Faculty of Science
School of Mathematics & Statistics

MATH5846
Introduction to Probability and Stochastic Processes

Semester 1, 2018

Cricos Provider Code: 00098G

MATH5846 – Course Outline

Course Authority and lecturer: Dr Leung Lung Chan **Office:** RC-1036.
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Consultations: Please speak to the lecturer in class or email to arrange a time.

Credit, Prerequisites, Exclusions: This course counts for 6 Units of Credit (6UOC). There are no prerequisites or exclusions for this course.

Lectures: The lectures run in weeks 2-7 of the UNSW Semester 1.
In 2018, the class meets on Wednesdays and Fridays. The first class is on Wednesday 7th March.
The last class would have been on Friday 20th April.

In each 3 hour class meeting there will be a couple of hours of lectures, a tutorial time and a short break.
(The final examination is scheduled for the following Friday, 27th April, at 5pm. Location will be announced closer to the time.)

Course Overview

Probabilistic concepts are necessary to study complex phenomena arising in Engineering, Biology, Medicine and Economics. This course introduces basic concepts which are needed to analyze such phenomena: including the concepts of random events, random variables, structures of dependence, computation of probabilities using the Central Limit Theorem, Markov chains and Brownian motion.

Learning Outcomes and relation to Graduate Attributes

After completing this course, students will be able to:

- Understand the principles of probability and be able to apply this theory to practical and theoretical problems.
- Use key theoretical tools to explore properties of random variables.
- Derive fundamental results in the theory of probability and random variables.
- Apply principles of Markov Chains and Brownian motion to practical and theoretical problems.

These outcomes contribute to the development of the UNSW Graduate Capabilities. Most explicitly the outcomes contribute to the development of these capabilities as described by the Science Faculty Graduate Attributes, in particular:

1 **Research, inquiry and analytical thinking abilities** Statistical analysis is fundamental to the research process. There is a major focus on this attribute.

2 **Capability and motivation for intellectual development** Foundation skills in statistical inference and an understanding of random variables are essential in order to achieve a higher-level understanding in applied science.

6 **Information literacy** The ability to make appropriate and effective use of data and information requires good understanding of probability and variation.

Teaching strategies underpinning the course

New ideas and skills are introduced and demonstrated in lectures, then students develop these skills by applying them to specific tasks in tutorials and assignments. We believe that effective learning is best supported by a climate of inquiry, in which students are actively engaged in the learning process.

We believe that effective learning is achieved when students attend all classes, have prepared effectively for classes by reading through previous lecture notes, in the case of lectures, and, in the case of tutorials, by having made a serious attempt at doing for themselves the tutorial problems prior to the tutorials. Furthermore, lectures should be viewed by the student as an opportunity to learn, rather than just copy down lecture notes.

The art of logically setting out mathematics and statistics is best learned by watching and reading experienced practitioners and paying particular attention and then by attempting to do so in the tutorial exercises.

Assessment

UNSW assesses students under a standards based assessment policy. For how this policy is applied in the School of Mathematics and Statistics see

http://www.maths.unsw.edu.au/currentstudents/assessment-policies

MATH5846 assessment will consist of two hand-in assignments (10% each), a class test (20%), and a final examination (60%). For each assessment task, the main marking criteria will be clear and logical presentation of correct solutions.

Assignments: There are 2 written assignments. These assignments are due at the start of the Wednesday classes - at 5pm on 14th March and 11th April.

It is intended that the assignments will be handwritten and submitted in hard copy at the start of the lecture time. With the permission of the lecturer, students may typeset (or LaTeX) their assignments if their mathematical typesetting is adequate. However, the reason for weekly written hand-in work in this introductory courses is to give students an opportunity for feedback on the setting out of their mathematical argument, and typesetting is not necessarily an aid to this unless the student is very experienced in LaTeX. Furthermore, the class test and the examination are necessarily handwritten assessments.
Assignments must be YOUR OWN WORK, or severe penalties will be incurred.

Weighting: Each assignment has a 10% weighting in your final mark.

Class Test:

Duration: 45 minutes, held during class, starting at 5pm, Wednesday 28th March.

The test will be held at the start of the class time.

A mid-session test gives an opportunity for students to demonstrate their understanding of the first part of the course, and to receive feedback on the presentation of their solutions **under examination conditions**.

Feedback on class test and response to feedback: The lecturer will attempt and intend to return the marked class test within a week. Students are advised to follow up with the lecturer any queries they have about their marked work.

Weighting: 20% of your final mark.

Final Examination:

Duration: 2 hours, **Friday 27th April** at 5pm.
Students who have another class timetabled for 5pm 27th April should notify the lecturer for MATH5846 as soon as possible so that alternative arrangements for the final exam can be made for these students.

Rationale: The final exam assesses student mastery of the whole course.

Weighting: 60% of your final mark.

The final exam will be a 'closed book' examination, that is students are not permitted to bring in any notes, books etc. Further details about the final examination will be available in class closer to the time. Announcements will also be made on the MATH5846 web page.

Every class is different, and to accommodate this, some variation from the above assessment schedule may be prudent. Hence the above schedule should be considered as a guide only, as it may possibly not be strictly adhered to. In the case of assessment dates, no changes will be made without consultation with the class as well as confirmation being posted as an announcement on the course web page.

