine-world#Breadth-Studies

COMP10001 Foundations of Computing [SM1] (1)

Contributed by David Cochrane-Davis

Exemption status	None.
Lecturer(s)	Professor Tim Baldwin Associate Professor Andrew Turpin Assorted guest lecturers
Weekly contact hours	3 × 1-hour lectures 1 × 2-hour workshop
Assessments	Online worksheets on Grok 10% Individual project, due in Week 6 10% Individual project, due in Week 9 10% Individual project, due in Week 12 10% 45-minute mid-semester test in Week 7 10% 2-hour end-of-semester exam 50%
Textbook recommendation	There isn't one. All materials are either available online or given to you.
Lecture capture	Full (both audio and video).
Year and semester reviewed	2016 Semester 1

Comments

This is one of the breadth subjects that first-year Actuarial students often choose to do. The subject is mostly an introduction to programming with Python, with a small section on HTML, and a lecture or two on algorithms (to encourage students to do the follow up COMP10002 *Foundations of Algorithms*). The assessment is almost all Python programming, with just a small section on the exam being theoretical.

COMP10001 Foundations of Computing has a reputation for being an extremely hard subject, but I disagree. It is certainly challenging; it requires steady work throughout the semester; it can be extraordinarily frustrating at times — but it is not "I'm going to fail!" hard. Though it is challenging, there is also scope for getting a very good mark, as the tutors are pretty nice about marking assignments (and the exam is only 50%).

Do not be put off by the subject because you don't have any programming experience — I went in with absolutely none and ended up with a very high H1.

I found Foundations of Computing to be an excellent introduction to programming and would heavily recommend choosing it as your first semester breadth subject.

This review was previously published in the 2016 mid-year edition of the *Actuarial Students' Society Subject Review*.

Subject content

COMP10001 Foundations of Computing focusses on programming in Python 3.4 — an easy to learn language that is used in a wide variety of areas, including data science, engineering, science, and many other fields. The content can be separated into two sections:

- Programming with Python [Weeks 1–8]

  The first four weeks of the subject are an introduction to programming aimed at complete beginners, explaining material such as

  - types,
  - variables,
  - conditionals,
  - sequences,
  - functions
  - lists, tuples, sets, dictionaries, and
  - commenting.

  The next four weeks focus on teaching students how to solve problems using Python, as well as introducing concepts such as

  - exception handling,
  - libraries,
  - files and input/output, and
  - debugging.

  The mid-semester test (Week 7) includes material from Weeks 1–6. The three assignments utilise skills and knowledge from the first eight weeks.

  After these eight weeks, you will be competent enough to write programs in Python to solve problems given to you (which is basically what the three assignments are).

- The last three teaching weeks (9–11; 12 is used for revision) cover a few different topics, including URLs and the Internet, HTML, algorithms, and character encoding. There is far less focus on this part of the subject on the exam, but make sure you understand it all.

The subject uses a site called Grok to conduct most of the actual coding — I found it to be very smooth and efficient for a first-time user.

In my opinion, the best two parts of COMP10001 Foundations of Computing were the guest lectures and the assignments. There were five guest lectures spread throughout the semester (always on Thursdays), including people from Google, IBM, some startups, and a cryptography academic. They provide some great insight into what computing can do and what you can get out of learning how to program. Also, the content from these lectures IS EXAMINABLE! Do not ignore them.

The three assignments in 2016 Semester 1 were as follows:

- Assignment 1 required students to program a basic implementation of RSA encryption, mostly by following guidelines. Please note that you are marked on your commenting of code as well as the actual code.
- Assignment 2 required students to write a program that took a list of phonemes and gave the most probable grapheme representation of said list — basically a speech-to-text converter.

- Assignment 3 was in my opinion the highlight of the semester. Students wrote a program to play a card game that Tim (the lecturer) had altered, and then all programs were entered into a tournament against each other. About 25% of the marks were given for how well you did in the tournament.

You get around three weeks to complete each assignment, which is plenty. I would recommend starting early and working steadily on them. They are not doable the night before.

Lectures

In 2016 Semester 1, there were two main lecturers (Tim Baldwin and Andrew Turpin). The ones I went to were mostly Tim, but I watched a few recordings of the ones Andrew did. Both Tim and Andrew are good lecturers and are extremely willing to help if you go to them with questions (just try not to flood Tim's email).

I wouldn't say the first eight weeks of lectures are essential if you are learning well using Grok, but I would heavily recommend at least watching the recordings and going to both the guest lectures, and the lectures in Weeks 9–12.

Workshops

Workshops run for 2 hours, with the first hour being a pretty normal tutorial and the second hour being lab time for you to do worksheets/assignments and ask your tutor/demonstrators for assistance. In the tutorial part, you are given a tutorial sheet (this is different from the worksheets), and you go through the problems on this sheet. These are often similar to those on the exam, except the ones on the exam are easier — don't worry if you are struggling to complete the tute questions by yourself.

Once again, attendance is not essential for the first eight weeks, but I would again extremely heavily recommend going to the ones in Weeks 9–12 and would encourage you to attend all of them.

Mid-semester test and end-of-semester exam

Both of these assessments are based around it being quite accessible to the average student but with both having a few questions that only the best students will get.

The mid-semester test is 45 minutes long and takes place in Wilson Hall; it covers content in Weeks 1–6. Don't worry too much if you don't ace it.

The end-of-semester exam is 2 hours. The format is the same as those in previous years, and multiple practice exams are given along with solutions.

Hurdles

There are two hurdles in this subject. To pass, you need

- 50% (30/60) for the mid-semester test and end-of-semester exam combined; and
- 50% (20/40) for the worksheets and assignments combined.

These are both very easy to get, and Tim is willing to be quite lenient in their application.

Final comments and tips

Learning programming does not just teach you how to write code — it also teaches you how to solve problems both creatively and logically and imparts skills that will be useful in both future studies and work. This subject is in my opinion the most practical of the breadths you can take, and I absolutely loved it — so I would recommend you give it a go!

In order to do well in this subject, you will have to work steadily. Do not try and cram; do not try and do the assignments the night before. Set aside a reasonable amount of time each week to read and practise the material and you'll do well.

COMP10001 Foundations of Computing [SM1] (2)

Exemption status	None.	
Lecturer(s)	Professor Tim Baldwin Associate Professor Andrew Turpin Assorted guest lecturers	
Weekly contact hours	3 × 1-hour lectures 1 × 2-hour workshop	
Assessments	Online worksheets on Grok	10%
	Individual project, due in Week 6	10%
	Individual project, due in Week 9	10%
	Individual project, due in Week 12	10%
	45-minute mid-semester test in Week 7	10%
	2-hour end-of-semester exam	50%
Textbook recommendation	None.	
Lecture capture	Full (both audio and video).	
Year and semester reviewed	2016 Semester 1	

Comments

This subject is a great introduction to programming for people with no prior experience. Before taking this subject, I was intimidated by the idea of programming and struggled to learn in my own time. This subject is very well structured and presents programming concepts in an elementary and welcoming way.

Subject content

Python (version 3) is the only programming language used in this subject. You do not need to download the program itself, as it is presented in a very user-interactive terminal on your browser through the Grok platform.

Weeks 1–6 cover the main tools used in Python to enable you to code. The main concepts covered include variables, types, conditionals, sequences, functions, iteration, and exception handling. Having completed the first six weeks, you should confidently be able to write you own small programs even if you had no prior coding experience.

I found these first six weeks very manageable because all the concepts taught had complementary online worksheets run on the Grok platform. When learning a new skill such as programming for the first time, it is important to simply rote-learn concepts to become accustomed to the language of programming. The external push from the worksheets allowed me to grasp new concepts in a simple manner.

Weeks 7–12 apply the tools taught in the first six weeks to other programming languages, applications, and functions. There is a focus on both the conceptual and practical aspects of computing. The conceptual applications studied are recursion

This review was previously published in the 2016 mid-year edition of the *Actuarial Students' Society Subject Review*.

in programming and algorithm structures. Practical applications include the internet, coding in HTML, multimedia, and character encoding. These concepts require a bit of memorisation but only represent 10–15% on the final exam.

Lectures

In general, lectures are very well structured and followed the online worksheets closely in the first six weeks. The lecturers did not always follow the slides, focussing on conceptual thinking. It is not crucial to attend lectures for the first six weeks given that the online worksheets covered the same concepts.

From Week 4 onwards, this subject also had a revision/advanced lecture or a guest lecture per week. The revision lectures were structured like a consultation with the lecturer just answering questions. As there were two lecturers, the advanced lecture occurred at the same time as the revision lecture. I found the advanced lectures too fast-paced given my lack of past computing experience, but the material was not examinable.

The guest lecture was conducted by programmers in the industry going through their area of work. The coding by the guest lecturers was also on non-Python languages/terminals like JSON and JavaScript, and I found it difficult to follow. However, the bigger picture concepts and ideas these professionals worked on were very interesting and also tested on the final exam. In 2016 Semester 1, the guest lectures covered speech recognition, cryptography, simulation, and programming chatbots.

Tutorials

Tutorials are 2 hours long, consisting of a weekly tutorial sheet and computer lab time. The first hour involves working through a revision sheet with programming questions similar to the ones in the exam. The purpose of this is to prepare students to code on paper to prepare better for the exams. I found coding on paper very organised compared to working on the computer.

The second hour of the tutorial was simply doing online Grok worksheets or projects at your own pace with the tutors and demonstrators offering help. I personally found the second hour boring as you could do the online exercises in your own time. However, I strongly recommend attending the entire tutorial because when you are learning a skill for the first time, there are many conceptual problems that you did not think was an issue in the first place. Attending the tutorial can uncover some of these problems that you can then work on in your own time.

Assignments

Out of all the subjects I have done, the projects in this subject were by far the funnest and most engaging. The project questions were structured like separate questions where you had to write a function for each question. These components of the project combined to serve a practical purpose in computing such as cryptography and speech recognition. However you did not need to know any extra details to do the questions. The third project involved writing a program to play a specific card game. This was also structured as a sequence of smaller questions and required you to think for yourself as a programmer. For two out of three projects, there was even a bonus question that allowed you to gain up to 2 extra percentage points to your overall score. It was not uncommon to see students get full marks for the projects having finished the bonus questions.

Mid-semester test and end-of-semester exam

As for the mid-semester test and end-of-semester exam, the main focus is on handwriting simple functions and understanding the structure of computing data types. There is also a small section on the practical applications of computing such as algorithms, HTML, the internet, and guest lecture material. This exam is not something you can cram for, because the questions that you encounter are most likely to be completely new. The exam tests your intuition in regards to the logic of programming and this skill can only be developed by continuously improving throughout the semester and thinking about underlying concepts in your worksheets rather than just completing the question correctly.

Suitability for breadth

Programming is an essential skill for actuaries. Personally, I find it extremely difficult for students with no programming background to learn the skill in their own. A university subject is a great way for students to get comfortable with the language and thought process of computing.

For Actuarial students with strong work ethic and problem-solving skills, the difficulty of this subject should not be a hurdle as long as you continuously practice. I strongly recommend students with no experience in computing to take this subject for breadth.

Tips

My main tip for success for this subject and other computing subjects is to simply practise continuously. To do well in this subject, you must obtain a sense of thinking like a programmer, i.e. knowing intuitively how you can use a limited set of resources and functions to solve a larger problem. In the exams and projects, you will most likely have never seen any similar questions before and will need to rely on your intuition. However, this sense can be easily developed by practising on a continuous basis. Trust the process and the results will come.

ECON20002 Intermediate Microeconomics [SUM]

Exemption status	None.	
Lecturer(s)	Summer Semester	Ms Svetlana Danilkina
	Semester 1	Dr Reshad Ahsan
Weekly contact hours	Summer Semester	2 × 2-hour lectures 2 × 1-hour tutorials
	Semester 1	2 × 1-hour lectures 1 × 1-hour tutorial
Assessments	Tutorial attendance and participation	10%
	30-minute online multiple-choice test	10%
	2 individual assignments	2 × 10%
	2-hour end-of-semester exam	60%
Textbook recommendation	Pindyk, R. S., & Rubinfield, D. L. (2013). *Microeconomics*. Harlow, UK: Pearson Education. The textbook is a very good complement to the slides to gain further understanding of the concepts that are discussed. However, I do not believe it is essential and students can still achieve exceptional results without the textbook.	
Lecture capture	Full (both audio and video).	
Year and semester reviewed	2016 Summer Term	

Comments

I saw ECON20002 Intermediate Microeconomics as an extension of ECON10004 *Introductory Microeconomics*, where all the topics from first year were touched upon and explained further. However, do not get complacent as there are still new topics covered. This subject contains much more maths based problems compared to its first year counterpart, which included algebra, partial differentiation and tangency.

