
UNSW SYDNEY

# UNSW SCIENCE

# SCHOOL OF MATHS AND STATISTICS

## MATH5846

## Introduction to
## Probability and Stochastic Processes

## Term 1, 2019

Cricos Provider Code: 00098G

# MATH5846 – Course Outline

**Course Authority and lecturer:** Dr. Jia Deng
**Office:** RC-1033 **Email**: jia.deng@unsw.edu.au

**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 1-5 of the UNSW Term 1, 2019.
Wednesday 4:00pm - 7:00pm in Old Main Building G31
Friday 5:00pm - 8:00pm in Old Main Building G31

(The final examination is scheduled for Friday, 5th April, at 5pm, and the location of the exam will be announced closer to 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, simple 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.

4 **Communication** Discussions in class and written submissions for assignments will develop your skills in communicating statistical ideas.

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 mid-session 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.
Assignment one will be released in week 1 Friday and will be collected in week 2 Friday (at the beginning of the lecture).
Assignment two will be released in week 4 Wednesday and will be collected in week 5 Wednesday (at the beginning of the lecture).

It is intended that the assignments will be handwritten/typed and submitted in hard copy at the start of the lecture time.
Assignments must be YOUR OWN WORK, or severe penalties will be incurred.

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

### Mid-session Test

**Duration:** one hour, held during class, starting at 5pm, Friday 8th March.

A mid-session test will assess student mastery of the material covered in the first part of the course. It gives an opportunity for students to individually demonstrate their understanding of course materials **under examination conditions**.

**Weighting:** 20% of your final mark.

### Final Examination

**Duration:** 2 hours, **Friday 5th April** at 5pm, location to be announced closer to time.

**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.

**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`

# Schedule and Syllabus

| Week beginning | Topics |
|---|---|
| 1: 18/02/2019 | Ch.1 & Ch.2 & Ch.3 |
| 2: 25/02/2019 | Ch.4 & Ch.5 |
| 3: 04/03/2019 | Ch.6; Mid-session test on Friday 8th March |
| 4: 11/03/2019 | Ch.7 |
| 5: 18/03/2019 | Ch.7 & Ch.8 |

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

**Lecture notes**: Lecture notes for this course will be provided on Moodle.

**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 with Applications, Sixth Edition, Duxbury Advanced Series, Denis D Wackerly, William Mendenhall III & Richard L. Scheaffer.
- Mathematical Statistics and Data Analysis, J.A. Rice.
- Introduction to Probability Models, S. Ross.
- A First Course in Stochastic Processes, S. Karlin and H. M. Taylor.

### 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. It is common practice to discuss informally with students how the course and their mastery of it are progressing.

## 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