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[refer to the ANU Campus Map  
\(map GH32, reference G3\)](#)

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## Course Outline

### STAT3004/STAT7018 Stochastic Modelling Semester 2, 2011

*STUDENTS: Course details change from semester to semester. Please check that you are reading the Course Outline for the correct semester.*

#### Course Description

This course is an introduction to the field of *stochastic processes*, which are ordered collections of (generally dependent) random variables, usually indexed by either time or space. They are used to model dynamic relationships involving random events in a wide variety of disciplines including engineering, the natural and social sciences as well as financial, managerial and actuarial settings.

The course consists of four parts. The first consisting of a short review of basic probability concepts and a discussion of conditional probability and conditional expectation. The second and third, which will comprise the majority of the lectures, present an introduction to the basic concepts and an investigation of the long-run behaviour, respectively, of simple stochastic processes in discrete time; namely, Markov chains. Finally, the fourth section will be comprised of various topics regarding some important forms of continuous-time stochastic processes including Poisson processes and other Markov pure jump processes, as well as Brownian motion and other related Gaussian processes as time permits.

#### Contacts

Role	Office address	Email	Telephone	Consultation Times
Course Convenor and Lecturer (Course Authority) <i>Boris Buchmann</i>	Room 4.03 CBE Bldg 26c	<a href="mailto:boris.buchmann@anu.edu.au">boris.buchmann@anu.edu.au</a>	57 296	Wednesday 13.00-15.00
Tutor/s <i>TBA</i>	TBA	TBA	TBA	TBA
School Student Administrators	Room 4.48 CBE Buiding	<a href="mailto:tracy.skinner@anu.edu.au">tracy.skinner@anu.edu.au</a>	NA	NA

<i>Tracy Skinner</i>	26c			
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## Communication

**Email** If necessary, the lecturers and tutors for this course will contact students on their official ANU student email address. Information about your enrolment and fees from the Registrar and Student Services' office will also be sent to this email address.

**Announcements** Students are expected to check the Wattle site for announcements about this course, e.g. changes to timetables or notifications of cancellations. Notifications of emergency cancellations of lectures or tutorials will be posted on the door of the relevant room.

### Course URLs

More information about this course may be found on:

- [Study @ ANU](#),
- the [College of Business and Economics website](#), and
- [Wattle](#), the University's online learning environment. Log on to Wattle using your student number and your ISIS password.

## Course Information

**Learning Outcomes** On completion of this course students should have an understanding of and be able to apply the techniques outlined in the course description. More particularly:

- *Conditioning and Transformations*
- *Markov Chains Techniques: First-Step Analysis, Long-Run Behaviour, Stationary and Invariant Distributions*
- *Continuous-time Markov Processes: Generators, Holding Times, Embedded Chains, Poisson Processes*
- *Classical Markov Chains in Insurance, Engineering and Biology*
- *Brownian Motion and Related Processes*

**Workload** Students taking this course are expected to commit at least 10--12 hours a week to completing the work.

This will include:

- *3 hours lectures*
- *1 hour tutorials*
- *remaining hours: private study, group work and/or Wattle*

**Course Delivery** All class material will be made available on Wattle.

The course consists out of four parts: The first part contains a review of basic probability concepts and a discussion of conditional probability and conditional expectation. The second and third part, which will comprise the majority of the lectures, present an introduction to the basic concepts and the long run behaviour of Markov chains in discrete time. Finally, the fourth part will be compromised of various topics regarding some important forms of continuous-time stochastic processes as Poisson processes, pure jump Markov processes, as well as Brownian motion if time permits.


Tutorials will be held on a weekly basis, starting from Week 3. Tutorial problems will be made available on WATTLE, and students are strongly encouraged to attempt solution prior to attending tutorials.

Starting from Week 2, short weekly online quizzes will made available on WATTLE, always, at the end of each week.