Subject content

1. Introduction — Lectures 1–2
2. Consumer Preferences — Lectures 3–10
3. Theory of the Firm — Lectures 11–16
4. General Equilibrium — Lectures 17–18
5. Monopolies and Oligopolies — Lectures 19–22
6. Review — Lectures 23–24

The subject is well structured and aims to build upon the content that is taught in each lecture. Bear in mind, since I did this in the summer, some of the content that is taught during semester is taken out due to time constraints. However I do not believe it would change the way in which the subject is taught.

The first couple of lectures eases into the subject, discussing the administrative aspects. Svetlana then gets straight into the content, discussing consumer preferences. This topic highlights how consumers have constraints and how a limited budget is allocated amongst two goods whilst taking consumer satisfaction into account.

Following on from this, Svetlana delves into the theory of the firm. Here it is discussed how a firm will allocate their limited resources between capital and labour to optimise production. How a firm minimises cost given a set output as well as profit maximisation of a firm is also discussed.

Theory of the Firm was followed by the topic in which I found most tedious and somewhat difficult; General Equilibrium. This area of Economics is concerned about the notion that, when welfare is gained by a consumer, there is a loss in welfare for another. Whilst this seems straightforward, it takes most students some time to understand this conceptually. However, do not fear; if required, resort to the textbook and some extra online reading to gain another perspective. This will solidify what Svetlana explains in lectures and assist students in grasping this idea.

Finally, I thought Monopolies and Oligopolies were quite similar to that of this subject's first year counterpart. This area discusses how monopolies maximise profits, market power as well as game theory, concepts that should not be new to most students. The subject was then shortly wrapped up with a revision lecture or two which skimmed through the main concepts.

Whilst the subject was well taught, the nature of doing this subject in the Summer Semester is that it is fast paced. From memory, my final lecture was on a Friday and the exam was held on the following Monday. So there is not much of a SWOTVAC. I cannot stress how important it is to be on top of the content from day one because come final lecture, you should be close to being ready to sit an exam.

Lectures

As mentioned earlier, I completed this subject in the Summer Semester which involved 2-hour lectures twice a week. I personally find sitting through a two hour lecture quite difficult, especially during the nice summer days. However, I must say that Svetlana appreciates the fact that her students attend lectures and endeavours to make lectures as engaging as possible, encouraging students to make economics related jokes as well as holding live quizzes concerning the content.

Whilst the lectures were fully recorded, I attended each and every lecture as I enjoyed listening to Svetlana's explanations in person. Svetlana talks through the lecture slides and explains each concept by providing an example, helping students grasp concepts immediately. Nevertheless, keep in mind that these examples are rather simplistic and that exam questions will be of a greater difficulty.

I personally really enjoyed attending the lectures. Even during the wonderful summer days, I genuinely looked forward to attending Svetlana's classes as I thought she was a brilliant lecturer who was able to explain concepts in a clear way, which allowed me to grasp new material immediately.

Tutorials

Like all other first year economics subjects, Intermediate Microeconomics also follows the method of "blue sheet" and "pink sheet" where the blue sheet is the pre-tutorial work that should be completed prior to the tutorial and the pink sheet is completed in the tutorial itself.

Given the scarce amount of practice exams for the syllabus taught in the semester I completed this subject, these tutorial questions were my main method of preparing for the exam.

Like all other subjects, the ways in which these tutorials work will depend upon your tutor. My tutor allocated most of the time to work with other students to discuss the pink sheet questions. He would then write up the solutions closer to the end of the class. More often than not, there was not enough time to go through the solutions. Therefore I recommend answering these questions to the best of one's abilities and making use of the consultation hours to ensure that concepts are being fully understood.

Assignments

In my semester of this subject, there were two assignments which were to be completed individually. I must say, the assignments were quite a jump in difficulty relative to the tutorial questions and the lecture examples. Whilst tedious and difficult, if students understand concepts well, they should be able to utilise what is taught in class to answer assignment questions to a high standard.

The assignments primarily require students to work with variables rather than plugging numbers into equations, stressing the importance of understanding the intuition behind the economic concepts taught in lectures rather than just rote learning. Some questions required students to sketch certain graphs followed by an economic explanation.

Each assignment contributed 10% towards the final grade.

Mid-semester test

The mid-semester is conducted online and is purely multiple choice with a time limit of 30 minutes. This also contributed 10% towards the final grade. A practice test is provided in preparation for the mid-semester test. However, I found the practice test quite simple compared to the actual test.

The test is tricky and requires students to really think. There was a good mix between theoretical questions and questions that required calculations. The mid-semester test focused primarily on the concepts of consumer preferences, which made it easier to study for as students knew what exactly would be tested.

End-of-semester exam

The exam consisted of 10 multiple choice questions. There were three short-answer questions where students were to pick two of their liking. There were three extended response questions where again, students were to pick two of their liking. This was advantageous as students could stay away from areas which caused them difficulty. However, I personally think it is good to prepare for every topic as you can then go into the exam and have the luxury of choosing questions based upon your taste rather than difficulty.

It has been said that the difficulty of Intermediate Microeconomics exams fluctuate from semester to semester. In the Summer Semester of 2016, I felt that the exam closely followed the harder tutorial questions. This in fact caused a bit of trouble for students who purely focused their exam preparation on previous exams. The moral here is that whilst it is good to complete previous exams as practice, do not neglect blue or pink tutorial sheets as similar questions may arise in the actual exam.

Concluding remarks

As a student who has always enjoyed university economics, this was a great subject to undertake as an elective. For a student who doesn't mind putting in effort for an elective, enjoys maths but more importantly enjoys economics, this will be a wonderful subject choice. It is a good subject to complete over the Summer Semester as the workload is not too heavy and it will allow students to under-load in the later periods of their degree, which is useful when subjects are of greater difficulty.

Overall, this was one of the most enjoyable subjects of my university degree thus far. Wishing you all the very best! ☺

ECON20005 Competition and Strategy

Exemption status	None
Lecturer(s)	Dr. Jun Xiao
Weekly contact hours	2 × 1-hour lectures 1 × 1-hour tutorial
Assessments	3 Individual Assignments 30% 2-hour end-of-semester exam* 70% *If your exam mark exceeds the score you would receive with these weightings, then your exam will count for 100% instead.
Textbook recommendation	A. Dixit and S. Skeath, Games of Strategy, 2nd Edition or later. I didn't find the text useful, although it does have a broader range of examples and covers more special cases compared to the lecture slides.
Lecture capture	Full (both audio and Video).
Year and semester reviewed	2016 Semester 2

Comments

Before reading this review, please note that the content taught in this subject and how it is assessed may vary significantly between different lecturers. Judging by past exams, Dr. Jun Xiao's approach (2016 Semester 2) was much more numerical and application-focused compared to Professor Harry Clarke's (2015 Semester 2), which consisted of more theory and definitions.

In Dr. Jun Xiao's semesters, this subject makes a great elective for actuarial students wanting to take a break from hardcore probability and statistics without having to learn much new content.

A downside is that the content learnt will not help directly with the actuarial course (although a small chapter in CT6 is Decision Theory), nor later on in actuarial work. But working through tutorials sets, assignments and practice exams will definitely stimulate logical and strategic thinking, which are skills that can be taken anywhere.

Subject content

This subject delves into the Game Theory topic introduced in ECON10004 *Introductory Microeconomics* by exploring different types of games and their implications. Although ECON10004 is a prerequisite, all game theory concepts (such as Nash Equilibria) will be taught from the ground up. The only knowledge that needs to be carried over is an understanding of Demand/Supply and how to represent it graphically.

Competition and Strategy is broken up as follows:

1. Basic game theory concepts: Nash equilibria, two–player sequential/simultaneous games
2. Application of concepts to:

(a) Repeated games: collusion, cheating
(b) Monopoly and different types of Oligopoly competition
(c) Rent seeking
(d) Location models
(e) Asymmetric information and adverse selection
(f) Collective action games
(g) Auctions
(h) Contracts
(i) Wars

Although the course guide only mentions topics up to Auctions, Jun ended up providing relatively brief introductions on two extra topics which were also assessable, but did not end up being assessed. As mentioned before, the focus of the subject (at least up to Auctions) is to apply basic techniques to arrive at quantitative results for different scenarios, e.g. *What strategy should each player adopt or how much should each player produce/invest/bid in order to maximize their payoff?* Fortunately, expected values (used to set up the required function) and partial differentiation/solving simultaneous equations (used to find critical points for said function) from VCE Mathematical Methods/Calculus 2 are all you need to solve this type of problem. This is why I believe there is limited new content to learn here, especially for actuarial students.

Furthermore, since Jun's focus is on application, he will never ask for a definition or a regurgitation of a theorem. Hooray!

Things do, however, become more complicated for the topics towards the end of the semester and when special boundary cases arise — this is where a solid understanding of the basic game theory concepts are required. And, as with all Economics subjects, intuitive explanations for numerical results are often required, so understanding the context of questions given in the assignments/exam is also important.

Lectures

Dr. Jun Xiao is a mindful, clear, and engaging lecturer. The lecture structure is quite standard, with Jun first introducing the context of a new topic and thereafter going through one or two examples with the class, often ending with a discussion of a real-life case study. At the beginning of the semester, the pace of the lectures was quite slow, but Jun acted on the feedback he received as a part of the interim subject survey and spent less time on basic ideas, allowing for the addition of two extra topics at the end of the semester. Along with the case study examples, Jun also encouraged the class to be actively involved in discussing key proofs/results. If you find this type of engagement effective, definitely attend lectures.

With that said, the lecture slides themselves are quite comprehensive to the point where the core content could be learnt by simply reading them.

Tutorials

The tutorials for this subject should definitely be attended. There is a set of tutorial questions each week which the tutors (attempt to) work through, giving explanations of how to approach each type of question before providing a step-by-step solution, usually with the amount of working you would need for full marks in an assessment. Only brief answers (without explanations/working) are posted online, so the majority of learning how to do well in the subject comes from the tutorials.

For certain weeks, the set questions were repetitive and purely computational. I found it very helpful when my tutor (Daniel) recognized this and simply went through one example of this type of question, explaining the ideas behind each computational step, leaving us to do the set questions in our time. He used the remaining time to cover more interesting

questions on the topic and revised concepts for other topics. In the end, some of the interesting cases he went through even appeared on the exam! Either way, the tutor explaining concepts from his own point of view really helped to consolidate my understanding.

The only problem with the set questions is that sometimes there are simply too many to go through. The tutors recognize this and do select their questions carefully for the tutorial, but a lack of detailed solutions online may still leave question marks around small things.

Assignments

Assignments should be attempted individually before checking with others, as they are a great source of practice as exam-style questions. In fact, as mentioned in the overview of this subject, a good exam will override worse assignment marks, so it doesn't really matter whether marks are dropped here.

The assignment questions in my semester were an extension of lecture examples, and were at the same level or harder than tutorial questions. The questions were largely computational, long and tedious most of the time, and to get full marks all reasoning and working steps had to be shown – even intermediate algebraic steps. This does help you get comfortable with all the math in the subject, though. Intuitive explanations were also always required, some of which had to be produced using logic as they hadn't been covered in lectures or tutorials. Overall, there were many places where marks were easily lost, but I felt that collecting assignments and understanding exactly where things went wrong helped my understanding in this subject and increased my confidence coming into exam.

End-of-semester exam

If Daniel is still one of the tutors of the subject, exam revision material will be plentiful. He provides three of his own practice papers, a question bank with plenty of questions for each topic, and even his own guides. His guides explain each topic from the ground up, and are a pretty safe fall back if you ever miss a lecture and don't have time to go back and watch it. Along with this, Jun provides one past paper as a sample.

The exam itself follows the same structure as the samples — 120 minutes for 120 marks, with about 5–6 questions of similar length. The exam consists mainly of the standard questions found in tutorial sets and assignments, with only 20 to 30 marks worth being "new" and designed to challenge students. These challenging questions usually require logical thinking and a theoretical approach to answer. As with most other subjects, understanding concepts in depth and learning from mistakes made in assignments will make you much better off compared to just memorizing particular examples.

Depending on how quickly the calculus, algebra, and number crunching are done, there should be enough time to finish the exam even after factoring in the extra thinking time required for the harder questions. However, it is probably wise to be careful with the computational bit, as this does make up more of the exam and will probably be penalized more harshly if incorrect.

