



# STAT810

## Statistical Theory

S1 External 2018

*Dept of Statistics*

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#### Disclaimer

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## General Information

Unit convenor and teaching staff

Unit Convenor

Ian Marschner

[ian.marschner@mq.edu.au](mailto:ian.marschner@mq.edu.au)

Contact via [ian.marschner@mq.edu.au](mailto:ian.marschner@mq.edu.au)

Room 5.25, Level 5, 12 Wally's Walk (E7A)

10am Wed

Credit points

4

Prerequisites

Corequisites

((Admission to MAppStat or GradCertAppStat or GradDipAppStat or MDataSc or MSc) and (MATH604 and STAT670 and STAT680 and STAT683)) or (admission to MActPrac)

Co-badged status

Unit description

This unit introduces the fundamental principles of statistical inference and estimation theory. The unit begins with a discussion of probability concepts, including relative frequency, random variables, distributions and large sample theory. A discussion of estimation concepts is provided, particularly unbiasedness, consistency and efficiency. Likelihood theory is then developed, including the concept of sufficiency and the maximum likelihood approach to estimation. Hypothesis testing concepts and methods are discussed with a particular focus on likelihood ratio, score and Wald tests. An introduction to Bayesian inference principles is also provided.

## Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at <https://www.mq.edu.au/study/calendar-of-dates>

## Learning Outcomes

On successful completion of this unit, you will be able to:

be familiar with probability concepts, including random variables and probability distributions for discrete, continuous and multivariate situations and know how to apply these concepts in the context of statistical inference and sampling

understand fundamental large sample concepts in probability, including modes of convergence and the central limit theorem and be able to apply these concepts to practical problems

understand the principles and theory of estimation, including unbiasedness, consistency and relative efficiency, as well as the likelihood function and maximum likelihood estimation

understand the principles and theory of statistical hypothesis testing, including likelihood ratio tests, score tests and Wald tests

understand the principles of Bayesian inference

## General Assessment Information

### ASSIGNMENT SUBMISSION

Students must submit assignments via the iLearn website.

### LATE SUBMISSION OF ASSIGNMENTS

In case of late submission of an assignment, if no special consideration has been granted, 10% of the earned mark will be deducted for each day that the assignment is late, up to a maximum of 50%. After 5 days, including weekends and public holidays, a mark of 0% will be awarded for the assignment.

### SUPPLEMENTARY EXAMS

If you receive [special consideration](#) for the final exam, a supplementary exam will be scheduled in the interval between the regular exam period and the start of the next session. By making a special consideration application for the final exam you are declaring yourself available for a resit during the supplementary examination period and will not be eligible for a second special consideration approval based on pre-existing commitments. Please ensure you are familiar with the [policy](#) prior to submitting an application. You can check the supplementary exam information page on FSE101 in iLearn ([bit.ly/FSESup](http://bit.ly/FSESup)) for dates, and approved applicants will receive an individual notification one week prior to the exam with the exact date and time of their supplementary examination.

### SPECIAL CONSIDERATION

The only excuse for not sitting an examination at the designated time is because of documented illness of unavoidable disruption. In these special circumstances you may apply for special consideration via [ask.mq.edu.au](http://ask.mq.edu.au).

## Assessment Tasks

Name	Weighting	Hurdle	Due
<a href="#"><u>Assignment 1</u></a>	15%	No	03/04/2018
<a href="#"><u>Assignment 2</u></a>	15%	No	15/5/2018
<a href="#"><u>Assignment 3</u></a>	15%	No	05/06/2018
<a href="#"><u>Final examination</u></a>	55%	No	To be determined

### Assignment 1

Due: **03/04/2018**

Weighting: **15%**

Assignment 1

On successful completion you will be able to:

- be familiar with probability concepts, including random variables and probability distributions for discrete, continuous and multivariate situations and know how to apply these concepts in the context of statistical inference and sampling
- understand fundamental large sample concepts in probability, including modes of convergence and the central limit theorem and be able to apply these concepts to practical problems

### Assignment 2

Due: **15/5/2018**

Weighting: **15%**

Assignment 2

On successful completion you will be able to:

- understand the principles and theory of estimation, including unbiasedness, consistency and relative efficiency, as well as the likelihood function and maximum likelihood estimation

### Assignment 3

Due: **05/06/2018**

Weighting: **15%**

Assignment 3

On successful completion you will be able to:

- understand the principles and theory of statistical hypothesis testing, including likelihood ratio tests, score tests and Wald tests
- understand the principles of Bayesian inference

## Final examination

Due: **To be determined**

Weighting: **55%**

Final examination

On successful completion you will be able to:

- be familiar with probability concepts, including random variables and probability distributions for discrete, continuous and multivariate situations and know how to apply these concepts in the context of statistical inference and sampling
- understand fundamental large sample concepts in probability, including modes of convergence and the central limit theorem and be able to apply these concepts to practical problems
- understand the principles and theory of estimation, including unbiasedness, consistency and relative efficiency, as well as the likelihood function and maximum likelihood estimation
- understand the principles and theory of statistical hypothesis testing, including likelihood ratio tests, score tests and Wald tests
- understand the principles of Bayesian inference

## Delivery and Resources

### LECTURE NOTES AND OTHER MATERIALS

Lecture notes and audio recordings of lectures will be made available to external students via the unit's iLearn website (see Internet Resources below).