**Attendance Requirements** No marks will be given for attendance.

### **Tutorial Registration**

Enrolment in tutorials will be completed online using the Electronic Teaching Assistant (ETA). To enrol, follow these instructions:

1. Go to <http://eta.fec.anu.edu.au>.
2. You will see the Student Login page. To log into the system, enter your University ID (your student number) and password (your ISIS password) in the appropriate fields and hit the **Login** button.
3. Read any news items or announcements.
4. Select "Sign Up!" from the left-hand navigation bar.
5. Select your courses from the list. To select multiple courses, hold down the control key. On PCs, this is the **Ctrl** key; on Macs, it is the  key. Hold this key down while selecting courses with the mouse. Once courses are selected, hit the **SUBMIT** button.
6. A confirmation of class enrolments will be displayed. In addition, an email confirmation of class enrolments will be sent to your student account.
7. For security purposes, please ensure that you click the **LOGOUT** link on the confirmation page, or close the browser window when you have finished your selections.
8. If you experience any difficulties, please contact the School Office (see page 1 for contact details).

## Study Schedule (Tentatively)

Week beginning	Theme / Topic / Module	Activity	Assignment
1	Preliminaries I		
2	Preliminaries II		Quiz 1
3	Markov Chain I	Tutorial 1	Quiz 2
4	Markov Chain II	Tutorial 2	Quiz 3
5	Markov Chain III	Tutorial 3	Quiz 4
6	Markov Chain III	Tutorial 4	Assignment
7	Some More Preliminaries III	Tutorial 5	Quiz 5
8	Pure Jump I	Tutorial 6	Quiz 6
9	Pure Jump II	Tutorial 7	Quiz 7
10	Pure Jump-III	Tutorial 8	Quiz 8
11	Brownian Motion	Tutorial 9	Quiz 9
12	Brownian Motion	Tutorial 10	Quiz 10
13	Revision	Tutorial 11	

## Assessment

### Proposed Assessment Schedule

Details about assessment may change during the first two weeks of semester. Please ensure that you check with your lecturer or tutor about any changes. Changes to the assessment schedule will be posted to the Wattle site:

Assessment item	Weighting (%)
Midterm Assignment	25
Quizzes	5
Final Examination	70 %

### Learning Outcomes-Assessment

*Suggested wording and layout*

How well have you achieved the learning outcomes for this course? Your lecturer makes this judgement based on your assignments and examination papers.

To be more specific, at the end of each week, starting from week 2, there will be quizzes to make sure that the essentials are well understood.

By using quizzes alone we do learn how to apply and combine different techniques over longer time periods. To this end, covering the first part on Markov Chains, a midterm assignment complements the quizzes. In the final exam, which covers the whole course, we test, using a different levels of difficulty, ranging from essential to more advanced questions, how well the material was received over the whole course

**Scaling** Your final mark for the course will be based on the **raw** marks allocated for midterm assignment, quizzes and final examination. 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.

**Examinations** Final Exam (Closed Book)

Students enrolled in STAT7018 (the graduate versions of the course) are reminded that their final examination will contain additional material of a slightly more in-depth, theoretical nature.

## **Texts and Other Reading**

**Prescribed Texts** A detailed script will be made available on WATTLE.

### **Optional Reading**

Lefebvre, Mario, Applied Stochastic Processes Springer, 2007

Ross, Sheldon M, Introduction to probability models Edition 9th ed Academic Press, c2007

Stirzaker, David Stochastic processes and models Oxford ; New York, Press, 2005

These books will be made available in Hancock Library. (Buying is optional).

## **Course-related Matters**

**Requisites** STAT2001 Introductory Mathematical Statistics

**Co-teaching** STAT7018 (Graduate Cohort).

## **General Information for all Students**

*The information on pp 7-11 will be made available on the College website and / or in a block on the CBE Wattle template as soon as possible.*

### **CBE Student Office**

<http://www.cbe.anu.edu.au/>

The CBE Student Office provides assistance with program and course selection, enrolment, change of program, variation to enrolment, status and other general matters. It is located on Level 2 of CBE Building 26c, contact details:

- T: (61) 02 6125 3807
- E: info.cbe@anu.edu.au

### **Main Administrative Dates 2011**

[http://www.anu.edu.au/sas/SEAP\\_guide/](http://www.anu.edu.au/sas/SEAP_guide/)

The main administrative dates regarding teaching sessions, course census dates, examination period, graduation and enrolment variations (i.e. add and drop courses) are available from the ANU SEAP Guide 2011.

### **Associate Dean (Education)**

Dr Royston Gustavson is the Associate Dean (Education) in the ANU College of Business & Economics.