JAPN10001 Japanese 1

Exemption status	None.
Lecturer(s)	Dr Ikuko Nakane
Weekly contact hours	2 × 1.5-hour seminar 1 × 1-hour lecture
Assessments	Test held during seminars 15% Oral assessment, due middle of semester and end of semester 20% 600-word cultural discovery project, due end of semester 15% 2-hour end-of-semester exam 50% A minimum of 80% class attendance is required for the subject; the roll is marked in both lectures and seminars.
Textbook recommendation	Banno, E., Ikeda, Y., Ohno, Y., Shinagawa, C., & Tokashiki, K. (2011). *Genki 1 Textbook: An Integrated Course in Elementary Japanese*. Tokyo, JP: Japan Times. Banno, E. (2011). *Genki 1 Workbook: An Integrated Course in Elementary Japanese*. Tokyo, JP: Japan Times. ✓ The textbook and workbook set is highly recommended, as the lecturers and tutors frequently refer to these books' exercises in lectures and seminars.
Lecture capture	Full (both audio and video).
Year and semester reviewed	2015 Semester 1

Comments

Subject content

This subject is designed for students with no Japanese learning background. Students will develop the essential foundation of Japanese literacy, which allows engagement in social events and situations in an appropriate manner, while drawing on background knowledge in their first language. Specific learning objectives include:

- The two sets of Japanese syllabaries (hiragana and katakana) and around 60 kanji characters;
- Communication skills required to deal with initial social encounters (self-introduction and greetings), exchanging information on everyday life routines and surroundings, and activities in which they are likely to engage in establishing a new life in a foreign country (e.g. shopping, finding ways); and
- Development of an intercultural understanding through identification of common Japanese rituals and routines, reflecting on their own culture, and comparing them.

This review was previously published in the 2016 mid-year edition of the *Actuarial Students' Society Subject Review*.

Lectures

Lectures in this subject contain a summary of the week's content — usually a combination of syllabaries/characters, grammar, conversations in social encounters (e.g. self-introduction, asking for directions), as well as some fun Japanese cultural facts. The lecture only provides an overview of the week's content, and further details and more exercises will be carried out in seminars to help strengthen understanding and aid memorisation. Meanwhile, lectures are fully recorded, and complete lecture notes are usually uploaded to the LMS beforehand progressively (some lecture notes are particularly helpful as a summary sheet of the week). Although you can still keep up with everything without going to every single lecture, it should be noted that 80% attendance of both lectures and seminars is a hurdle to pass Japanese 1; you will need to go to the lecture stream in which you registered to mark your name on the attendance sheet.

Seminars

Seminar attendance is necessary and strongly recommended in Japanese 1. A lot of the subject content that is only gone through briefly in lectures is discussed in much greater details in seminars. There are two seminars per week, each containing a combination of reading, listening, and speaking components that are structured along the textbook exercises. Generally, there is more speaking practice than reading and listening — you'll be paired or grouped with people sitting next to you. Tutors are usually very kind and encouraging, which helps beginners with little prior knowledge of Japanese like me step out of my comfort zone to interact with other people in a new language. Personally I find that speaking Japanese really consolidates the grammar or key points in my mind. Thus, seminars are a great opportunity to master the subject.

Assessments

There are a few parts of assessments in Japanese 1.

- Five in-class tests that are worth 15%, each of which is marked out of 30. These are held in the seminars every two weeks, starting from Week 3. The questions usually include translation, vocabulary, characters, and dictation (listening) sections and are quite straight-forward. If you engage in seminar activities and put some effort into memorising the grammar and vocabulary after class, it is pretty easy to do well. As a reference, in 2015 Semester 1, most people in my class received above 20/30.
- Two oral assessments that are each worth 10%. You need to find a partner in your seminar and act out some role-play activities. Both conversations will be around 10 turns (about 3 minutes) and describe social encounters such as meeting and greeting, discussing hobbies and past experiences, or asking for the time or directions using phrases/grammar you've learnt in class. The marking is based on the creativity, originality, pronunciation, and, most importantly, variety in the use of grammar and vocabulary. From personal experience, it's not hard to get a reasonable mark for oral assessments, yet extra effort in creativity/pronunciation/familiarization/performance is needed if you want a very high score.
- A cultural discovery project worth 15% that is due before the exam period. This is a short essay that justifies and compares Japanese with another language you speak, in terms of characters such as gender markers, polite forms, and how attitudes of speakers are revealed. This analysis needs to be based on your second oral conversation's content; thus it's important to keep what you want to include in this cultural discovery project when writing your script for the oral assessment.

- The end-of-semester exam worth 50%. The exam is 2 hours long, and most of my peers found that this was sufficient. The lecturer will release the structure of the exam closer to SWOTVAC, and there's no listening section in the exam. There was no specimen exam or past exam paper provided (at least in 2015 Semester 1), so I'd say the best way to prepare is to revisit the textbook and redo workbook exercises that you initially got wrong, as well as the in-class tests. The exam itself is not very hard, and good attention to detail can help you get great grades relatively easily.

Suitability as a breadth

This subject is a good breadth to choose for anyone interested in Japanese culture and, obviously, wanting to learn Japanese systematically. It is definitely fast-paced for those who have barely learnt Japanese before, and there's a lot of content to learn and memorize, e.g. it covers hiragana and katagana in the first four weeks and then 12 kanji characters each week afterwards. However, as long as you try to keep on top of everything as the subject progresses, it is still manageable; otherwise, it is just going to be too much of a pain when exams approach. For those who have a bit background in learning Japanese, this subject shouldn't be too hard, and for students who know Chinese characters well, as you may already know, the kanji part will be quite similar, which might give you an advantage.

Overall, Japanese 1 is a quite fulfilling subject, especially if you're into Japanese culture. It is also very well-organized by the faculty and fairly easy to pick up by beginners; I would recommend anyone wanting to find out more about Japan and its language to give it a go.

MAST20022 Group Theory and Linear Algebra

Exemption status	None.
Lecturer(s)	Dr Alexandru (Alex) Ghitza
Weekly contact hours	3 × 1-hour lectures 1 × 1-hour tutorial
Assessments	3 individual assignments 20% 3-hour end-of-semester exam 80%
Textbook recommendation	No external texts required. A **very** comprehensive set of lecture notes is provided and is certainly sufficient.
Lecture capture	Full (both audio and video) — the document camera may not be used; please see below for more comments.
Year and semester reviewed	2016 Semester 2

Comments

Just what is *group theory*? Why am I learning linear algebra again? And why is it that every time I tell someone about this subject they think I'm talking about two subjects?

MAST20022 Group Theory and Linear Algebra is a second-year subject that is a prerequisite for third-year *Pure Mathematics* subjects. Pure mathematics, being the obscure field it is, is certainly no less obscure as a maths specialisation, which is probably why your general audience always assumes you are talking about two subjects.

Group theory is the study of a mathematical construct called *groups* (surprise surprise). Groups are best motivated by the observation that in mathematics, there are many types of sets that, when endowed with a certain operation (a rule of combining two elements in the set), satisfy some common properties, namely

1. associativity: $(a \cdot (b \cdot c) = (a \cdot b) \cdot c$; tersely, your order of evaluation is irrelevant);
2. identity: there is a "do nothing" element; and
3. invertibility: every element has an element that "undoes" it.

A common example would be the integers $\mathbf{Z}$ under addition: addition is associative, permits an identity element (namely 0), and naturally gives rise to an inverse for every integer (just negate the integer). Such properties seem like fairly simple properties to come about, and, indeed, in GTLA you will come across a variety of groups.

Group theory forms a natural foundation for the field of *abstract algebra*, which, loosely, is the study of the structure of sets in mathematics. In this sense, GTLA opens students to further studies in algebra at the university. Unfortunately, aside from MAST30005 *Algebra*, these subjects are taught at the graduate level. The field of algebra enjoys the reputation of being a rather beautiful field of mathematics, and this same sentiment manifests in the university environment: MAST30005 *Algebra* is widely reputed to be one of the most enjoyable undergraduate maths subjects. Personally I believe its beauty lies in the fact that groups are introduced with only the simple properties mentioned above, but as more structure (read: conditions and properties) is imposed on the groups, the results become increasingly rich and eye-opening (at least that happens to be my take on GTLA). If ever there was anything I would call "mathemagic", this would be it.

So far I have yet to mention linear algebra. Why exactly is this subject a combination of both group theory and linear algebra, and where is the relationship between them? The group theory and linear algebra topics in GTLA happen to be fairly disjoint; one could outright label each topic as either "group theory" or "linear algebra" without hesitation. However, there are a few parallels between the structures of vector spaces and groups, the most obvious of which is that a vector space over a field satisfies all the aforementioned properties of being a group! As you will see, there are more parallels (bases and generating sets, (normal) subgroups and linear subspaces, homomorphisms and linear transformations); some of these are mentioned, so rest assured that, despite the abstract nature of the group theory topics, many phenomena you have in fact encountered in earlier linear algebra studies. The only other connection that was obvious to me was that some of the groups we worked with directly involved matrices and their properties.

Being a pure maths subject, you might expect the content in GTLA (particularly the group theory topics) to be quite separated from "real world" applications. To an extent this is true (please do not enrol into the subject expecting the content to be as tangible as insurance mathematics often is in the ACTL major); however, Alex does present some highly intriguing applications of both group theory and linear algebra, such as in computer cryptography, special relativity, chemistry (brief mention), and even stochastic processes! Some of these have entire lectures dedicated to them (but are not examinable), in case a passing mention of applicability is not convincing enough.

I would say that students studying GTLA tended to be maths students (no surprise here) but also physics students who might be considering further studies in quantum physics. Quantum physics, to my knowledge, relies on the theory of metric spaces and Hilbert spaces (cue MAST30026 *Metric and Hilbert Spaces*, although it is not a prerequisite for the university subjects on quantum physics), which, in turn, relies on some of the content in GTLA.

The difficulty of GTLA lies in its breadth of content. The lectures are very proof-based, and there are many smaller results and properties presented aside from the main ones, some of which you will need to recall very quickly and use frequently. It is a style of mathematics rarely found outside pure maths and is understandably a struggle for students for which GTLA is a first exposure to pure maths beyond first-year linear algebra and real analysis. Alex takes a very structured approach to this subject (teaching theory and then giving **many** examples), and consequently it was far easier learning this subject than one might expect from its content.

Subject content

There are five major areas of discussion in the subject, and they are conveniently allocated (usually) one question in Part B of the examination (more on that later). These are:

1. the Jordan normal form;
2. an introductory discussion on groups with a slight focus on normal subgroups;
3. inner product spaces;
4. group actions; and
5. the Sylow theorems (or, more generally, classifying groups).

Introductory topics Alex begins with a short illustration on what sorts of problems motivate the study of abstract algebra. From this short lecture alone it was quite easy to see that this subject was going to be different from first-year maths subjects. With uses in studying symmetry, geometric properties, and number systems, the main theme was that abstract algebra is quite literally the abstraction of ideas that are present in various mathematical objects.

The first point of call (even before the Jordan normal form) is the discussion of the principle of mathematical induction (which should be familiar from MAST10008 *Accelerated Mathematics 1*) and something called the *well-ordering property*, which

states that a non-empty subset of the natural numbers $\mathbf{N}$ always has a smallest element. The principle of mathematical induction and the well-ordering property are shown in lectures to be equivalent.

At a glance it is probably unclear why the well-ordering property is important or even why it is a result on its own (it sounds "obvious"). Perhaps this is more an example of the fragility of mathematical logic: In AM1 you may have used the principle of mathematical induction several times without questioning its validity. It turns out that when setting up the theoretical environment for studying mathematics, either the principle of mathematical induction or the well-ordering property needs to be introduced as an *axiom*, that is, something accepted as true without proof. Once this is done, the other is immediately true due to their equivalence, and you can use them to your heart's desire.

This delicate and rigorous approach to logic is somewhat characteristic of studies in pure mathematics, and at various points throughout GTLA and further pure maths studies, you will probably come across proofs for things which you deemed intuitive or obvious.

Following this is some basic number theory and definitions of some types of groups. Number theory is the theory surrounding integers and investigates aspects such as divisibility or factorisation. Admittedly it is not a very prominent topic in GTLA; the areas discussed are the Euclidean algorithm (arising from the division algorithm), Bezout's identity, some properties regarding divisibility, some modular arithmetic, and the fundamental theorem of arithmetic. The results here are discussed in the context of the integers, but some generalise (to an extent) to other sets, such as the set of polynomials. In fact, you will encounter Bezout's identity applied to polynomials later on.

The $\mathbf{Z}/n\mathbf{Z}$ class of groups is carefully defined during the discussion of modular arithmetic (even though you have not been told what a group is). This class of groups reappears frequently in GTLA and is probably the type of group with which you will become most familiar.

