# STAT2032

## Financial Mathematics

### Course Description

Compound interest functions; valuation of annuities certain; loans repayable by instalments; comparison of value and yield of cash flow transactions; valuation of fixed interest securities, with and without tax on interest and capital gains; duration and volatility of securities; introduction to concept of immunisation and matching; consumer credit contracts; introduction to stochastic interest rate models.

<table>
<thead>
<tr>
<th><strong>Mode of Delivery</strong></th>
<th>On campus</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prerequisites</strong></td>
<td>STAT1008 – Quantitative Research Methods OR STAT1003 – Statistical Techniques</td>
</tr>
<tr>
<td><strong>Incompatible Courses</strong></td>
<td>STAT6046</td>
</tr>
<tr>
<td><strong>Co-taught Courses</strong></td>
<td>STAT6046. Graduate students attend joint classes with undergraduates but are assessed separately.</td>
</tr>
<tr>
<td><strong>Course Convener:</strong></td>
<td>Aaron Bruhn</td>
</tr>
<tr>
<td><strong>Phone:</strong></td>
<td>02 6125 4904</td>
</tr>
<tr>
<td><strong>Email:</strong></td>
<td><a href="mailto:Aaron.bruhn@anu.edu.au">Aaron.bruhn@anu.edu.au</a></td>
</tr>
<tr>
<td><strong>Office hours for student consultation:</strong></td>
<td>I am available in my office for consultations from 1pm – 2pm on Mondays, and 3.30pm – 4.30pm on Wednesdays, in all weeks in term time (other than week 2, when I am away). You are also more than welcome to contact me, arrange an appointment, or come and see me outside these hours.</td>
</tr>
<tr>
<td><strong>Research Interests</strong></td>
<td>Prior to coming to ANU, Aaron worked as an actuary in Life Insurance and then as a Principal Economic and Financial Advisor in public service. He is interested in a range of areas of actuarial science, including life insurance, superannuation, and a number of non-traditional fields.</td>
</tr>
<tr>
<td><strong>Tutor(s):</strong></td>
<td>To be advised.</td>
</tr>
<tr>
<td><strong>Administrator</strong></td>
<td>Anna Pickering</td>
</tr>
<tr>
<td><strong>E-mail</strong></td>
<td><a href="mailto:Anna.pickering@anu.edu.au">Anna.pickering@anu.edu.au</a></td>
</tr>
<tr>
<td><strong>Phone</strong></td>
<td>(+61 2 612 59045)</td>
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</tbody>
</table>

**SEMESTER 2**

2018
COURSE OVERVIEW

Learning Outcomes
Upon successful completion of the requirements for this course, students should have the knowledge and skills to:

- Define and describe the use of cash flow models, simple and compound rates of interest and discount as well as compare and distinguish between nominal and effective rates of interest and discount.
- Describe various types of annuities and perpetuities and use them to solve financial transaction problems.
- Describe equations of value and various tools like linear interpolation & annuity tables.
- Compare capital budgeting decision tools like Net Present Values, Internal Rates of Return and Discounted Payback Periods.
- Analyse basic fixed interest financial transactions like Loan Valuation, Fixed Interest securities (eg. Bonds) and employ the skills developed in this course to evaluate such transactions. Incorporate the effects of taxation on such financial transactions.
- Explain arbitrage and its use in the valuation of forward contracts. Employ term structure of interest rates to calculate forward and spot rates.
- Define interest rate risk in terms of duration and convexity of fixed interest products. Define immunisation and assess its use in mitigating interest rate risk
- Understand the basics of stochastic interest rate models and use it to evaluate simple cash flow models.

Assessment Summary

<table>
<thead>
<tr>
<th>Assessment Task</th>
<th>Value</th>
<th>Due Date</th>
<th>Date for Return of Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Assignment 1</td>
<td>5%</td>
<td>Friday 24th August</td>
<td>Friday 31st August</td>
</tr>
<tr>
<td>2. Mid Semester Exam</td>
<td>20%</td>
<td>Week 7 of class. Date to be advised.</td>
<td>To be advised.</td>
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<tr>
<td>(redeemable)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Assignment 2</td>
<td>5%</td>
<td>Friday 12th October</td>
<td>Friday 19th October</td>
</tr>
<tr>
<td>5. Final Exam</td>
<td>70%</td>
<td>To be advised.</td>
<td>To be advised.</td>
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</table>

Research-Led Teaching
This course covers the relevant parts of the Actuaries Institute syllabus, pertaining to subject CT1 (Financial Mathematics). Wherever possible the examples used in this course will reflect real world situations to emphasize the use of the techniques covered.

Feedback Staff
Feedback
Students will be given feedback in the following forms in this course:
Following the mid-semester examination, feedback will be given to the whole class about the general performance on the exam.

In addition, students will have an opportunity to look over their script-book following both the mid-semester and final examinations.

Students will also have the opportunity to speak with the tutors and the lecturer about their individual performance in the assignments.

