The University of Western Australia  
School of Mathematics & Statistics  
 STAT3361 RANDOM PROCESSES & THEIR APPLICATIONS  
Unit Information (2009)

Credit: 6 points
Availability: Semester 1
Lecturer: A/Prof Tony Pakes, Room 2.39 (pakes@maths.uwa.edu.au). I am available to help you at any time I’m in my office, but it’s best to email for an appointment.

Outcomes: Students are able to apply statistical reasoning to analyse the essential structure of problems involving random processes; extend their knowledge of mathematical and statistical techniques and adapt known solutions to different situations; communicate effectively with others; present mathematical results in a logical and coherent fashion; and undertake continuous learning, aware that an understanding of fundamentals is necessary for effective application.

Content: This unit presents basic ideas in the theory of random processes in discrete and continuous time, developed in parallel with a wide range of applications and examples. The core material is the theory of Markov Chains in discrete and continuous time. Further material may include Poisson processes, birth-death processes, renewal process, stochastic simulation and Markov Chain Monte Carlo methods. Applications are drawn from bioinformatics, computer science, epidemiology, finance, genetics, image processing, operations research (inventory, reliability and queueing models) and spatial data. In more detail, I expect to cover the content as follows.
1. Introduction to stochastic processes; Random walk on a graph; Idea of Markov dependence. [1 lecture.]
2. Conditional probability; Law of total probability; Conditional laws and expectation; Pattern formation in Bernoulli trials. [About 2 lectures.]
3. Definition of Markov chains; Markov model building; Transition laws & matrices; Examples of Markov modelling; Transient laws; Occupation times; Stationary & limiting laws; Cost models; Hitting times. [About 14 lectures.]
4. Markov processes; The exponential law and ‘good as new’ property; Sample path construction; The Poisson process & other examples; Transient laws & uniformization; Occupation times; Stationary & limiting laws; Cost models; Hitting times. [About 15 lectures.]


Lectures: Five per fortnight - check the timetable.

Practice classes: One per fortnight, starting in Week 2. You will be given un-assessed practice exercises whose solutions will be posted in the unit web page. You should regard these as training for the assessed assignment questions. In other words, don’t ignore them!
**Computer labs:** You will use the Maple symbolic mathematics package in the Maths Computing Lab (MCL) (or at home) for numerical computations with Markov models. Detailed instructions will be given later, and you do the work in your own time. Some assignment questions will involve Maple computation, and you take two Maple tests in MCL. These give you easy marks if you do your homework.

**Assessment:** This comprises a three-hour final examination worth 60%; Two assignments worth 24% in total & Two half-hour tests worth 8% each. The aggregate mark for the assignments will be calculated as the total over both assignments. The tests are held in the Mathematics Computing Laboratory to assess your ability in using the Maple package. All assessment tasks require students to apply their knowledge of the unit content to solve previously unseen problems. Credit is given for clarity and correctness of presentation as well as for actual results.

**Collaboration & plagiarism:** You are encouraged to discuss among yourselves the work required for answering assignment questions, and to seek my help if required. However all work submitted for assessment must either be your own work, or it must be attributed if it is not your own work. Submitting work done by others as if it were your own is one form of plagiarism, a serious offence against UWA regulations. This includes the submission of assignment answers which are copies of some essentially original version. Refer to the relevant Faculty policy on this matter at the web address below.

**Calculators:** Only calculators with the faculty-approved sticker will be permitted for use in tests and the exam. Refer to the Faculty policy.

**What you should know!** Ideally you will know and understand the work on conditional probability, random variables, and probability distributions which you met in first and/or second-year units. You will need some matrix algebra and a little calculus.

**Policies:** There are several University and Faculty policies which you are expected to know and adhere to.

2. Plagiarism (Faculty): See http://www.ecm.uwa.edu.au/for/students/pol.plagiarism
3. Assessment (Faculty): Unit marks may be scaled in line with the Faculty of Engineering, Computing and Mathematics policy. See http://www.ecm.uwa.edu.au/for/students/pol.assess
4. Examination and appeals (Faculty): http://www.ecm.uwa.edu.au/for/students/pol.exams
5. Supplementary exams: This may vary between faculties, but generally speaking a supplementary exam will be allowed to students within one unit of completing their degree and provided the mark is between 45% and 49% inclusive, and provided the student is currently enrolled in the unit. Refer to your faculty Subdean if you find yourself in this position.

6. Missed assessment tasks: If you miss a test or submitting an assignment due to illness, or other legitimate reason, then you should apply to your faculty Subdean for ‘Special Consideration’. If your application is successful, then a letter is sent to your lecturers requesting them to adjust their marking for the missed assessment. A new University policy is that “applications for consideration, deferral of tests or exams or extensions of time for assignments on medical, personal or other grounds must be lodged with the faculty office no later than three working days after the due date for the assessment in question.” Exceptional cases may be considered.

A.G. Pakes (02/02/09)

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1Or Associate Dean (students), etc. Terminology now differs widely between faculties.