Following the number theory topics, some types of groups are defined. Starting with the most general, these are:

1. rings,
2. commutative rings,
3. fields, and
4. algebraically closed fields.

All algebraically closed fields are fields, and all fields are commutative rings, and so on. The purpose of this short section is to define fields and algebraically closed fields, which is necessary to understand the next topic on the Jordan normal form, as they are mentioned in some definitions and results.

Properties specific to these types of groups are not really discussed in GTLA, but it is important to know what the definitions of these types of groups are. Admittedly it might be easier to revisit these definitions once you are taught the definition of a group (which is yet to take place at this point).

The Jordan normal form The first major topic, the Jordan normal form, essentially occupies the lectures in Weeks 3 to 6. The main result can be stated quite easily, but there is a myriad of intermediate results leading up to it. In fact, you do not even discuss all the intermediate results completely (an important one is left for MAST30005 *Algebra*).

The motivation behind studying the Jordan normal form is that many square matrices, when interpreted as linear transformations, are actually the "same" linear transformation but expressed with respect to a different basis. Equivalently, a linear transformation interpreted for different bases gives you many different matrix representations, but they are fundamentally really one and the same. Imagine, in $\mathbf{R}^3$

- a dilation by a factor of 2 from the x–y plane; and
- a dilation by a factor of 2 from the y–z plane.

These are really quite similar — they are the same linear transformation but for different bases.

The Jordan normal form of a matrix is the simplest square matrix among all those which can be said to be the same linear transformation as the original (the basis will generally be different). Notably, the Jordan normal form is unique up to permutation of the basis vectors, and its simplicity comes in the form of being almost diagonal.

This topic comes under linear algebra, and you will need to be familiar with first-year linear algebra content to understand this topic, as there is **very** little time for revision, and new ideas are introduced fairly quickly. Make sure you know what these are: subspaces, spans, bases, row reduction, the rank–nullity theorem, linear transformations, change of basis, eigenvalues, and eigenvectors. Alex includes thorough notes for these first-year topics, but they are hardly discussed in lectures.

The number of intermediate results for this topic is quite remarkable, and it will probably be overwhelming to be familiar with all of them. I would recommend being familiar with properties of *invariant subspaces* (subspaces which are invariant under a linear transformation), as they are most easily examined; there are quite a few tricks involved with the other intermediate results.

Overall this topic is a very involved and instructive exposure to the Jordan normal form; there are numerous defined stages, and the way it is delivered certainly feels like you are stepping through history (the stages are something like: square matrices → block diagonal matrices → upper triangular block diagonal matrices → almost diagonal matrices i.e. the Jordan normal form).

The topic concludes with lectures discussing applications of these results to special relativity and Markov chains.

Introduction to groups After 6 weeks of lectures, you are finally properly introduced to the foreign half of the namesake of this subject. Several definitions and properties are immediately thrown at you; as a completely new mathematical object, it is bound to be overwhelming at the offset.

My recommendation is to study these new definitions, properties, and concepts in the context of a single group. This is done in many examples in lectures, but if you find this to be insufficient in consolidating these concepts, then isolating a single group (maybe a dihedral group or $\mathbf{Z}/n\mathbf{Z}$) and studying all the discussed concepts (subgroups, orders, finding generators, finding homomorphisms to other groups, normal subgroups, applying the first isomorphism theorem, and so on) in the context of that group may help.

In becoming familiar with these concepts, I also found it invaluable linking group concepts with those in vector spaces. There are some very obvious parallels, and your greater familiarity with vector spaces may mean that drawing parallels allows you to grasp the group concepts more quickly.

There are several classes of groups appearing frequently throughout GTLA. You definitely need to know what these are by their symbolic representations, as they may not be defined in the questions that use them. These include

- $\mathbf{Z}/n\mathbf{Z}$ for natural n under addition (for $n > 1$ but especially prime n);
- the dihedral group D_n consisting of symmetries of a regular n-gon for $n > 2$;
- the symmetric group S_n consisting of permutations of n distinct elements;
- the general linear group $\mathrm{GL}_n(K)$ consisting of invertible $n \times n$ matrices with entries in a field K (with the operation being matrix multiplication); and
- the special linear group $\mathrm{SL}_n(K)$ consisting of $n \times n$ matrices with determinant 1 with entries in a field K (with the operation being matrix multiplication).

With algebra being the study of structures of sets, some concepts are introduced in this topic to study the structure of groups. The existence of a *homomorphism* between two groups means that their structures are similar (in the way that

elements interact with each other). The existence of an *isomorphism* between two groups means that their structures are identical.

The main result in this topic is the *first isomorphism theorem*, which gives a decomposition of a group's structure if there is a homomorphism with another group. For example, the non-zero complex numbers under multiplication is a group, and, using the first isomorphism theorem, one part of its structure can be identified as the structure of the positive real numbers under multiplication.

Another notion related to the decomposition of group structure is a *normal subgroup*. Together with the first isomorphism theorem (in which normal subgroups make an appearance anyway), they make up the majority of the methods used to study group structure in GTLA.

One of the other important sections in this topic is the theory on free groups. A *free group* is a type of group where elements have minimal properties (this is not a rigorous description). By imposing properties on certain elements, a free group assumes more structure. Free groups are introduced to discuss *group presentations*, which, given a particular group structure, are the ways of changing the structure of a free group to arrive at that particular group structure.

Group presentations are thus bare representations of group structure. They are not used heavily in GTLA, but it is good to know that there is a universal notation for talking about group structures. Sometimes Alex may use a group presentation to denote a group [structure] instead of using its common name, mostly for dihedral groups (the group presentations have the potential to be horrendous). There is also a small section on using group presentations to study homomorphisms between groups.

At the end of this topic is a short example relating group theory to RSA cryptography.

Inner product spaces After a decent exposure to group theory is a topic on inner product spaces, beginning at around Week 10.

Inner products are no stranger: you have encountered its definition in AM1.

An inner product space is simply a vector space endowed with an inner product. With an inner product, notions like distance, length, orthogonality, and angle come into existence. This topic is (probably) the most important in preparing for future studies in topology (MAST30026 *Metric and Hilbert Spaces*).

While inner products were largely studied in the context of real numbers in AM1, the treatment in GTLA is more general. This is important if you remember a part of the definition of an inner product as symmetry — this is not true outside the real numbers.

The Gram–Schmidt process makes a reappearance with the appropriate reassurance that it is indeed an algorithm for finite-dimensional inner product spaces.

The most important concept introduced is the *adjoint* of a linear transformation on an inner product space. Its inclusion seems somewhat arbitrary at first but is necessary in discussing the intermediate results leading up to the major result of this topic. Linear transformations can be classified as certain types if conditions involving itself and its adjoint are satisfied. The different ways of characterising these types of linear transformations is the focus of a few of the results in lectures and problems in the tutorials and exams — sometimes you will be asked to prove that two different characterisations are equivalent. This can be quite difficult because of the numerous characterisations (I certainly do not recommend memorising the proofs), but luckily in exam situations hints are given.

The *spectral theorem*, the main result of this topic, states the conditions under which matrices can be represented as a diagonal matrix with respect to an orthonormal basis. You may recall in AM1 that this was always possible for real

symmetric matrices; that was no coincidence, and the spectral theorem is the more general result.

Group actions This is a short topic which begins in the middle of Week 11.

A *group action* is a set of rules dictating how a group interacts with a general set. The set may even be a group itself, which makes for slightly richer results.

There is a bit of terminology to learn, particularly when discussing the *conjugation* group action (this is a type of group action on a group).

The main result here is the *orbit–stabiliser formula*, which relates the number of elements in the group involved in a group action to other characteristics of the group action. These characteristics of the group action happen to be relatively easy to determine (at least that is the case in GTLA), so the result is useful when the group is not completely known.

Sylow theorems This topic is even shorter than the topic on group actions is and only takes one or two lectures — in fact, it is included under the group actions section in the notes, even though the results themselves do not involve group actions. They are, however, a generalisation of Cauchy's theorem, the proof of which relies on group actions.

The Sylow (pronounced *sill-low*) theorems are results that assert the existence of subgroups of certain sizes in a group. More precisely, there are four results, and you will have to memorise these results, because their proofs are not discussed in GTLA (I gather they are probably far too difficult).

These theorems are the last major tool used to study the structure of groups in GTLA, and the relevant problems in the exam are usually also the harder ones.

The subject ends on a brief note of the massive mathematical work dedicated to classifying group structure. From 1955 to 2004, mathematicians collaborated to classify all *finite simple groups* — *finite* referring to the number of elements in the group and *simple* referring to the fact that the structure is monolithic and cannot be decomposed further. It was a work that required tens of thousands of pages and is just further proof that group theory, though founded on a novel three-part definition of a group, is certainly no simple matter.

Lectures

Alex produces a ridiculously comprehensive set of lectures notes, on which the lectures are based completely. These are incrementally provided on the subject's website at http://www.ms.unimelb.edu.au/~aghitza@unimelb/teaching/gtla/ (Alex really only used the LMS for some announcement emails). The set of notes is beautifully produced in LaTeX, with numbering and labelling of basically everything (such as Theorem 4.43, Lemma 3.22, or Example 4.9). The notes are even labelled with the dates on which content was discussed in lectures and some estimates of when future content will be covered.

That is not to say that lectures are unnecessary, but it is certainly a relief that basically everything discussed in lectures is written in mathematical prose.

The lectures themselves are of a high quality, and Alex consistently gives clear concise explanations for new concepts. Being an abstract subject, it was brilliant to see so many examples for everything. After introducing new concepts (or sometimes before the introduction, in order to clarify the motivation for studying them), Alex would discuss concrete examples and explain how parts of the definitions were satisfied, how the properties hold, how to apply an algorithm to this case, and so on. It was helpful to see all the theory in action in a lecture, and this made the subject far less intimidating.

Even putting aside the fantastic lecture quality, I would recommend going to lectures simply because Alex makes most of his announcements there. Unless you are stringent in regularly checking the subject website (or watching lecture recordings), it is possible you may be late in finding out important information. Sometimes tutorials also required content from the current week (more on that later), which means even lecture recordings are not timely enough.

Alex does not ask the students many questions during lectures, but keep in mind there is consistently quite a lot of material that needs to be covered, so opportunities for open brainstorming by students are few and far between.

On the note of the amount of content, I would say that in 2016 Semester 2 lectures were slightly behind, given that there was sometimes a bit of rushing at the end of lectures. All content was covered by the end, however.

Alex writes on the whiteboard during lectures, so it is ideal not to sit too far back. Technically both video (for the document camera) and audio are recorded, but the video is inherently not of much use. In 2016 Semester 2, Alex used the document camera for one of the lecturing venues because the students were seated too far from the whiteboard for it to be useful. I assume that this means the whiteboard will always be used unless it is physically infeasible during lectures.

Tutorials

Tutorials follow the traditional format for maths subjects. You are given a tutorial sheet at the start of the tutorial and form groups to solve the problems.

I would say that tutorial problems were generally hard, but this needs qualification: because of the new concepts and definitions that were consistently being introduced in lectures each week, unless you were consistently up to date with a good memory of all the definitions and results, you would not even be able to attempt the more basic problems on the tutorial sheets.

Realistically speaking, there were only ever one or two problems (out of seven or eight) that required innovative ideas or tricks; tutorial problems were by and large computational or simple applications of definitions or results. Sometimes a technique that was used in a proof in lectures would come in use, so it is important not only to know the content delivered in lectures, but also some of the methods and tricks employed in some of the delivered proofs, which Alex may not always explicitly point out. For example, if you are given that an inner product of certain elements in a vector space is always 0, then attempting to make both operands the same expression would mean that the operand has to equal 0 by the definition of an inner product. This is a technique used a few times in the inner product spaces topic.

Tutorial sheets are made available online on the subject's website, and at the end of the week solutions are also made available. The solutions contain fairly comprehensive working, so you should be able to understand solutions to all tutorial problems by the end of the semester.

I am not sure if this was intentional, but sometimes tutorial problems involved content which had only been delivered in lectures occurring in the same week as the tutorial. Older students will know that problem-based tutorials usually only have problems that need content covered up until the end of the previous week. I took this as a further sign that lectures were behind schedule, but even though my own tutorial was in the middle of the week, I never encountered problems in tutorials that needed content that was yet to be covered, so it is possible that the tutorials were deliberately scheduled to make this possible.

Assignments

There are three assignments throughout the semester, all uploaded on the subject's website (not the LMS). These are collectively worth 20% of your final grade; precise information about the breakdown was not provided.

Make sure you know when they are released, because assignment releases were not announced on the LMS; Alex points out in lectures when they are released, although this was sometimes one or two days after it was already available on the website (in case you are very keen).