### **ANU Student Support**

Academic Skills and Learning Centre

<http://www.anu.edu.au/academicskills/>

The Academic Skills and Learning Centre, in the Pauline Griffin Building, offers services to students regarding a range of academic issues including essay writing, note-taking, referencing, reading, examination preparation, and plagiarism.

### **ANU College**

<http://www.anucollege.com.au/>

ANU College offers the following introductory and extended programs:

- maths bridging courses; and
- English language support for students from non-English-speaking backgrounds.

### **Information Literacy Program**

<http://ilp.anu.edu.au/index.html>

Workshops are available to undergraduate and graduate students to develop skills in handling information and communication technologies.

## **Policies, Procedures and Rules**

### **ANU SEAP Guide 2010**

[http://www.anu.edu.au/sas/SEAP\\_guide/](http://www.anu.edu.au/sas/SEAP_guide/)

The Student Enrolment and Administrative Procedures Guide (SEAP) supplements the ANU Undergraduate Handbook information available on Study@ANU (<http://info.anu.edu.au/studyat/>), the ANU Rules (<http://www.anu.edu.au/cabs/rules/>), and the Graduate Research website (<http://www.anu.edu.au/graduate/>).

### **Information for Enrolled Students**

[http://cbe.anu.edu.au/Current\\_Students/general\\_info/](http://cbe.anu.edu.au/Current_Students/general_info/)

Students are expected to be familiar with the ANU College of Business & Economics and university-wide policies and procedures on the following:

- Code of Practice for Student Academic Honesty
- Assessment Arrangements for Students from Language Backgrounds Other Than English
- Academic Progress Rules and Procedures
- Special examinations/consideration
- Supplementary examinations
- Review of assessment procedures

### **Special Examinations**

[http://cbe.anu.edu.au/Current\\_Students/general\\_info/specexam.asp](http://cbe.anu.edu.au/Current_Students/general_info/specexam.asp)

You must contact the College Office for guidance on the procedure for special examinations for final examination. Do not approach your lecturer for this information.

Students who are unable to attend an examination for reasons outlined in the policies above, may **apply** to sit a special examination by lodging an application with the College Student Administration Office no later than 72 hours after the scheduled examination. It is important to emphasise that **travel arrangements and minor illnesses are not normally acceptable grounds for special examinations** (Section 2, College 'Special Examination Policy').

**Section 7.7 of the 'Student Enrolment and Procedures Guide 2009' states:**

***Students must make themselves available for the duration of the examination period in order to attend any special examination that may be required.***

If you know in advance of circumstances whereby you will be unable to sit the examination, you should lodge an application for a special examination as soon as possible.

The dates on which Special Examinations will be held will be published on the School website when the final timetable is published.

Applications for special examinations must be correctly completed with all original supporting documentation attached. Where an application is made on the grounds of sickness, Section B of the application **must be completed by a medical practitioner** and a detailed medical certificate stating the effect on your capacity to sit the examination is required.

**The medical certificate must carry the stamp from the medical practice, and will not always be sufficient evidence.**

Special examinations are **not** automatically granted. If approved, successful candidates are required to contact the relevant School Office to obtain details of the special exam. If you do not sit the examination, or your application for a special examination is declined, then you will fail the course as incomplete.

It is not grounds for a further special examination if students are not contactable and miss the scheduled examination date.

### **Special Consideration**

If illness or other disruptive events have affected your preparation for, or performance during, an examination, you can bring this to the attention of the examiners by making a request for special consideration using the Application for Special Consideration form.

Requests for special consideration must be lodged with the relevant **School Office** before the scheduled date of the examination. However, if it relates to a problem that arose during the examination, it should be submitted immediately after the examination (see the invigilator).

Requests for special consideration must be accompanied by documentation of the illness and/or a letter setting out the reasons for the difficulties in studying for or sitting an examination. The examiners will take this into account in awarding the final grade.

### **Special Arrangements**

If you have a disability or disorder (permanent or temporary) which makes undertaking a formal sit-down examination difficult, then ***you are responsible for requesting special arrangements to be made for your examination.*** In the past these arrangements have included the use of special equipment, additional time, writing breaks, a scribe (someone to write for you), etc.

Please contact the Examinations and Graduations Office early in the semester and **at least 10 days prior to the examination period.**

Failure to make appropriate arrangements for an examination may result in a subsequent application for a special examination/special consideration being declined.

