STAT2005
Introduction to Stochastic Processes

This is a first course on stochastic processes, which are random processes occurring in time or space. Stochastic processes are used to model dynamic relationships involving random events in a wide variety of disciplines including the natural and social sciences, and in financial, managerial and actuarial settings. The course consists of a short review of basic probability concepts and a discussion of conditional probability and conditional expectation, followed by an introduction to the basic concepts and an investigation of the long-run behaviour of Markov chains in discrete time, countable state space. The course also covers some important 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.

<table>
<thead>
<tr>
<th>Mode of Delivery</th>
<th>On campus</th>
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</thead>
<tbody>
<tr>
<td>Prerequisites</td>
<td>STAT2001 Introductory Mathematical Statistics</td>
</tr>
<tr>
<td>Co-taught Courses</td>
<td>STAT7004</td>
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<tr>
<td>Course Convener</td>
<td>Dr. Yuguang Ipsen</td>
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<td>Email</td>
<td><a href="mailto:yuguang.ipsen@anu.edu.au">yuguang.ipsen@anu.edu.au</a></td>
</tr>
<tr>
<td>Office Hours</td>
<td>TBA</td>
</tr>
<tr>
<td>Research Interests</td>
<td>General theory and applications of stochastic processes</td>
</tr>
<tr>
<td>Relevant Administrator</td>
<td>Smriti Bajracharya</td>
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<td>Email</td>
<td><a href="mailto:Smriti.Bajracharya@anu.edu.au">Smriti.Bajracharya@anu.edu.au</a></td>
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SEMESTER 2
2018
COURSE OVERVIEW

Learning Outcomes

On satisfying the requirements for this course, students will have the knowledge and skills to:

1. demonstrate the concepts and investigation of the long-run behavior, respectively, of simple stochastic processes in discrete time; namely, Markov chains.

2. demonstrate in detail the various topics of continuous-time stochastic processes, with topics drawn from:
   a. Poisson processes
   b. other Markov pure jump processes
   c. Brownian motion
   d. other related Gaussian processes

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>Assignment 1</td>
<td>20%</td>
<td>Week 5</td>
<td>Week 6</td>
</tr>
<tr>
<td>Assignment 2</td>
<td>20%</td>
<td>Week 11</td>
<td>Week 12</td>
</tr>
<tr>
<td>Final Exam</td>
<td>60%</td>
<td>Exam Period</td>
<td>TBA by RSFAS</td>
</tr>
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</table>

Research-Led Teaching

ANU has a rich history of research in the area of applied probability and stochastic processes. The lecturer is an active researcher in the area of stochastic processes and their applications, with a keen interest to attract talented students for research projects.

Feedback

Staff Feedback
Students will be given feedback in the following forms in this course:

- feedback from two assignments
- weekly feedback from tutors during tutorials and their consultation hours
- feedback from the lecturer after class and during her office hours
- feedback from course online forum on Wattle
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 Universitys academic standards, and implement them. You can find the Universitys 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

Commonwealth supported students and domestic full-fee paying students generally must be able to complete the requirements of their program of study without the imposition of fees that are additional to the student contribution amount or tuition fees.

Provided that its payment is in accordance with the Act, a fee is of a kind that is into any one or more of the following categories:

(a) It is a charge for a good or service that is not essential to the course of study.

(b) It is a charge for an alternative form, or alternative forms, of access to a good or service that is an essential component of the course of study but is otherwise made readily available at no additional fee by the higher education provider.

(c) It is a charge for an essential good or service that the student has the choice of acquiring from a supplier other than the higher education provider and is for:

   (i) equipment or items which become the physical property of the student and are not consumed during the course of study; or

   (ii) food, transport and accommodation costs associated with the provision of field trips that form part of the course of study.

(d) It is a fine or a penalty provided it is imposed principally as a disincentive and not in order to raise revenue or cover administrative costs.
Additional course costs
Not applicable.

Examination material or equipment
To be announced on Wattle

Recommended Resources
Purchase of textbooks is OPTIONAL. The course material follows selectively


Other examples of similar texts are

- Stochastic Processes and Models (2005) by David Stirzaker

ROUGH COURSE SCHEDULE

<table>
<thead>
<tr>
<th>Week</th>
<th>Summary of Activities</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Revision on Probability Theory</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Random Variables</td>
<td>Release Assignment 1</td>
</tr>
<tr>
<td>3</td>
<td>Conditional Probability and Conditional Expectation</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Markov Chains 1</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Markov Chains 2</td>
<td>Assignment 1 due (20%)</td>
</tr>
<tr>
<td>6</td>
<td>Markov Chains 3</td>
<td>Return Assignment 1</td>
</tr>
<tr>
<td></td>
<td>Mid Semester Break</td>
<td></td>
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<tr>
<td>7</td>
<td>The Exponential Distribution and Poisson Process 1</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>The Exponential Distribution and Poisson Process 2</td>
<td>Release Assignment 2</td>
</tr>
<tr>
<td>9</td>
<td>Continuous-time Markov Chains 1</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Continuous-time Markov Chains 2</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Brownian Motion and Stationary Processes 1</td>
<td>Assignment 2 is due (20%)</td>
</tr>
<tr>
<td>12</td>
<td>Brownian Motion and Stationary Processes 2</td>
<td>Return Assignment 2</td>
</tr>
<tr>
<td></td>
<td>Examination Period</td>
<td>Final Exam (60%)</td>
</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.

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: Provide detailed solutions to questions based on materials from Weeks 1 to 4. You may type your answer in a type-setting software or you may hand-write parts of your answers. Please ensure that your handwriting is legible. Although verbal discussions with others (fellow students, tutors, lecturer) are allowed, the content of your assignment must be produced by you as an individual and must comply with academic integrity policies given here.

Assessment Task 2: Assignment 2
Details of task: Provide detailed solutions to questions based on materials from Weeks 1 to 0. For details, see Assessment Task 1.

Assessment Task 3: Final Exam
Details of task: Closed book exam on all topics covered in lectures. A formula sheet is provided. Further details will be provided closer to the exam date.

Results of two assignments and Final Exam determine the final raw mark according to the proposed scheme. Both assignments are not optional and non-redeemable. Under special circumstances (eg. medical certificate) by the discretion of the Course Convenor, the weighting of either or both assignments can be moved to the final exam. Students are encouraged to attempt both assignments during the course. Moving the weightings of both assignments to the final exam is highly advised against by the Course Convenor.

No submission of assessment tasks after the due date will be permitted. Students who do not submit assignments and do not have a permission granted by the the due date will receive a zero.

Final Exam is compulsory. Students who meet the requirements for a special exam (eg. medical certificate) will be provided with one. Students who do not sit the final exam and do not meet the necessary requirements for a special exam will fail.

Examination(s)

See Assessment Tasks. Further details will be provided closer to the exam data.
**Assignment submission**

**Online Submission:** Unless an exemption has been approved by the Associate Dean (Education) a submission must be through Turnitin. 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.

**Returning assignments**

Assignments will be graded and returned online.

**Resubmission of assignments**

Resubmission of the assignment is not allowed under any circumstance.

**Referencing requirements**

Although formal scholarly referencing may not be necessary for the assignments, you must adhere to academic integrity policies (see details of Assessment Task 1).

**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 licensors 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 students 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/