Assignments are released before the required content has been fully covered, but it is still possible to complete some of it at the time of release. Students are given slightly more than two weeks to submit for each assignment.

Assignments are not very difficult and are fairly short; the difficulty is comparable to those on tutorial sheets, and most assignment problems are also direct computations or simple applications of results. In 2016, there was one question which introduced a new concept, but it was not mentioned again elsewhere.

Be careful to give full justification for everything; rigour is absolutely vital in pure maths.

End-of-semester exam

The exam is 3 hours long and is divided into Parts A and B. As with many maths subjects, it constitutes 80% of your final grade in GTLA. Historically, the exams that Alex has prepared have all been worth 100 marks each, with Parts A and B each worth 50 marks.

Part A is an act of mercy, honestly (given the difficulty of this subject): it consists purely of tutorial questions, many of which are reproduced verbatim, others of which may involve different numbers but otherwise can be dispensed with identically. This is announced by Alex to be the case, so this is not secret information or anything.

The message here is clearly that you should practise and be able to provide solutions to **every single** tutorial problem. This is not very far from knowing all the definitions and results fairly competently, but as mentioned earlier the more technique-based problems will require more attention. I am not recommending that you memorise solutions to all the tutorial problems; I am, however, advocating in favour of a good knowledge of all the definitions and results (no surprise here) and a reasonable familiarity with the techniques used in some of the harder tutorial problems.

Part A contributes a maximum of 40 to your final grade, so with a reasonable assignment performance, passing GTLA should not be an issue, even if you insist on rote-learning solutions to tutorial problems. Note that this is not a hurdle exam.

Part B is the more involved section of the paper, with a multi-part question dedicated to each of the topics outlined in the subject content above. Group actions and Sylow theorems are treated as one topic, so it is possible that one may not be tested in Part B.

The questions in this section are overall substantially harder than all tutorial problems (even the harder tutorial problems). The difficulty is mitigated in that marks are split between more parts, many of which are clues towards what may be useful in later parts. Sometimes hints are also explicitly included for harder questions.

There is nothing in Part B which requires the reproduction of a proof given in lectures, so there is no need to memorise those proofs. You may be required to prove a simpler version of results in lectures, however. For example, if a proof of the equivalence of statements A, B, and C was given in lectures by proving $A \Rightarrow B$, $B \Rightarrow C$, and $C \Rightarrow A$, you may be required to prove in Part B of the exam that A and C are equivalent, i.e. that $A \Rightarrow C$ and $C \Rightarrow A$, noting that $A \Rightarrow C$ is probably easier to prove than proving both $A \Rightarrow B$ and $B \Rightarrow C$.

Some of the question parts in Part B will require original arguments that you may not have encountered before. This is hit-and-miss from student to student, so do not fret about these parts. I found that the hardest question in Part B was usually a question regarding group actions or the Sylow theorems. In particular, classifying group structure with the Sylow theorems was not always very straightforward; Alex does some examples of these in lectures, but it is clear that there is no methodical approach that applies to all groups. (There is also the 50-year classification of finite simple groups in case you are not convinced.)

Occasionally you will be asked in Part B to write down a theorem statement. This is something you should do verbatim, as the wording of mathematical theorems is always very precise, so I recommend memorising all the statements of the major result from each of the topics mentioned earlier. In particular, do not forget smaller details like the requirement for a vector space to be finite-dimensional, a field to be algebraically closed, or whether the existence of something is unique. These are all vital details which taint the accuracy of your statement. Technically, of course, you are simply **wrong** if you omit anything, because this is maths. On the other hand, do not accidentally add more conditions to restrict the result, because what you state will then not be the required theorem, even though it may still be a true statement.

It helps if you are somewhat familiar with the proofs of these major theorems, because then you may be able to justify the conditions stated in the theorem even if you have not memorised the theorem statement verbatim. For example, the requirement for vector spaces to have finite dimension is because some of the theorems deal with matrices, which are by nature of finite dimension. The requirement for the field to be algebraically closed in the theorem about the Jordan normal form is because we require the minimal polynomial to be factored completely into linear factors, which is not always possible if the field is not algebraically closed.

You should expect to use the major theorem for each topic in Part B for the topics which are assessed, so try and apply the major theorem if you are ever stumped.

Concluding remarks

GTLA is a long stride away from most other undergraduate maths subjects (and an even further stride from actuarial subjects), but if you are comfortable with abstract theory, then it gives you an insight into a very beautiful area of mathematics. The hard work is there, but so is the satisfaction.

MAST30020 Probability for Inference

Exemption status	None.
Lecturer(s)	Professor Konstantin (Kostya) Borovkov
Weekly contact hours	3 × 1-hour lectures 1 × 1-hour problem-solving class
Assessments	10 individual assignments 20% 3-hour end-of-semester exam 80%
Textbook recommendation	Karr, A. F. (1993). *Probability*. New York, US: Springer-Verlag New York. The lecture slides and problem sheets contain references to this book. It is available as a digital copy for free as long as you are a student at the university, though it is not really needed; the lecture notes are self-sufficient.
Lecture capture	Full (both audio and video).
Year and semester reviewed	2016 Semester 1

Comments

MAST30020 Probability for Inference will open your eyes to how hard undergraduate studies in probability can be.

This is a demanding subject in every possible way. The theory is dense and the workload immense. Neither breadth nor depth are sacrificed in the delivery of this subject. Probability for Inference is a rigorous treatment of probability theory within the limitations of an undergraduate course, and it approaches the field from the perspective of measure theory, which is an area only taught at a graduate level at this university. There is reasonable discussion on an unexpectedly wide variety of aspects, even though a perfect understanding would require tools beyond those of an undergraduate.

Fortunately you have the perfect lecturer for this subject: Kostya (which he is called instead of Konstantin) is a lively and humorous lecturer who is able to balance the very rigorous topics with accessible explanations. He is always prepared to help the students who help themselves. That is, he will not mollycoddle you, but he is certainly very willing to guide and prompt you, and I find that approach to be optimal in this subject.

In many respects, Probability for Inference resembles MAST10009 *Accelerated Mathematics 2*. Both reconstruct an area of mathematics of which you have a rudimentary knowledge prior to taking the subject. AM2 guides you through the rigour that was sorely missing in your high school calculus studies, while Probability for Inference revisits the content in MAST20004 *Probability* far more meticulously. Indeed, just like AM2, you will probably struggle heavily for the earlier parts of the course, and it is these earlier topics that will support your understanding and star in some vital arguments for other problems and topics occurring later in the semester.

This subject is an elective for the *Statistics and Stochastic Processes* specialisation of the Mathematics and Statistics major in the *Bachelor of Science*. Naturally, most of the cohort for Probability for Inference are students intending to specialise in *Statistics and Stochastic Processes*. However, you will quickly find that many of the students are those from other specialisations who have returned for a second taste of probability after a pleasant experience in MAST20004 *Probability*

This review was previously published in the 2016 mid-year edition of the *Actuarial Students' Society Subject Review*.

or MAST20006 *Probability for Statistics*. There are also some *Master of Science* students taking this for their secondary area of mathematical study.

As fickle students you are probably aware that subject choices often come down to the quality of the lecturer (or, more precisely, a vicarious judgement thereof). The rather high enrolment in this third-year subject (59 students in 2016 Semester 1) despite its notoriety for being so difficult and its status as merely an elective is only a testament to just how fantastic of a lecturer Kostya is.

Subject content

Probability for Inference ties together many of the loose threads in *Probability* and *Statistics* while introducing some new tools and techniques. Overall I would label Probability for Inference as a subject in both probability theory and mathematical statistics (mathematical statistics referring to the mechanics behind various statistical tools and frameworks). The course (as well as Kostya himself) places heavy emphasis on rigour and proof, and the content is heavily abstract and conceptual but is delivered exceptionally well in an accessible manner by Kostya.

Probability for Inference begins with the same few definitions that you probably glossed over at the beginning of *Probability*. However, it introduces the concept of σ-*algebras*, which may have been tersely mentioned in *Probability* as the set of events which are "nice". One of the most fascinating aspects of σ-algebras to me is that it can be seen as the mathematical manifestation of information or, more strictly, information "potential" from observations of random quantities. This particular way of viewing information as a σ-algebra is precisely the motivation behind the use of martingales in higher level financial mathematics (ACTL40004 *Advanced Financial Mathematics I* and beyond, although to some extent ACTL30005 *Models for Insurance and Finance* also).

A few properties of probabilities (i.e. the function that assigns fractional values to events, often with the familiar notation $\mathbf{P}$) are discussed. The probability axioms are, of course, part of this. Most of the other properties relate to sequences of events, which is something you will not have seen in *Probability*. Following this are the familiar faces of distribution functions, probability mass functions, and density functions, but they are of course introduced in the context of our newer framework.

Random variables and expectations are the next point of discussion. Again these are rebuilt from a more rigorous perspective than in *Probability*, and again some unfamiliar properties of and results regarding expectation are discussed (yes, there is more to expectation than just linearity). The concept of conditional expectation is the next topic; it is probably the first hurdle in this subject if you have found the content manageable so far, as conditional expectation is no longer the tame computational beast that it may have been in *Probability*. In my opinion, conceptualising expectations and conditional expectations as the "best guess" of some random quantity (possibly given some information beforehand for conditional expectations) is the way to navigate through this topic and further uses of expectation. In fact, thinking about conditional expectations in this way corresponds very naturally to the Bayesian estimator under the quadratic loss function, which you may recall from MAST20005 *Statistics*.

With so much content falling under the field of probability theory, you may doubt the relevance of "Inference" in this subject's name. Fear not, for the weeks you have spent learning mind-numbing probability theory is about to find some use in statistics right within this subject! The discussion on statistics in this subject takes place in two parts, with the interlude dedicated to two areas of probability theory, one of which is the unequivocal cornerstone of (frequentist) statistics, and the other of which is indispensable in the study of further probability theory.

The first part of discussion on statistics covers and extends some of the theoretical topics encountered in MAST20005 *Statistics*: maximum likelihood estimation and sufficiency. The prominent theorems in this section are none other than the

Neyman–Fisher factorisation theorem and the Rao–Blackwell theorem. This section is entirely taught from first principles, as *Statistics* is not actually a prerequisite for Probability for Inference. I enjoyed the treatment of these two topics far better than I did in *Statistics*, although that likely comes down to a personal appreciation for more theoretical discussion.

The two sections of probability theory that follow this opening discussion on statistics are limit theorems and characteristic functions. From *Probability* you should already be familiar with the law of large numbers and the central limit theorem; these are the main limit theorems, and in this section the mechanics behind these two theorems and other related phenomena will be examined. There is a slight resemblance to limits as taught in AM2, in that you should be prepared to maintain an ϵ–N-level of rigour in your solutions.

The section on characteristic functions was, to me, the most eye-opening of this subject. Characteristic functions may have been mentioned in passing in *Probability*, around the time that moment-generating functions and probability-generating functions were introduced. Characteristic functions retain many properties of moment-generating functions (uniqueness, can be used to circumvent convolution integrals, can be used to compute moments through differentiation), but are (subjectively) **better**. One of the ways in which it is superior is that the characteristic function of a random variable is always well-defined; the same cannot be said for moment-generating functions. The characteristic function of a random variable is the Fourier transform of its density (with respect to an appropriate measure), and indeed a perfect inspection of some of its properties will mandate some results from complex analysis; however, the lectures will be manageable without having studied complex analysis. As a consequence, the density function and the characteristic function of a random variable (or rather, its distribution) are intimately connected. I gather that many of the properties discussed in this subject likely follow from corresponding results in Fourier analysis; in any case, the expectations of the cohort for characteristic functions will not require experience with complex analysis.

Characteristic functions are mainly used to revisit and establish some of the limit theorems. This is done with the assistance of Taylor polynomials. In Probability for Inference, you must be[come] very comfortable with single-variable Taylor polynomials (and be willing to accept that Taylor's theorem holds in the complex case if you have not studied complex analysis). In particular, whereas in AM2 you may have used Taylor's theorem with Lagrange's form of the remainder, in Probability for Inference, the use of Taylor's theorem is accompanied by Peano's form of the remainder, which simply uses Landau's Little-O notation to express the remainder term in Taylor expansion. For the purposes of this subject, Peano's form is probably more concise and suitable than Lagrange's form is.

The return to statistics is signified by an excursion into the validity of the chi-squared goodness-of-fit test. In *Statistics*, it is not immediately clear how the claimed null distribution of the test statistic is a valid approximation. With the results on limit theorems and characteristic functions, you are now able to conclusively establish the rationale behind the null distribution used in this goodness-of-fit test.

