



UNSW SCIENCE
School of Maths and Statistics

Course outline

MATH3801

Probability and Stochastic Processes

MATH3901

Higher Probability and Stochastic Processes

MATH5901

Stochastic Processes

Term 1, 2023

Assumed knowledge / Pre-Requisite MATH5901: (MATH2501 or MATH2601) and (MATH2011 or MATH2111) and (MATH2801 or MATH2901), or admitted to a Postgraduate Mathematics or Statistics program.

Exclusions: MATH3801 or MATH3901 (jointly taught with MATH5901)

We are aware some course exclusions on the Handbook may be different to the School website. We are in the process of updating this information. Meanwhile, students should be following the Handbook course information with the School website information as a supplement.

Course Aims – MATH3801/MATH3901

This course is an introduction to the theory of stochastic processes. Informally, a stochastic process is a random quantity that evolves over time, like a gambler's net fortune and the price fluctuations of a stock on any stock exchange, for instance.

The main aims of this course are: 1) to provide a thorough but straightforward account of basic probability theory; 2) to introduce basic ideas and tools of the theory of stochastic processes; and 3) to discuss in depth through many examples important stochastic processes, including Markov

Course Aims – MATH5901

This course aims to introduce some of the basic ideas and tools of the theory of stochastic processes. The theory of stochastic processes deals with phenomena evolving randomly in time and/or space, such as prices on financial markets, air temperature or wind velocity, spread of diseases, number of hospital admissions in certain area, and many others.

This course introduces some of the basic ideas and tools to study such phenomena. In particular, we will introduce Markov Chains (both in discrete and continuous time), Poisson processes, Brownian motion and Martingales. The course will also cover other important but less routine topics, like Markov decision processes and some elements of queueing theory.

Course Description – MATH3801/MATH3901

Introduction to stochastic processes, that is, processes that evolve over time such as price fluctuations of a stock. The course emphasises theory and applications and covers discrete- and continuous-time Markov chains, Poisson processes and Brownian motion.

Course Description – MATH5901

Stochastic processes are mathematical models to describe the evolution in time of random phenomena encountered in many areas such as finance, biology, engineering, and social sciences. This course is a non-measure theoretic introduction to stochastic processes, so students not familiar with the language of measure theory can still learn about the essence of stochastic processes. After taking this course, students can go on to take the advanced stochastic process course MATH5835, which is a measure-theoretic treatment of the topic.

Assessment and Deadlines

Assessment	Week	Weighting %	Course Learning Outcome (CLO)
Assignment1 (individual, Moodle Quiz)	Week 3	15%	CLO2, CLO3
Assignment 2	Week 10	25%	CLO1, CLO2, CLO3
Final Exam		60%	CLO1, CLO2, CLO3

Late Submission of Assessment Tasks

No late submissions will be accepted. (Where "late" in this context means after any extensions granted for Special Consideration or Equitable Learning Provisions.)

Course Learning Outcomes (CLO) – MATH3801/MATH3901

1. Recognise which analysis procedure is appropriate for a given research problem.
2. Apply probability theory to practical problems.
3. Understand the usefulness of Stochastic Processes in their professional area.

Course Learning Outcomes (CLO) – MATH5901

1. State the defining properties of various stochastic process models and related random element.
2. Identify appropriate stochastic process model(s) for a given research problem.
3. Provide logical and coherent proofs of fundamental results in the theory of stochastic processes.
4. Derive important quantities or features for given stochastic processes from their defining properties.

Course Schedule

The course will include material taken from some of the following topics. This is should only serve as a guide as it is not an extensive list of the material to be covered and the timings are approximate. The course content is ultimately defined by the material covered in lectures.

Weeks	Topic
1	Probability and Random Variables
2	(Conditional) Expectation and Integral Transforms
3	Central Limit Theorem and Convergence of Random Variables
4	Important Stochastic Processes
5	Markov Property and Martingales
7	Wiener Process and Brownian Motion
8	Stochastic Calculus and Ito Formula
9	Simple SDEs and Applications
10	Revision

Recommended Textbooks

- Probability and Random Processes (3rd Edition) by G. Grimmett and D. Stirzaker (Oxford)
- Introduction to Stochastic Calculus with Applications by Fima Klebaner (second or third edition by Imperial College Press)
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Moodle

Log in to Moodle to find announcements, general information, notes, lecture slide, classroom tutorial and assessments etc.

<https://moodle.telt.unsw.edu.au>

School of Mathematics and Statistic and UNSW Policies

The School of Mathematics and Statistics has adopted a number of policies relating to enrolment, attendance, assessment, plagiarism, cheating, special consideration etc. These are in addition to the Policies of The University of New South Wales. Individual courses may also adopt other policies in addition to or replacing some of the School ones. These will be clearly notified in the Course Initial Handout and on the Course Home Pages on the Maths Stats web site.

