

**UNSW SCIENCE**  
**School of Maths and Statistics**

**Course outline**  
**MATH3811**  
**Statistical Inference**

**MATH3911**  
**Higher Statistical Inference**

**Term 1, 2020**



## Course Description/Aims

The aim of the course is to introduce the main ideas and principles behind the parametric and non-parametric inference procedures. The basic methods of inference used throughout Statistics will be discussed rigorously. Students will learn how to choose the appropriate inference procedure and how to perform inference using the chosen procedure.

Coverage of the main parametric and non-parametric and techniques used in statistics. Uniformly minimum variance estimation. Cramer-Rao inequality, Lehmann-Scheffe theorem. Monotone likelihood ratio distributions and uniformly most powerful unbiased tests. Generalised likelihood ratio tests, exact tests and large sample tests. Bayesian point estimation, interval estimation and hypothesis testing. Robustness and bootstrap resampling. Order statistics, goodness of fit, contingency tables. Statistical inference based on ranks. One sample, two sample and k-sample problems, blocked data, independence and association.

## Assessment and Deadlines

Assessment	Week	Weighting
Assignment 1	Assignment 1- due Friday, March 13, 5pm (week 4)	10
Mid Term Test	Midterm test Tuesday, 11am-12, March 31 (week 7)	20
Assignment 2	Assignment 2-due Friday, April 17, 5pm (week 9)	10
Final exam	TBA	60
Total		100

## Additional Assessment Information

## 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	The general Inference problem (2 hours). Principles of Statistical Inference (2 hours)	Lecture notes
2	Principles of Statistical Inference (continued) (2 hours). Information and Likelihood (2 hours)	Lecture notes
3	Maximum likelihood Inference (4 hours)	Lecture notes

<b>4</b>	Hypothesis testing including Generalized Likelihood Ratio Test (GLRT) (4 hours)	Lecture notes
<b>5</b>	Bayesian Inference (2 hours). Bootstrap and jackknife (2 hours)	Lecture notes
<b>6</b>	Self study	
<b>7</b>	Midsession test (one hour). Bootstrap computing in R (1 hour). Order statistics (2 hours)	Lecture notes
<b>8</b>	Robustness (2 hours including computing in R). Rank-based inference (2 hours)	Lecture notes
<b>9</b>	Rank-based inference continued (1 hour). Goodness-of-fit tests, contingency tables (3 hours)	Lecture notes
<b>10</b>	K sample problems (2 hours). Measures of association (2 hours)	Lecture notes

## Textbooks

**GJJ** Garthwaite, P., Jolliffe, I., Jones, B. (GJJ), *Statistical Inference*. Second Edition. Oxford University Press (2002). This is the recommended text.

**HMckKC** Hogg, R., McKean, J., Craig, A. (HMckKC) *Introduction to Mathematical Statistics*, Sixth Edition. Pearson Education (2005).

**D** Davison, A. C., *Statistical models*, Cambridge University Press (2008).

**ZL** Zwanzig, S., Liero, H. *Introduction to the Theory of Statistical Inference*, Taylor and Francis (2011).

**YS\*** Young, G. and Smith, R., *Essentials of Statistical Inference*, Cambridge University Press (2005).

**G** Gibbons, J.D. and Chakraborti, S., *Nonparametric Statistical Inference*, Fourth Edition, Marcel Dekker (2003).

**C** Conover, W.J., *Practical Nonparametric Statistics*, Third Edition, Wiley (1999).

Most of the material will be in the lecture notes!

From the textbooks, the recommended text **GJJ** will be most useful! Two copies of the book are available in the library. The bookshop also has it but it may be expensive to buy and you could try to buy cheaper used copies from Amazon.

**HMckKC** is your Second year Statistics text. Some topics and tutorial examples from this text can be useful. However, **HMckKC** does not cover all topics deeply enough for the purpose of this course. The text **ZL** is a good compact textbook which also contains useful exercise problems, some of them with complete solutions.

The other references are suitable as additional reading for the interested students. They complement the lecture notes and the recommended text. The course consists basically of two parts: parametric inference and nonparametric inference. **G** and **C** are suitable for the nonparametric part. The text **YS** has a star attached to it. It is a little bit more advanced text and is recommended to those students who want to challenge themselves “to the limit”.

## Course Learning Outcomes (CLO)

- Show how Statistical Inference arises from the first principles of Probability Theory
- Demonstrate knowledge of the concepts of finite-sample and asymptotic efficiency of Inference Procedure
- Estimate key population parameters of interest, to test hypotheses about them and to construct confidence regions
- Use in practice the Nonparametric estimation and testing procedures
- Use the R/SPLUS packages to generate output for the most common Inference Procedures. More specifically, how to perform computer intensive calculations such as bootstrapping, robust estimation and nonparametrics within R/SPLUS

## 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

The main computing laboratory is Room G012 of the Red Centre. You can get to this lab by entering the building through the main entrance to the School of Mathematics (on the Mezzanine Level) and then going down the stairs to the Ground Level. A second smaller lab is Room M020, on the mezzanine level of the Red Centre.

For more information, including opening hours, see the computing facilities webpage:

<https://www.maths.unsw.edu.au/currentstudents/computing-facilities>

Remember that there will always be unscheduled periods when the computers are not working because of equipment problems and that this is not a valid excuse for not completing tests on time.

## 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 <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](mailto: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.