Calculators: For mid-session tests and final exams, students must supply their own calculator. Only calculators on the UNSW list of approved calculators may be used. Calculators must be given a UNSW approved sticker, obtained from the School of Mathematics and Statistics Office, and other student or Faculty centres. The UNSW list of calculators approved for use in end of semester exams is available at: `https://student.unsw.edu.au/exams`

It is intended that the following topics will be covered in the given order. Sometimes the particular chapters will not fit exactly into a particular week.

Chapter 1 – Probability: Experiments, axioms and basic results, conditional probability, independence, Bayes' Formula.

Chapter 2 – Random Variables: Definition, cumulative distribution function, discrete and continuous random variables, expectations, moments, standard deviation, moment generating functions, Chebychev's Inequality.

Chapter 3 – Common Distributions: Bernoulli, Binomial, Poisson, Geometric, Hypergeometric, Uniform, Normal, Exponential, Gamma and Beta distributions.

Chapter 4 – Bivariate Distributions: Joint cdf, probability and density functions, conditional probability and density functions, conditional expected value and variance, covariance, correlation, bivariate normal, extension to n variables.

Chapter 5 – Transformations: Linear transformations, probability integral transformations, bivariate transformations, sums of independent random variables.

Chapter 6 – Convergence of Random Variables: Convergence in probability, weak law of large numbers, Central Limit Theorem, applications.

Chapter 7 – Markov chains.

Chapter 8 – Brownian motion.

Additional resources and support

Exercises: Tutorial exercises for each chapter will be made available on the course

web page. These problems are for you to do to enhance mastery of the course.

Textbooks: Although there is no set text for this course, the following references may prove useful. These books are available from the UNSW library, and are all available from the main shelves as well as available for from the 'High Use Collection'.

Mathematical Statistics and Data Analysis, J.A. Rice.

Introduction to Probability Models, S. Ross

UNSW Moodle

The School of Mathematics and Statistics uses the Learning Management System called Moodle. To log in to Moodle use your zID and zPass at the following URL:

http://moodle.telt.unsw.edu.au

Once logged in, you should see a link to MATH5846 that will take you to the MATH5846 homepage in Moodle. All course materials, including lecture notes, will be available on this homepage. Please check UNSW Moodle regularly.
In the general information section there is a link called "Maths & Stats Marks". This takes you to a page where you can log in with your zPass and see the marks recorded for various assessment tasks. Before the final examination you should log in here and check that your assignment and test marks have been correctly recorded.

Course Evaluation and Development

The School of Mathematics and Statistics evaluates each course each time it is run. We carefully consider the student responses and their implications for course development.

Academic integrity, referencing and plagiarism

Academic integrity is fundamental to success at university. Academic integrity can be defined as a commitment to six fundamental values in academic pursuits: honesty, trust, fairness, respect, responsibility and courage.
At UNSW, this means that your work must be your own, and others ideas should be appropriately acknowledged. If you don't follow these rules, plagiarism may be detected in your work.
Further information about academic integrity and plagiarism can be located at the *Current Students* site `https://student.unsw.edu.au/plagiarism`, and the *ELISE*

training site `http://subjectguides.library.unsw.edu.au/elise/presenting`. Additional resources concerning conduct obligations of students can be found on the *Conduct and Integrity Unit* site `https://student.unsw.edu.au/conduct` .

University policies and Administrative matters

Additional Assessment and **School Rules and Regulations**: See the School of Mathematics and Statistics web page for general policy on additional assessment, and for fuller details of the general rules regarding attendance, release of marks, special consideration etc.

http://www.maths.unsw.edu.au/currentstudents/assessment-policies

Applications for Special Consideration

If you feel that your performance in, or attendance at a final examination has been affected by illness or circumstances beyond your control, or if you missed the examination because of illness or other compelling reasons, you may apply for special consideration. Such an application may lead to the granting of Additional Assessment. Within 3 days of the affected examination, or at least as soon as possible, you must submit a request for Special Consideration.
In the special case of MATH5846, since this is a short course and finishes mid-semester, this submission must be made directly to the course lecturer by email or telephone call (as well as to to UNSW Student Central ON-LINE) with supporting documentation attached.

You will NOT be granted Additional Assessment in a course if your performance in the course (judged by attendance, class tests, assignments and examinations) does not meet a minimal standard. A total mark of greater than 40% on all assessment not affected by a request for Special Consideration will normally be regarded as the minimal standard for award of Additional Assessment.

As from S1, 2016 students with a final mark in the range of 45-49 will be permitted to take the Additional Assessment Exam as a <u>Concessional</u> Additional Assessment. The final mark after completing the <u>Concessional</u> Additional Assessment will not increase to a mark higher than 50. (This capping will not apply if you applied for Special Consideration in the usual way because of illness or other circumstances.)

Additional support for students

- The Current Students Gateway: https://student.unsw.edu.au/

- Academic Skills and Support: https://student.unsw.edu.au/academic-skills
- Student Wellbeing, Health and Safety: https://student.unsw.edu.au/wellbeing
- Disability Support Services: https://student.unsw.edu.au/disability-services
- UNSW IT Service Centre: https://www.it.unsw.edu.au/students/index.html