Students in courses run by the School of Mathematics and Statistics should be aware of the School and Course policies by reading the appropriate pages on the Maths Stats web site starting at:

<https://www.maths.unsw.edu.au/currentstudents/assessment-policies>

The School of Mathematics and Statistics will assume that all its students have read and understood the School policies on the above pages and any individual course policies on the Course Initial Handout and Course Home Page. Lack of knowledge about a policy will not be an excuse for failing to follow the procedure in it.

Academic Integrity and Plagiarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic

integrity. All UNSW staff and students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.*

The **UNSW Student Code** provides a framework for the standard of conduct expected of UNSW students with respect to their academic integrity and behaviour. It outlines the primary obligations of students and directs staff and students to the Code and related procedures.

In addition, it is important that students understand that it is not permissible to buy essay/writing services from third parties as the use of such services constitutes plagiarism because it involves using the words or ideas of others and passing them off as your own. Nor is it permissible to sell copies of lecture or tutorial notes as students do not own the rights to this intellectual property.

If a student breaches the Student Code with respect to academic integrity, the University may take disciplinary action under the **Student Misconduct Procedure**.

The UNSW Student Code and the Student Misconduct Procedure can be found at:

<https://student.unsw.edu.au/plagiarism>

An online Module "[Working with Academic Integrity](https://student.unsw.edu.au/aim)" (<https://student.unsw.edu.au/aim>) is a six-lesson interactive self-paced Moodle module exploring and explaining all of these terms and placing them into your learning context. It will be the best one-hour investment you've ever made.

Plagiarism

Plagiarism is presenting another person's work or ideas as your own. Plagiarism is a serious breach of ethics at UNSW and is not taken lightly. So how do you avoid it? A one-minute video for an overview of how you can avoid plagiarism can be found

<https://student.unsw.edu.au/plagiarism>.

Additional Support

ELISE (Enabling Library and Information Skills for Everyone)

ELISE is designed to introduce new students to studying at UNSW.

Completing the ELISE tutorial and quiz will enable you to:

- analyse topics, plan responses and organise research for academic writing and other assessment tasks
- effectively and efficiently find appropriate information sources and evaluate relevance to your needs
- use and manage information effectively to accomplish a specific purpose
- better manage your time
- understand your rights and responsibilities as a student at UNSW
- be aware of plagiarism, copyright, UNSW Student Code of Conduct and Acceptable Use of UNSW ICT Resources Policy
- be aware of the standards of behaviour expected of everyone in the UNSW community

- locate services and information about UNSW and UNSW Library

Some of these areas will be familiar to you, others will be new. Gaining a solid understanding of all the related aspects of ELISE will help you make the most of your studies at UNSW.

The *ELISE* training webpages:

<https://subjectguides.library.unsw.edu.au/elise/aboutelise>

Equitable Learning Services (ELS)

If you suffer from a chronic or ongoing illness that has, or is likely to, put you at a serious disadvantage, then you should contact the Equitable Learning Services (previously known as SEADU) who provide confidential support and advice.

They assist students:

- living with disabilities
- with long- or short-term health concerns and/or mental health issues
- who are primary carers
- from low SES backgrounds
- of diverse genders, sexes and sexualities
- from refugee and refugee-like backgrounds
- from rural and remote backgrounds
- who are the first in their family to undertake a bachelor-level degree.

Their web site is: <https://student.unsw.edu.au/els/services>

Equitable Learning Services (ELS) may determine that your condition requires special arrangements for assessment tasks. Once the School has been notified of these, we will make every effort to meet the arrangements specified by ELS.

Additionally, if you have suffered significant misadventure that affects your ability to complete the course, please contact your Lecturer-in-charge in the first instance.

Academic Skills Support and the Learning Centre

The Learning Centre offers academic support programs to all students at UNSW Australia. We assist students to develop approaches to learning that will enable them to succeed in their academic study. For further information on these programs please go to:

<http://www.lc.unsw.edu.au/services-programs>

Applications for Special Consideration for Missed Assessment

Please adhere to the Special Consideration Policy and Procedures provided on the web page below when applying for special consideration.

<https://student.unsw.edu.au/special-consideration>

Please note that the application is not considered by the Course Authority, it is considered by a

centralised team of staff at the Nucleus Student Hub.

The School will contact you (via student email account) after special consideration has been granted to reschedule your missed assessment, for a *lab test or paper-based test* only.

For applications for special consideration for *assignment extensions*, please note that the new submission date and/or outcome will be communicated through the special consideration web site only, no communication will be received from the School.

For Dates on Final Term Exams and Supplementary Exams please check the “Key Dates for Exams” ahead of time to avoid booking holidays or work obligations.

<https://student.unsw.edu.au/exam-dates>

If you believe your application for Special Consideration has not been processed, you should email specialconsideration@unsw.edu.au immediately for advice.

Course Evaluation and Development (MyExperience)

Student feedback is very important to continual course improvement. This is demonstrated within the School of Mathematics and Statistics by the implementation of the UNSW online student survey *myExperience*, which allows students to evaluate their learning experiences in an anonymous way. *myExperience* survey reports are produced for each survey. They are released to staff after all student assessment results are finalised and released to students. Course convenor will use the feedback to make ongoing improvements to the course.