

UNSW SCIENCE
School of Maths and Statistics

Course outline

MATH3871/MATH5960
Bayesian Inference and Computation

Term 3, 2020

Course Description/Aims

After describing the fundamentals of Bayesian inference, this course will examine the specification of prior and posterior distributions, Bayesian decision theoretic concepts, the ideas behind Bayesian hypothesis tests, model choice and model averaging, and evaluate the capabilities of several common model types, such as hierarchical and mixture models. An important part of Bayesian inference is the requirement to numerically evaluate complex integrals on a routine basis. Accordingly, this course will also introduce the ideas behind Monte Carlo integration, importance sampling, rejection sampling, Markov chain Monte Carlo samplers such as the Gibbs sampler and the Metropolis-Hastings algorithm, and use of the WinBUGS posterior simulation software.

Assessment and Deadlines

Assessment	Week	Weighting
Quiz 1	23/09/2020	20
Quiz 2	28/10/2020	15
Class Participation	Throughout the Term	5
Final Exam	UNSW Exam Period	60
	Total	100

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	Reading (if applicable)
1	Introduction to Bayesian analysis & Random Generators	Refer to Moodle
2	Prior distributions & Inversion Sampling	Refer to Moodle
3	Normal Model & Monte Carlo methods and Rejection Sampling	Refer to Moodle
4	Decision Theory & Importance Sampling	Refer to Moodle
5	Monte Carlo Markov Chains & Gibbs Sampling	Refer to Moodle
7	Hierarchical Models	Refer to Moodle
8	Bayesian Hypothesis Testing & Metropolis-Hastings	Refer to Moodle
9	Linear Models	Refer to Moodle
10	Mixture Models	Refer to Moodle

Textbooks

Recommended Text

- Peter Hoff, "A First Course in Bayesian Statistical Methods", Springer Texts in Statistics

Course Learning Outcomes (CLO)

- Provide a background in the concepts and philosophy of Bayesian inference
- Demonstrate an understanding of how common model types work, and be able to construct models for new problems
- Show an appreciation of the importance of computational techniques in Bayesian inference
- Perform real-world Bayesian data analyses

Moodle

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

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

Computing lab

Due to COVID-19 the Maths and Stats Computer Labs are currently unavailable. For more information should the situation change please see the computing facilities webpage: <https://www.maths.unsw.edu.au/currentstudents/computing-facilities>

School 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 at:

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

With many courses still being delivered online the School and the University are being vigilant and actively applying Plagiarism checks on students.

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 can assist students with:

- 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.

Additional Resource and Service areas

Please refer to the following link for a large amount of areas you can look for Resources and Services. <https://student.unsw.edu.au/guide>

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. The *myExperience* survey reports are produced for each course. They are released to staff after all student assessment results are finalised and released to students. Course convenor will use the feedback to make improvements.