The subject concludes with the discussion of empirical distribution functions and asymptotic behaviour of maximum likelihood estimators. The discussion on empirical distribution functions culminates in the fantastic Kolmogorov–Smirnov goodness-of-fit test, and like the chi-squared goodness-of-fit test, the null distribution is derived rigorously (with the quotation of some intermediate results which would probably take too much time to discuss). The discussion on maximum likelihood estimators shows how they are asymptotically normal and unbiased and establishes the relevance of Fisher information (remember the Rao–Cramér lower bound from *Statistics*?) in the mean-squared error (variance).

I would say that there is non-trivial overlap between Probability for Inference and ACTL30005 *Models for Insurance and Finance*, even though the ultimate aims of the two subjects are rather different, with MIF intending to be a foray into the probability theory required to handle the *Advanced Financial Mathematics* subjects in the Actuarial Studies Honours program. Both are constructed to be students' first exposure to probability theory from the perspective of measure theory (i.e. rigorous probability theory). For example, in both subjects, students will be introduced to σ-algebras and (a rigorous take on) conditional expectations, and while I have not completed MIF at the time of writing, neither of these can be

introduced successfully without the dedication of a few lectures.

Lectures

From the very beginning of the subject (actually, even before), the lecture slides for the entire subject are available online. They can be found on the LMS or on a page where Kostya makes available to the public the main resources in the subject (the link is http://www.ms.unimelb.edu.au/~s620323/). The set of slides is an excellent resource, and of course Kostya's lectures follow the slides perfectly (but he will add a bit more). There are usually some references to problems on problem sheets, so Kostya will update the slides every now and then if the problem sheets have changed since the last iteration of the subject.

Kostya delivers his lectures with the document camera switched on, and in the Russell Love Theatre (where most third-year maths subjects are held), the document camera occupies one of the projector screens, while the current slide occupies the other. In my semester of completion, the lecture recording consisted only of the activity on the document camera, so you would not be able to see what slide Kostya was currently discussing in the lecture recording.

The lectures are interactive, entertaining, and of course very educational. Kostya delivers lectures in his characteristic exuberant manner without sacrificing the care needed in rigorous arguments. As I have mentioned, I found that Kostya has the uncanny ability of translating the "burly" and intangible rigour of probability theory into very accessible intuitive arguments. Of course, what is intuition to one can easily be an absolute mystery to another; some of these pieces of intuition are not completely obvious, so to say, but with experience from lower level maths subjects (and particularly the variety of mathematical problems therein), what Kostya delivers as intuition should be mostly regarded as such by the cohort. For example, geometric properties of projections and convex sets are mentioned throughout the discussion of conditional expectations. This is perhaps not the best example of intuition (being a consequence of considering the set of random variables with 0 mean as a Hilbert space), but it highlights Kostya's resourcefulness in using analogies from other areas of mathematics to which most students will have had exposure. Another example is Kostya's explanation of Lebesgue integrals, which he summarises as partitioning the integrand by range rather than by domain as in the Riemann integral (with a strange example of counting money spread on the floor).

Kostya is always ready to ask the audience questions: some just to see if knowledge in the recent few lectures has been retained; others a prologue into the topic of discussion for the day; and occasionally a "Can I put this on the exam?" to make us ask ourselves whether we really know the content. Kostya's questions almost created an atmosphere of discussion, which I feel in the university study of mathematics is very necessary. Of course, the "discussion" was usually dominated by Kostya, but his questions were rarely unanswered, and the interaction between student(s) and teacher in the lecture hall created a sense of engagement which I have rarely found in a university subject.

The actual structure of a lecture naturally varies according to what's on the lecture slides. A lecture could contain

- an explanation of a difficult proof;
- outlines of proofs when they are beyond an undergraduate student;
- explanations of multiple smaller proofs (particularly when exploring properties); or
- intuition for or demonstrations of the more abstract concepts.

None of these are particularly surprising in a maths subject, but it is of course the higher proportion of proofs in this subject which gives Probability for Inference its overall theoretical orientation. Now, Kostya's (unspoken) expectation is that any proof which is given completely in lectures (i.e. not those which are clearly stated as beyond the undergraduate student) is fair game in an exam, and it is rather daunting that this refers to probably half of the slides. Kostya's aim is certainly not to encourage rote-learning. In fact, Kostya encourages the cohort to form the good habit of retaining the key ideas of a

mathematical proof, which, when combined with the mathematical tools at hand, are sufficient in reproducing the proof. I would strongly recommend highlighting and remembering the key ideas or techniques in all the proofs in the lecture slides. It develops your mathematical maturity and is also quite fulfilling when you realise that you are able to reproduce proofs without further assistance by just noting these key ideas. Of course, it is even more fulfilling to find these key ideas yourself; unfortunately that is rather difficult and thankfully not an expectation.

For a few weeks during the semester, Kostya also conducted in-class quizzes (not contributing to the final grade). This was done on the Socrative web platform, and students took part using their mobile phones. The questions were all true–false or multiple-choice questions and generally tested knowledge in the last few lectures or so. This was opt-in, but there was nothing to lose since the performance did not contribute to the final grade, so it was a good revision tool to check your understanding of the recent lectures. Not all the questions were as straightforward as you would expect of multiple questions, especially since there was an unofficial time constraint of however much time Kostya decided was necessary. Most questions seemed to set up some random variables and ask if certain statements regarding the random variables were true, which ranges from simple to quite puzzling given the scope of Probability for Inference.

In the final week, if there is time Kostya will spend some lectures doing a past exam. In my semester of completion the discussed exam was not a past exam to which solutions were available online (that would have been slightly redundant), so it is ideal to be present for these lectures.

Problem-solving classes

When you look at the university timetable entries for Probability for Inference, one of the most striking things is that there is only one time slot for the practical class. Unlike practical classes in other maths subjects, in Probability for Inference, these resemble lectures more than they do tutorials. In fact, they take place in the same place as the lectures (at least this was the case in my semester of completion).

Kostya calls these classes "problem-solving classes", and the entire class will consist of Kostya solving problems on the weekly problem sheet, which Kostya will print and bring to the classes as well as post online. These problems are not straightforward; even though Kostya readily encourages students to present solutions in problem-solving classes, there is hardly ever any student brave enough to do so. Even so, Kostya maintains interaction with the cohort as he does in lectures. Some of the problems in these classes are simple applications of the theory learnt in the lectures in the week before. However, by and large these problems require new techniques or arguments not seen in lectures. Kostya will also sometimes offer extra insight into the theory during these problem-solving classes, although this is the natural thing to do when completing problems which require new methods.

I think the benefit of attending problem-solving classes is clear. Any passionate student should want to see how the content in lectures can be used or extended in various problems. I think it is fair for problems resembling those on problem sheets to appear on exams, so you assume some risk by missing these classes (they are not recorded like the lectures). Kostya will also tell you that it should not be surprising if the exam contains similar questions; I do not recall that happening in my end-of-semester exam, however, so perhaps he was feeling generous in my semester of completion.

Problems listed on problem sheets are quite often referenced in lecture slides, and this creates a strong sense of coherence between the material in problem-solving classes and lectures. Often the situation will be that the significance of a certain problem on a problem sheet is highlighted in a later lecture (usually in the form of some small phenomenon). This reserves time in lectures for the more important aspects, but ensures students have a robust knowledge of everything that is happening.

It is regrettable that there is often not enough time for Kostya to go through all the problems on the problem sheet. Kostya often resorts to skipping computational steps or claiming some steps are obvious in order to save time; he will more readily

claim that something is obvious in these problem-solving classes than in lectures. Solutions are posted online after the class, but I still personally believe greater value is gained from hearing Kostya's explanations for some of the more difficult problems rather than reading solutions on paper. Nevertheless, for the problems not covered in the problem-solving class, it is your responsibility to be familiar with the solutions posted online.

Assignments

This is quite possibly the single aspect of Probability for Inference that will leave students with somewhat bitter memories.

You have ten assignments for this subject in total. In 2016 Semester 1, each was due at 5pm on Mondays from Weeks 3 to 12. These are all standard-length maths assignments — the length of these assignments does not compensate in any way for how many there are (the length of those in MAST20004 *Probability* are a good indication). This is simply an enormous time commitment for a single subject, and while I think the assignment workload is somewhat warranted due to the difficult theoretical nature of the subject, for me, ten assignments still falls on the extreme side.

The assignments problems are on the same sheet as the problem sheet (usually on the next page), and they are of a similar difficulty. The trouble is that to do well on the assignments requires (in my opinion) an excruciating amount of effort, not to mention how many of them there are to begin with. Kostya expects the rigour and detail which he himself displays in lectures, and for a first exposure to rigorous probability theory, sometimes it can be difficult to identify the areas that necessitate more rigour. The level of detail Kostya presents in problem-solving classes is a bad indication of what is expected of you; as I have said, Kostya is under time constraints during those problem-solving classes. However, a good indication, outside of the lecture slides, is probably the solutions to the problem sheets which Kostya posts online. One example of the level of detail required is that Kostya expects "by linearity" to be written somewhere when you use the linearity property of expectation or conditional expectation.

The scoring system for assignments is as follows: For each assignment, Kostya (or someone to whom he has delegated the marking) will select a question to mark for the entire cohort. This gives a mark for each assignment (or really, just the respective question selected for the assignment) that is usually out of 5 marks (but sometimes more). The average percentage over all ten assignments (equal weighting among all ten) then receives a 20% weighting in the calculation of the final grade, with the percentage on the exam receiving the remaining 80% weighting.

This also means that a mark on one assignment may have more effect on your final grade than that on another assignment (very marginally), but you will not know which assignments these are, as you are not told beforehand the maximum mark of any assignment. For example, if there were 3 assignments marked out of 2, 10, and 50 (just an example — the maximum marks are more consistent in reality), and your scores were 1, 10, and 50 respectively, then the percentages earned on your assignments would be 50%, 100%, and 100% respectively, and your average percentage would be 83% (rounded down). Notice that if the single mark you had lost was on the third assignment rather than the first, your average percentage would have been 99% instead (rounded down).

Kostya published assignments marks twice throughout the semester: once after the fifth assignment, and once after all ten assignments. Students were listed by student number (no names). For brevity, here were the summary statistics after all ten assignments in my semester of completion, the data in consideration being the the average percentages multiplied by 20. (The minimum of 0 is not a mistake.)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0.00	10.29	12.65	12.33	16.23	19.20

As mentioned, the questions on assignments are of similar difficulty to those on the problem sheets, though probably

slightly easier. The questions are usually either computations or applications of the theory to prove some properties. Not all assignment questions are straightforward; some will require some thinking as to the optimal method of approach, although for the computational questions this is usually not the case. For some questions Kostya will provide hints; sometimes I found these somewhat unnecessary or a slight giveaway, but other times they offered the right amount of guidance.

As it was for problems on the problem sheet, the lectures slides will sometimes reference problems on the assignments. The reverse also happens; sometimes an assignment question will be the investigation of a property that was merely quoted but not established fully in lectures. All in all, the assignments and problem sheets are very coherent aspects of the subject which aim to give a more holistic understanding of probability theory.

End-of-semester exam

This is a 3-hour exam that is probably on the long side due to the nature of the content in Probability for Inference. No cheat sheet is allowed. A scientific calculator is allowed but will not be of much use.

I think that the level of difficulty of the exam is very consistent with the subject as a whole. This contrasts quite starkly with some of the actuarial subjects, where the difficulty of the subject before the exam and difficulty of the exam itself can potentially be night and day. That is to say, there are hardly any surprises on the exam for Probability for Inference, but it is still far from being easy.

The exam is more computational than the assignments, but theoretical questions still have decent representation.

Kostya expects a high degree of familiarity with the lecture slides (and possibly more, but you will perform decently with just being familiar with the lecture slides, although that is no small task anyway). As mentioned earlier, the proofs on these lecture slides will almost surely (but not certainly!) make an appearance on the exam. I mean this literally; there will be subquestions which effectively amount to reproducing some portion of the slides. You would, however, be a fool to rote-learn the proofs on the slides. That is not recommended, optimal, nor, in my opinion, acceptable for a student of third-year mathematics. In 2016 Semester 1, there were also some subquestions which had featured almost identically on assignments.

I believe the way to approach exam preparation for such a theoretical subject is no different to the preparation for the general theoretical mathematical subject. Familiarity with all the results of key theorems and properties is absolutely essential, but the next step varies in difficulty from student to student. Perfect preparation for the exam will involve, more specifically, familiarity with the techniques used to establish the key theorems and properties, and also some of the content outside the lecture slides. It is not possible to form an exhaustive list of areas with which you should be familiar, as this is nevertheless a third-year mathematics subject, and creativity and critical thinking, as well a good memory, will underpin any level of success in the subject. For example, something as simple as the square of any real number being nonnegative is a well-known fact to most students, but would you be able to recognise its utility for a question asking you to provide a proof (of something else)? Would you be able to recognise that an expression was in the form of the Taylor series for the exponential function if it wasn't explicitly provided in that form? These are the kinds of questions that you need to ask yourself if you are aiming for the highest levels of achievement in this subject and further mathematical studies (particularly if they are heavy on theory).