**Student Feedback**

ANU is committed to the demonstration of educational excellence and regularly seeks feedback from students. One of the key formal ways students have to provide feedback is through Student Experience of Learning Support (SELS) surveys. The feedback given in these surveys is anonymous and provides the Colleges, University Education Committee and Academic Board with opportunities to recognise excellent teaching, and opportunities for improvement.

For more information on student surveys at ANU and reports on the feedback provided on ANU courses, go to

http://unistats.anu.edu.au/surveys/selt/students/ and

http://unistats.anu.edu.au/surveys/selt/results/learning/

**Policies**

ANU has educational policies, procedures and guidelines, which are designed to ensure that staff and students are aware of the University’s academic standards, and implement them. You can find the University’s education policies and an explanatory glossary at:

http://policies.anu.edu.au/

Students are expected to have read the Academic Misconduct Rule before the commencement of their course.

Other key policies include:

- Student Assessment (Coursework)
- Student Surveys and Evaluations

**Required Resources**

**Examination material or equipment**

For both the mid-semester and final exam, you will be permitted to bring in a non-programmable calculator, and an English dictionary if required. Further information will be provided to students in lecture times and on Wattle.

**Recommended Resources**

All course notes and materials will be provided via Wattle. You need to have a non-programmable calculator for exercises, tutorials and assessment in this course.

You will need access to a computer to get the materials necessary for the course. We will use MS Excel in this course. Some in-class work will be illustrated using MS Excel. Learning guides and short video lectures will be made available on wattle for students to learn the application of the concepts taught in this course. Some assignment questions will require the use of MS Excel or a spreadsheet program.

Although there is no prescribed textbooks for this course, various supplementary material can enhance student learning.

**Supplementary Reading (Not Compulsory)**

individual chapters for your personal use. Please ensure you follow the ANU guidelines on copyright issues.

- J.J. McCutcheon and W.F. Scott (1986) An Introduction to the Mathematics of Finance, published for the Institute of Actuaries and Faculty of Actuaries by Heinemann
- Formula and Tables for Actuarial Examinations, 2002, ACTED Australia
- Course Material for CT1: Financial Mathematics, ACTED Australia

## COURSE SCHEDULE

<table>
<thead>
<tr>
<th>Week</th>
<th>Summary of Activities</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cash-flow models. Simple and compound interest. Accumulated and present values.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Nominal and effective rates of interest and discount. Force of interest. Introduction to annuities and their valuation.</td>
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<tr>
<td>3</td>
<td>Perpetuities. Continuous, increasing, decreasing and indexed annuities.</td>
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<tr>
<td>5</td>
<td>Loan valuation and payments. Capital budgeting including NPV, IRR and DPP.</td>
<td>Assignment 1 Due</td>
</tr>
<tr>
<td>6</td>
<td>Measuring investment performance. TWRR and MWRR.</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Valuation of fixed interest securities, with and without tax on interest and capital gains.</td>
<td>Mid-semester exam</td>
</tr>
<tr>
<td>8</td>
<td>Calculating yields. Allowing for callable features and inflation. Extending to property and share valuation.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Interest rate risk: duration, effective duration and convexity. Conditions for and determination of immunisation.</td>
<td>Assignment 2 Due</td>
</tr>
<tr>
<td>11</td>
<td>Introduction to stochastic interest rate models.</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Revision</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Examination period</td>
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</tr>
</tbody>
</table>

## ASSESSMENT REQUIREMENTS

The ANU is using Turnitin to enhance student citation and referencing techniques, and to assess assignment submissions as a component of the University’s approach to managing
Academic Integrity. For additional information regarding Turnitin please visit the ANU Online website.

Students may choose not to submit assessment items through Turnitin. In this instance you will be required to submit, alongside the assessment item itself, copies of all references included in the assessment item.

As a further academic integrity control, students may be selected for a 15 minute individual oral examination of their written assessment submissions.

Any student identified, either during the current semester or in retrospect, as having used ghost writing services will be investigated under the University’s Academic Misconduct Rule.

**Assessment Tasks**

**Assessment Task 1: Assignment 1**

Details of task:

Assignment 1 questions will be provided to all students at the relevant time on the course Wattle page. The assignment is designed to assess the students’ application of the various topics covered in this course, up to and including the material in week 3. Students are expected to complete this assignment individually. Students will have to complete their assignment using a spreadsheet (MS Excel). The submission is online via Wattle. More details will be provided during the lectures and on Wattle.

Value: 5%

Due date: Friday 24th August 3:00pm (Week 5)

**Assessment Task 2: Mid-semester exam**

Details of task: This exam will be 90 minutes long. It will cover topics up to and including the material in week 5.

Value: 20.0% (redeemable)

Due date: Week 7 of semester (date to be advised)

**Assessment Task 3: Assignment 2**

Assignment 2 questions will be provided to all students at the relevant time on the course Wattle page. The assignment is designed to assess the students’ application of the various topics covered in this course, up to and including the material in week 8. Students are expected to complete this assignment individually. Students will have to complete their assignment using a spreadsheet (MS Excel). The submission is online via Wattle. More details will be provided during the lectures and on Wattle.