### **Disabilities**

If you have any queries about special arrangements with respect to disabilities, please refer to the Disabilities Officer. The ANU Disability Services Centre's website is at <http://www.anu.edu.au/disabilities/>.

### **Supplementary Examinations**

<http://www.anu.edu.au/cabs/rules/ExamsRules.pdf>

In accordance with the University Examinations Rules 2009 (No. 3), you may be provided with a supplementary examination.

If you have qualified for a supplementary examination, your grade will be recorded as a PX on your Notification of Results. **You must notify the School Office, in writing (email is satisfactory), within 7 days of the official publication date of examination results to indicate your acceptance or otherwise to sit the supplementary examination.**

If you pass the supplementary examination you will receive the grade of PS (pass at supplementary examination) and a mark of 50. If you are unsuccessful, or you decide not to sit the supplementary examination, your grade will be recorded as N (fail) and your original mark will stand.

Supplementary examinations will be held early in the next semester on dates to be advised. For information regarding the timing and venues for supplementary examinations please refer to the school websites in week 2 of the current semester:

ABIS: <http://www.cbe.anu.edu.au/schools/abis/>

ECONOMICS: <http://www.cbe.anu.edu.au/schools/eco/>

FAS: <http://www.cbe.anu.edu.au/schools/fas/>

MMIB: <http://www.cbe.anu.edu.au/schools/mmib/>

Travel plans should be made accordingly as travel plans are not an acceptable reason to miss a supplementary examination.

## Results and Examinations

In accordance with the University Assessment Grades/Codes, CBE applies the following scale when awarding grades:

### Final Pass Grades

HD – High Distinction	80–100
D – Distinction	70–79
CR – Credit	60–69
P – Pass	50–59
PS – Pass at supplementary examination	50

### Final Fail Grades

N – Fail	00–49
NCN – Not Completed/Fail	
WN – Withdrawn with failure	

### Interim Codes (used when a result for a course has not yet been finalised)

DA – Deferred assessment	
PX – Offered supplementary assessment	
RP – Result pending	
WA – Withheld for administrative reasons	

## Results Notification

To access results students should check their ISIS accounts on the advertised date for release of examination results. After publication, students enquiring about results must provide an ANU student card as proof of identification to the Examinations, Graduations, Prizes and Timetabling Office (Building 12). For privacy reasons students should not make enquiries regarding the results of other students.

## Examination Timetable – Final Examination Period

<http://timetable.anu.edu.au/>

Details of the final examination timetable are available on the ANU Timetabling website. The onus is upon students to acquire their own scheduling details.

## Examination Timetable – Mid-Semester Examinations

When a mid-semester exam is scheduled, timetable information will be posted by the relevant School.

## Misconduct

<http://www.anu.edu.au/cabs/rules/DisciplineRules.pdf>

In relation to an examination, misconduct on the part of a student includes:

- cheating;
- plagiarism (including the reproducing in, or submitting for assessment for, any examination, by way of copying, paraphrasing or summarising, without acknowledgement and with the intention to deceive, any work of another person as the student's own work, with or without the knowledge or consent of that other person);
- submitting for an examination any work previously submitted for examination (except with the approval of the prescribed authority);
- failing to comply with the University's instructions to students at, or in relation to, an examination;
- acting, or assisting another person to act dishonestly, in or in connection with an examination; and/or
- taking a prohibited document into an examination venue.

The administrative procedures regarding misconduct are incorporated in the ANU Discipline Rules.

## Plagiarism

<http://academichonesty.anu.edu.au/>

The College regards plagiarism as any appropriation of the ideas or expressions of another without relevant and appropriate acknowledgment. This includes un-attributed appropriation of text or content and may extend to improper referencing. Plagiarism will not be tolerated in any course and all discovered instances would be pursued to the full extent allowable under the rules.

Where students have doubts as to how to deal with or acknowledge source materials in course assignments they should consult the lecturer or tutor.

The penalties and administrative procedures regarding plagiarism are incorporated in the ANU Policy on Academic Honesty.

On-line material discussing plagiarism and referencing styles is available from the Academic Skills and Learning Centre Web page (<http://www.anu.edu.au/academicskills/>).