In terms of topic coverage in the exam, elements of all topics will be present, although this is only to be expected if you have personally experienced the twelve weeks of teaching by Kostya in Probability for Inference. Due to this, the structure of exams seems to remain somewhat invariant, in that there will be generally be

- one or two questions on the probability ($\mathbf{P}$) definition, axioms, and properties;
- one or two questions on the σ-algebra definition and properties;

- a question requiring the plot of a distribution or density function as well as the computation of other quantities relevant to the distribution;
- questions involving computations with or properties of expectations and conditional expectations;
- questions involving sufficient statistics and maximum likelihood estimation; and
- questions involving the convergence modes and characteristic functions.

Again, this is not an exhaustive list. There are most likely other more specific topics which make appearances on the exam less frequently, such as empirical distribution functions or multivariate (normal) distributions. However, the above list should contain the topics common in all exams for Probability for Inference. There will generally be proof-style questions for most of the topics present on the exam, but I believe more of the exam is computations rather than proofs.

Also of note is a true–false question (with multiple subquestions). These are not pure true–false questions, however; you still need to provide justification for your answer. These questions resemble those in the in-class quizzes, and the justifications will be mostly very short. Why is there a true–false question on the exam? Kostya admits that they are easy to mark — very honest answer.

Kostya is hesitant to make available the solutions to too many past exams, as he prefers students to learn content rather than "learn exams" (i.e. prepare specifically for the sorts of questions on previous exams). In my semester of completion there were just two past exams with solutions provided. More past exams were available on the library website, but Kostya refused to provide solutions to those.

Concluding remarks

MAST30020 Probability for Inference is a well-administered and rewarding subject, but certainly not for the light-hearted. It is an excellent foundation to have for further studies in probability theory and (mathematical) statistics. As an Actuarial student, if you are prepared to dedicate effort into a subject which may only be breadth study and you are interested in the intricate mechanics of probability theory, then I highly recommend this subject.

An interesting fact: Kostya's father was a student of the great Kolmogorov himself! I was also told that Kostya's father was in fact Kolmogorov's best student, although I was unable to verify that myself. In fact, Kostya publishes research with his father, who is by now somewhere in his eighties.

MGMT30006 Managing Innovation and Entrepreneurship

Exemption status	None.
Lecturer(s)	Ms Jingjing Wang
Weekly contact hours	1 × 2-hour lectures 1 × 1-hour tutorials
Assessments	Tutorial participation 8% Weekly note submission 2% Individual analytical essay, due in Week 4 15% Group case study analysis, due in Week 9 15% 2-hour end-of-semester exam 60%
Textbook recommendation	Fredrick, H., O'Connor, A and Kuratko, D.F. (2013). *Entrepreneurship Theory/Process/Practice* (3rd ed.), Cengage learning Australia Pty Ltd
Lecture capture	Full (both audio and video). However, only the slides are recorded. As most of the lecture is improvised with active student participation, it is difficult to hear what discussions are going on.
Year and semester reviewed	2016 Semester 2

Comments

Taking MGMT30006 Managing Innovation and Entrepreneurship will be the most unique experience for any actuarial student, as the teaching and examination methods are fairly subjective compared to the rigid structure of traditional actuarial subjects.

Personally, the experience for me was extremely enjoyable — I learnt a lot about the start-up scene in Melbourne, alongside the entire pathway that start-ups generally run. Whether I am able to apply it to the real world remains another question, but I enjoy reading case studies about successful/struggling start-ups and entrepreneurs, and there is no shortage of those in this subject.

Please note that performance in MGMT20001 *Organisational Behaviour* is not a good reflection of performance in this subject, as this focuses completely on the concept of start-ups and entrepreneurships. Ideally, this subject is great for any actuarial students seeking non-traditional pathways in their career, as the relevance to the rest of the actuarial major is almost zero.

The pre-requisites for MGMT30006 are MGMT10002 *Principles of Management* and at least 12.5 points of level-2 subjects taught by the Department of Management. While under usual circumstances, MGMT10002 will not be a breadth actuarial students will take, if one performs well enough in *Organisational Behaviour*, it is possible to waive the MGMT10002 requirement.

There is plenty of support from the lecturer Ms Jingjing if you ask for it, and like any other management subject, it is a good idea to get a feel for what the lecturer is looking for in your assessments.

The Management Learning Experience

If you have not completed *Organisational Behaviour*, please read the following paragraph. For all others who have gone through the tribulations of OB, feel free to skip the following paragraph.

Management subjects at the University of Melbourne are taught in an entirely different manner, encouraging active tutorial participation, sharing of ideas and concepts, but most importantly, utilising your own thoughts and opinions to add value to your assessments. Therefore, it is extremely important to be able to convey one's ideas in a descriptive and understandable manner in written form. Poor writing habits, including an inability to convey meaningful ideas in sentences will definitely lead to an unexpectedly poor subject result. Personally, I believe it is difficult for one to truly change their writing habits in the short span of a single semester, so if you really are keen to take *Organisational Behaviour* or Managing Innovation and Entrepreneurship, please ensure that your writing is up to the high standards of university lecturers before you enter either subject. This is just a forward warning to make sure you get the most out of your management subjects.

Lectures

As mentioned above, lectures run for two hours each week, and as this is a third-year subject, there is likely only one lecturer and only one allotted lecture time. This means that if you are stuck with a Wednesday 9:00am lecture time, there's no getting out of it.

Unlike actuarial subjects, lectures in Managing Innovation and Entrepreneurship are focused on student contribution. I could tell you about what we covered in each lecture, but really, the way lectures were run was based on how students wanted to learn. For example, lectures would generally have a lot of videos about start-ups, and after watching each video, there would be ample time for students to discuss what was mentioned. As for the actual examinable content, it was interwoven between the videos and discussion, as Ms Jingjing subtly guided us towards deeper understanding.

In this regard, lectures were more like consulting panels where students would discuss their personal views on situations and back it up with logical assumptions and reasoning. Being a third-year subject, the quality of discussion was generally high, as many of the other students were entrepreneurs themselves with up-and-coming start-ups. Yes, this is a great way to actually get involved in a start-up!

Two of the lectures were strictly run by entrepreneurs from the University of Melbourne, here to both pitch and inform us of their successful ideas. It was an amazing opportunity to be able to speak with accomplished entrepreneurs, and to understand the grit, determination and long hours they had put in to reach where they were. This was definitely a highlight of the subject, as rarely are we given a chance to directly interact with specific industries.

Tutorials

Tutorial participation only accounted for 8% of the total subject mark, however the weekly note submission worth 2% was technically impossible to perform unless one went to the tutorial.

The note submission was basically a piece of paper one submitted each week which documented a new start-up or news article students had found in the previous week. It did not have to be long, but rather a simple breakdown of what was so interesting about the start-up or article, and how it was relevant to the subject or topic at hand. Indeed, by writing three sentences a week, one can fulfil their note submission and respectably earn 2% of their total mark.

Tutorials were where most of the learning truly took place for this subject, yet I would say that 90% of the tutorial was just discussion and talking. If you are someone who does not like to share ideas, this is probably not the subject for you, as you will be doing it every single week. There were about three or four tutorial questions that students would discuss in small groups, and basically share their answers at the end of the tutorial. Don't let the simplicity of tutorials trick you, these tutorial questions are also the ones that may appear on the final exam, so it's important to write down ideas and be able to spend 30 minutes writing about each one in preparation for the exam.

Assessment

Individual Analytical Essay

This is basically a stock-standard management essay, where you are required to write an individual essay on a given topic, using citations and references. Ensure that your referencing and Google Scholar skills are top-notch, or you will struggle to do well in this assessment.

As it is 1,500 words, it is quite short, so ensure that you only write about the most important points underlined by the topic.

The topic itself is usually about a topic you have learnt in the previous weeks, and you will need to support your answer using live examples of start-ups or entrepreneurs, rather than simple journal articles. Learn how to cite these non-academic articles, as you will be delving through them in search of relevant start-ups.

Group Case Study Analysis

While this was a group case study, 10% was based on individual essay submissions and 5% was on a slideshow presentation with members of the Department of Management and other entrepreneurs judging your pitch.

Basically, in our own teams, we either came up with our own idea for a start-up, or copied one off Shark Tank/Dragons Den (both really good television shows), and wrote about the proposed business structure, marketing plan and financials individually after discussing as a group. Finally, the pitch is a simple four slide Powerpoint presentation which involves outlining the start-up's product/service and other business details. Just imagine being on Shark Tank or Dragons Den, and you'll know how it feels.

Overall, if you're passionate about start-ups, it is extremely easy to do well in this one, especially if the pitch idea is one you genuinely believe in.

Written Exam

The end of semester assessment is a two-hour written exam, which is completely different from the assessment in *Organisational Behaviour*. For instance, you already know that some of the tutorial questions will be worth 50% of the exam, and the other 50% will be similar to the case study analysis, where we analysed a start-up business.

Again, I would like to remind you that performance in *Organisational Behaviour* is NOT a good indication of how well your exam result will be in Managing Innovation and Entrepreneurship.

Summary

As a commerce elective, this subject strays the furthest from your traditional actuarial units than any other subjects. Not only is there no maths, but the subject is mostly just talking and brainstorming ideas.

As an elective, I would only recommend this subject to those who have no idea what they are doing in actuarial studies and are honestly looking for a different experience which contrasts so significantly with actuarial studies that most employers are probably going to ask you why you chose this subject when handing in your academic transcript.

In all seriousness, this is a great way to learn about start-ups from an outsider perspective, so if you're interested in the small start-up space in Australia, this is also a great way to get your foot in the door for future career choices. Good luck, and I hope you embrace your non-traditional actuarial side by taking this subject!

MGMT30017 Global Managment Consulting — Seoul

Exemption status	None.	
Supervisor(s)	Dr Daejeong Choi	
Weekly contact hours	All week for 2 weeks	
Assessments	1-hour presentation to client company (Including 20 minutes Q & A)	30%
	Written report to client company	40%
	Individual reflective essay	20%
	Peer Assessment	10%
Textbook recommendation	No textbooks are required or prescribed	
Lecture capture	N/A	
Year and semester reviewed	2016 Winter Term	

Comments

MGMT30017 Global Management Consulting is a very different subject to normal university subjects. There are no lectures, no tutorials, no exams, and the subject is completed in two weeks at an international destination (Sounds great already!). For the July intake of the subject, destinations were: Berlin, Seoul, Shanghai, and Singapore. This subject is also a capstone subject with an application process (see **Application Process** section).

The subject gives students the opportunity to complete a management consulting style project for a client in an overseas country. Students are accompanied by an academic staff member to the country, and are required to work under fairly tight deadlines whereby the project must be completed, and a presentation delivered to the client, all within two weeks.

Many students walk into the subject thinking it will be a good chance for a holiday, and are often proved wrong. Those seeking a holiday can enjoy it after the subject is completed by staying back. You get some time to explore the city during the actual subject, but it ultimately depends on how efficiently the group works. Working through the weekend (especially the second weekend) is quite a common phenomenon (think 'SWOTVAC cramming for exam' style work patterns).

The Project and Learning Experience

Since there are no lectures, and no tutorials, most of the learning comes from working on the job whilst you are overseas. Twenty students visit each of the four cities, and for Seoul, the clients were: ANZ, Tourism Australia, IBM, Covestro (a pharmaceutical company), and Eukor (a shipping company).

For actuarial students, the projects are not often directly related to our studies, but this provides us with the opportunity to think about how we can apply our thinking and numeric ability to other areas. Every now and then, the client may be an insurance company. However, the projects are not designed to target one particular commerce discipline.

The subject gives actuarial students the opportunity to experience working in teams, with other students from different commerce disciplines. Students are also (inevitably) presented with the challenge of overcoming language barriers. The

clients are often able to speak English, but to various degrees of proficiency. The resources they give you may also be in a foreign language!

Lectures

There are no formal lectures for this subject. However, there is a **two day pre departure seminar** that all students **MUST** attend. The two day pre departure seminar usually takes place the weekend before students are recommended to fly out. During the two day seminar, various sessions are held regarding what to expect for the projects, how to identify resources, meeting your team, project briefing, and tips for successfully breaking down management consulting style projects. You also meet your academic staff during the two day seminar, and they provide information about how to safely get yourself from the airport to the hotel (This might sound trivial, but no one will be waiting at the airport ready to escort you to the hotel — the subject also gives students the opportunity to develop themselves in a personal sense!).