Value: 5%

Due date: Friday 12th October 3:00pm (Week 10)

**Assessment Task 4: Final Exam**

Details of task:

The final examination will be 3 hours long and will cover the entire syllabus. Specific details regarding examination conditions and the time and location for this examination will be provided on Wattle and in lectures once confirmed.

Value: 70% or 90%, depending on performance in mid-semestar exam.
Date: Specific date to be advised.

**Examination(s)**

The course includes formal examination through a mid-semester and final examination as described above.

**Assignment submission**

**Online Submission:** Assignments are submitted using Turnitin in the course Wattle site. You will be required to electronically sign a declaration as part of the submission of your assignment. Please keep a copy of the assignment for your records.

**Extensions and penalties**

Extensions and late submission of assessment pieces are covered by the Student Assessment (Coursework) Policy and Procedure.

The Course Convener may grant extensions for assessment pieces that are not examinations or take-home examinations. If you need an extension, you must request it in writing on or before the due date. If you have documented and appropriate medical evidence that demonstrates you were not able to request an extension on or before the due date, you may be able to request it after the due date.

No submission of assessment tasks without an extension after the due date will be permitted. If an assessment task is not submitted by the due date, a mark of 0 will be awarded.

**Returning assignments**

Assignments will be returned as soon as they are marked, at the next available lecture time, or you will be able to collect them from the School Office on level 4 of the CBE building.

**Resubmission of assignments**

Students will not be permitted to resubmit assignments.

**Referencing requirements**

Accepted academic practice for referencing sources that you use in presentations can be found via the links on the Wattle site, under the file named “ANU and College Policies, Program Information, Student Support Services and Assessment”. For a more interactive guide on what this is all about, please see [http://library.anu.edu.au/tutorials/plagiarism/](http://library.anu.edu.au/tutorials/plagiarism/).

**Scaling**

Your final mark for the course will be based on the raw marks allocated for each of your assessment items. However, your final mark may not be the same number as produced by that formula, as marks may be **scaled**. Any scaling applied will preserve the rank order of raw marks (i.e. if your raw mark exceeds that of another student, then your scaled mark will exceed the scaled mark of that student) and may be either up or down.

**Privacy Notice**

The ANU has made a number of third party, online, databases available for students to use. Use of each online database is conditional on student end users first agreeing to the database licensor’s terms of service and/or privacy policy. Students should read these carefully.

In some cases student end users will be required to register an account with the database licensor and submit personal information, including their: first name; last name; ANU email address; and other information.

In cases where student end users are asked to submit ‘content’ to a database, such as an assignment or short answers, the database licensor may only use the student’s ‘content’ in
accordance with the terms of service – including any (copyright) licence the student grants to the database licensor.

Any personal information or content a student submits may be stored by the licensor, potentially offshore, and will be used to process the database service in accordance with the licensors terms of service and/or privacy policy.

If any student chooses not to agree to the database licensor’s terms of service or privacy policy, the student will not be able to access and use the database. In these circumstances students should contact their lecturer to enquire about alternative arrangements that are available.

**Tutorial Seminar Registration**

Tutorial signup for this course will be done via the Wattle website. Detailed information about signup times will be provided on Wattle or during your first lecture. When tutorials are available for enrolment, follow these steps:

1. Log on to Wattle, and go to the course site
2. Click on the link “Tutorial enrolment”
3. On the right of the screen, click on the tab “Become Member of…..” for the tutorial class you wish to enter
4. Confirm your choice

If you need to change your enrolment, you will be able to do so by clicking on the tab “Leave group….” and then re-enrol in another group. You will not be able to enrol in groups that have reached their maximum number. Please note that enrolment in ISIS must be finalised for you to have access to Wattle.

**SUPPORT FOR STUDENTS**

The University offers a number of support services for students. Information on these is available online from [http://students.anu.edu.au/studentlife/](http://students.anu.edu.au/studentlife/)

**Actuarial profession information**

*Exemption from Actuarial Professional examination*

The Australian National University is accredited by the Actuaries Institute (IAAust) to provide students with exemptions from the Part I professional examinations of the Institute. Exemptions are recommended subject to obtaining sufficiently high grades in designated courses. This course closely follows the syllabus of Subject CT1 of the IAAust.

To qualify for an exemption from the IAAust professional examination CT1, students are required to receive a mark of 60% or greater in this course.

The standard required by the Actuaries Institute for an exemption will be upheld and thus no quota applies to the percentage of students receiving each grade in this course.

*University subscription to the Institute of Actuaries*

The Actuaries Institute allows students to become IAAust University Subscribers free of charge. Full time undergraduates studying at an accredited university who are members of a university student actuarial society are eligible. To sign up, go to: [http://www.actuaries.asn.au/Membership/MembershipoftheInstitute/Subscriber.aspx](http://www.actuaries.asn.au/Membership/MembershipoftheInstitute/Subscriber.aspx)

The University Subscriber offer is not a membership of the IAAust but a subscription to receive information on career opportunities, invitations to selected events, and online publications. You might also consider joining the IAAust – there are advantages in doing so while a full-time student. See: [http://www.actuaries.asn.au/Membership/MembershipoftheInstitute.aspx](http://www.actuaries.asn.au/Membership/MembershipoftheInstitute.aspx)