Assessments

Final Presentation to the Client

This presentation is made to the client on the second last day of the two week program. A few days before the final presentation, you have a practice run through with your academic in the hotel, and they provide you feedback. The presentation is 40 minutes long, and there is an additional 20 minutes for Q&A.

Written Report to the Client

This written report is due approximately a month after the final presentation. This meant most teams completed it within the first two weeks of semester 2 so they could enjoy the rest of their semester break.

Individual Written Reflection & Peer review

These are due a week after the written report deadline.

Overall speaking, the way the subject is graded seems slightly subjective with justification of scores given not as transparent as what actuarial students may be used to. However, the coordinators are evidently trying their best with the newly introduced marking criteria. Students should not walk into this subject assuming a guaranteed H1 — this may have been the case in previous years, but not under the new marking system.

Application Process

This subject is a capstone subject, so entry can be competitive. The application process consists of two main steps: an online application (including resume and cover letter) and a group interview. Shortlisting for a group interview is based purely on WAM.

(From the writer's experience) in the group interview, you are given a question to brainstorm as a group, and report back on after twenty minutes of discussion. Each person is then asked a single (somewhat) behavioural style question. Good luck!

MUSI10209/MUSI20168/MUSI30233 Glee Singing [SM1]

Exemption status None.

Lecturer(s) Trevor Jones

Weekly contact hours 1 × 1-hour lecture
1 × 1.5-hour tutorial/rehearsal

Assessments

	MUSI10209	MUSI20168	MUSI30233
11x weekly online quizzes	30%	30%	30%
Learning log	25%	25%	—
Song cultural analysis	—	15%	—
Research task	—	—	40%
Attendance	45%	30%	30%

Textbook recommendation No textbook. Sheet music for songs studied should be purchased

Lecture capture Full (both audio and video)

Year and semester reviewed 2016 Semester 1

Comments

Glee Singing gives students the opportunity to sing and perform a variety of pop songs in a group environment. Lectures introduce various basics of music and singing, including simple music theory, song structure, vocal styles and the social influence of music. Tutorials/rehearsals primarily involved singing and studying pop songs. The subject concludes with a final performance of the songs learned throughout the semester. It is in public, outside the Arts Centre. No prior experience or ability in music or singing is expected and is of little advantage. I found the subject to be very enjoyable and allowed me to experience and learn new things.

Please note that the subject has a total limit of 400 students among the 3 levels and it is first-in best-dressed. The only difference between the 3 levels is the assessment. Lectures and rehearsals are all taught together. Especially for those doing the actuarial program, it is best to do the level 2 subject. This is because it is better to take a different level 1 subject and it is also unnecessary to do MUSI30233 as the assessment is more challenging. Of course, your individual circumstances may vary.

Additionally, the subject is taught at the Southbank campus which is a short 10 minute tram ride down Swanston St.

Subject Content

The lectures cover the following topics:

1. What is Glee Club and Why do we Sing?

   Introduces the origins of a 'Glee Club' and the benefits of singing.

2. How the Voice Works

   Focuses on the anatomy of the throat and how we are able to sing.

3. Amanda Palmer

   Introduces how music is made, the use of traditional record labels and also more modern means such as using the internet and crowd-funding.

4. Vocal Health

   Teaches how to keep the voice healthy and be able to identify vocal health issues

5. Song Structure

   Introduces concepts such as choruses, verses and the form and structure of music

6. Songs in a broader cultural context (2 weeks)

   In the first week, presents arguments for the statement that songs are becoming more similar. In the second week, presents the social impact of music.

7. Warming Up and Tech Tools

   Teaches how to warm up your voice and how technology can help you do so.

8. Who writes Songs?

   Many songs are not written by those who sing them. This lecture introduces some artists and some songs you may have not known they wrote.

9. Vocal Styles and Genres

   The voice can produce many different styles, think Justin Bieber compared to Luciano Pavarotti. This lectures introduces the different ways people can sing.

10. Performance Elements

    In preparation for the final performance, this lecture introduces performance skills and ways to conquer nerves.

Lectures

Trevor is always energetic and passionate. Lectures are relaxed and he encourages participation when possible. Attending in person is not necessary as full recordings are available. It is important to go through the content studied as questions in the weekly quizzes are drawn directly from the lecture content.

Tutorials

Tutorials were the most enjoyable part of the subject. Most tutorials began with warm ups. This involved some basic sight reading and also some vocal exercises. The tutors are always very enthusiastic and energetic. After the warm up, the songs that would be performed at the final performance would be learned/sung. It is important to participate in tutorials. There were never solos so don't be afraid to sing.

The songs that were studied in my semester were:

- Royals by Lorde
- Sing by Amanda Palmer
- Mad World by Gary Jules
- If You're Out There by John Legend
- Roar by Katy Perry

Assessment

All three levels of the subject involve weekly quizzes. These are done online each week and consist of 5 questions each. The questions are relatively easy and are drawn directly from the lecture content. They are all due together at the end of the semester so it is possible to cram them all in towards the end. However, it is easiest to do them right after the lecture while content is fresh in your memory. The most challenging week was related to vocal styles and genres as it can be difficult to identify the different styles.

All three levels involve attendance. You must attend tutorials. Attendance will be taken in conjunction with a 'lyric quiz' where the tutor will ask you to complete a song lyric from the repertoire studied. Additionally, there were 3 blog entries in relation to topics covered in weeks 2, 4 and 9. It is up to you what to write about but it must relate to the topics.

Additionally, attendance at the final performance is compulsory and is a hurdle.

The level 1 and level 2 subject also require a learning log. This is a personal recount of your experiences in the subject, what you have learnt, challenges you have encountered and how you overcame them. It is beneficial to relate your challenges to the lecture topics. The word limit is 1000 words. It is due in the final week of semester.

The level 2 subject involves a cultural analysis. You will be presented a number of topics related to ideas discussed in lectures. You must choose one to write about. It will require some research. Word limit is 500 words. It is due towards the end of the semester.

The level 3 subject involves a 1500 word research task. You will be presented 1 topic to write about. It is due in the final week of semester.

Conclusion

I took this subject because I wanted to try a less 'normal' subject. Without a doubt, it was one of the most enjoyable and memorable parts of university. Although it had absolutely no relevance to becoming an actuary, it allowed me to experience new things, build confidence and simply have fun. It was also stress free and relatively easy to do well in. The time commitment was also much less, so it allowed me to spend more time on more crucial subjects. With all the stresses of our regular subjects, Glee Singing was a welcome relief and a subject that I highly recommend.

Subject Review Index

This section serves as an index for each subject review across all the different editions of the *Actuarial Students' Society Subject Review*.

Table 1: Core Subjects

Subject Code	2015 Start	2016 Start	Mid	End
ACCT10001		1	1	1
ACCT10002	2	2	2	2
ACTL10001	2	2	2	2
ECON10003		2	2	2
ECON10004	1	1	1	1
MAST10006		1	1	
MAST10007			S	S
MAST10008	1	1	1	1
MAST10009	2	2	2	2
ACTL20001	1	1	1	1
ACTL20002	2	2	2	2
ECON20001	2	2	2	2
FNCE20001	2	2	2	1
MAST20004	1	1	1	1
MAST20005	2	2	2	2
MGMT20001		2	2S	2S
ACTL30001	1	1	1	1
ACTL30002	1	1	1	1
ACTL30003	2	2	2	2
ACTL30004	2	2	2	2
ACTL30005	2	2	2	2
ACTL30006	1	1	1	1
ACTL40002		1	1	1
ACTL40003				2
ACTL40004		1	1	1
ACTL40005				A
ACTL40006		1	1	1
ACTL40008		2	2	2
ACTL40009				2

Table 2: Breadths and Electives

Subject Code	2015 Start	2016 Start	Mid	End
AGRI20030				J
BLAW10001		1	1	
BLAW20001		1	1	
COMP10001			1	1
COMP20005		2	2	
ECON20002		1	1	S
ECON20005				2
FNCE10001			1	
FNCE30007		2	2	
GERM10008		1	1	
JAPN10001			1	1
MAST20022				2
MAST30020			1	1
MGMT30006				2
MGMT30017				W
MUSI20168				1
D-MATHSC			O	

Legend	
1	Semester 1
2	Semester 2
S	Summer Term
W	Winter Term
J	July Intensive
A	All Year
O	Other

List of Exemptions

Table 3: Actuaries Institute exemption subjects and corresponding university subjects

Exemption subject	University subject
Part I	
CT1 Financial Mathematics	ACTL20001 Financial Mathematics I ACTL20002 Financial Mathematics II
CT2 Finance and Financial Reporting	ACCT10002 Introductory Financial Accounting FNCE10002 Principles of Finance[1]
CT3 Probability and Mathematical Statistics	MAST20004 Probability MAST20005 Statistics
CT4 Models	ACTL30001 Actuarial Modelling I ACTL30002 Actuarial Modelling II
CT5 Contingencies	ACTL30003 Contingencies
CT6 Statistical Methods	ACTL30004 Actuarial Statistics ACTL40002 Risk Theory I
CT7 Business Economics	ECON10004 Introductory Microeconomics ECON20001 Intermediate Macroeconomics
CT8 Financial Economics	ACTL30006 Financial Mathematics III ACTL40004 Advanced Financial Mathematics I
Part II	
Part IIA The Actuarial Control Cycle	ACTL40006 Actuarial Practice and Control I ACTL40007 Actuarial Practice and Control II
Part IIB Investment and Asset Modelling	ACTL40009 Actuarial Practice and Control III

Source: Centre for Actuarial Studies
Current as of 19th January 2017.

[1] Students are also eligible for the exemption if they complete FNCE20001 Business Finance

Equivalent Graduate Subjects

Subjects offered as part of the 2-year MC-ACTSCI *Master of Actuarial Science* or 1.5-year MC-COMACSC *Master of Commerce (Actuarial Science)* degrees allow graduate students to gain professional actuarial exemptions from the Actuaries Institute. Due to the overlap in content between these subjects and actuarial subjects offered as part of the B-COM *Bachelor of Commerce* and the BH-COM Honours program, we have listed graduate actuarial subjects with their undergraduate counterparts below. The reviews for undergraduate subjects included in the *Actuarial Students' Society Subject Review* will serve as an accurate reference of the content in the corresponding graduate subjects.

Some of these graduate actuarial subjects will share the same lectures as their undergraduate counterparts, as in Table 4. Others will just contribute to the same exemption subject as their undergraduate counterparts (and hence have common content), as in Table 5.

Table 4: Graduate and undergraduate actuarial subjects with common lectures

Graduate subject	Undergraduate subject
ACTL90003 Mathematics of Finance III	ACTL40004 Advanced Financial Mathematics I
ACTL90004 Insurance Risk Models	ACTL40002 Risk Theory I
ACTL90009 Actuarial Practice and Control III	ACTL40009 Actuarial Practice and Control III
ACTL90010 Actuarial Practice And Control I	ACTL40006 Actuarial Practice and Control I
ACTL90011 Actuarial Practice and Control II	ACTL40007 Actuarial Practice and Control II
ACTL90014 Insurance Risk Models II	ACTL40003 Risk Theory II
ACTL90015 Mathematics of Finance IV	ACTL40008 Advanced Financial Mathematics II

Table 5: Graduate and undergraduate actuarial subjects with common exemption subjects

	Graduate subject	Undergraduate subject
CT1	ACTL90001 Mathematics of Finance I	ACTL20001 Financial Mathematics I ACTL20002 Financial Mathematics II
CT4	ACTL90006 Life Insurance Models I ACTL90007 Life Insurance Models 2	ACTL30001 Actuarial Modelling I ACTL30002 Actuarial Modelling II
CT5	ACTL90005 Life Contingencies	ACTL30003 Contingencies
CT6	ACTL90008 Statistical Techniques in Insurance ACTL90004 Insurance Risk Models	ACTL30004 Actuarial Statistics ACTL40002 Risk Theory I
CT8	ACTL90002 Mathematics of Finance II ACTL90003 Mathematics of Finance III	ACTL30006 Financial Mathematics III ACTL40004 Advanced Financial Mathematics I
Part IIA	ACTL90010 Actuarial Practice And Control I ACTL90011 Actuarial Practice and Control II	ACTL40006 Actuarial Practice and Control I ACTL40007 Actuarial Practice and Control II
Part IIB	ACTL90009 Actuarial Practice and Control III	ACTL40009 Actuarial Practice and Control III