### TEXTBOOKS

The material and lecture notes are heavily based on the book:

**Inference Principles for Biostatisticians. I.C. Marschner. Chapman and Hall / CRC Press (2015).**

This book is recommended as additional reading beyond the lecture notes, but is not a compulsory text.

Additional readings and problems are also available in the following book:

**Mathematical Statistics with Applications, Seventh Edition. D.D. Wackerly, W. Mendenhall, R.L. Scheaffer. Duxbury Press.**

#### INTERNET RESOURCES / TECHNOLOGIES USED

This unit has an iLearn website available at <https://ilearn.mq.edu.au/login/MQ/>

Lecture notes: these will be available on the iLearn site prior to the lecture.

Audio recordings: all lectures will be recorded and will be available after the lecture.

Consult the iLearn website frequently. Other resources available include a discussion board, assignments, administrative updates etc.

#### CONSULTATION

Lecturers are available for consultation through iLearn and email, as well as during published consultation hours. For all administrative communications external students should contact:

Lesley Mooney

(02) 9850-8550

[lesley.mooney@mq.edu.au](mailto:lesley.mooney@mq.edu.au)

12WW (E7A) Building Level 6

## Unit Schedule

Weeks 1-12 will involve the study of 8 topics, each of which will consist of 1-2 lectures.

Week 13 will involve revision.

The 8 topics to be studied in this unit are as follows:

**Topic 1:** Probability and random samples

**Topic 2:** Large sample probability concepts

**Topic 3:** Estimation concepts

**Topic 4:** Likelihood

**Topic 5:** Estimation methods

**Topic 6:** Hypothesis testing concepts

**Topic 7:** Hypothesis testing methods

**Topic 8:** Bayesian inference

## Policies and Procedures

Macquarie University policies and procedures are accessible from [Policy Central \(https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central\)](https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- [Academic Appeals Policy](#)
- [Academic Integrity Policy](#)
- [Academic Progression Policy](#)
- [Assessment Policy](#)
- [Fitness to Practice Procedure](#)
- [Grade Appeal Policy](#)
- [Complaint Management Procedure for Students and Members of the Public](#)
- [Special Consideration Policy](#) (**Note:** *The Special Consideration Policy is effective from 4 December 2017 and replaces the Disruption to Studies Policy.*)

Undergraduate students seeking more policy resources can visit the [Student Policy Gateway \(https://students.mq.edu.au/support/study/student-policy-gateway\)](https://students.mq.edu.au/support/study/student-policy-gateway). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

If you would like to see all the policies relevant to Learning and Teaching visit [Policy Central \(https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central\)](https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central).

## Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: <https://students.mq.edu.au/study/getting-started/student-conduct>

## Results

Results shown in *iLearn*, or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in [eStudent](#). For more information visit [ask.mq.edu.au](http://ask.mq.edu.au).

## Student Support

Macquarie University provides a range of support services for students. For details, visit <http://students.mq.edu.au/support/>

## Learning Skills

Learning Skills ([mq.edu.au/learningskills](http://mq.edu.au/learningskills)) provides academic writing resources and study strategies to improve your marks and take control of your study.

- [Workshops](#)

- [StudyWise](#)
- [Academic Integrity Module for Students](#)
- [Ask a Learning Adviser](#)

## Student Services and Support

Students with a disability are encouraged to contact the [Disability Service](#) who can provide appropriate help with any issues that arise during their studies.

## Student Enquiries

For all student enquiries, visit Student Connect at [ask.mq.edu.au](http://ask.mq.edu.au)

## IT Help

For help with University computer systems and technology, visit [http://www.mq.edu.au/about\\_us/offices\\_and\\_units/information\\_technology/help/](http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/).

When using the University's IT, you must adhere to the [Acceptable Use of IT Resources Policy](#). The policy applies to all who connect to the MQ network including students.

## Graduate Capabilities

### PG - Capable of Professional and Personal Judgment and Initiative

Our postgraduates will demonstrate a high standard of discernment and common sense in their professional and personal judgment. They will have the ability to make informed choices and decisions that reflect both the nature of their professional work and their personal perspectives.

This graduate capability is supported by:

#### Learning outcomes

- understand the principles and theory of estimation, including unbiasedness, consistency and relative efficiency, as well as the likelihood function and maximum likelihood estimation
- understand the principles and theory of statistical hypothesis testing, including likelihood ratio tests, score tests and Wald tests
- understand the principles of Bayesian inference

#### Assessment tasks

- Assignment 3
- Final examination

### PG - Discipline Knowledge and Skills

Our postgraduates will be able to demonstrate a significantly enhanced depth and breadth of



knowledge, scholarly understanding, and specific subject content knowledge in their chosen fields.

This graduate capability is supported by:

## **Learning outcomes**

- be familiar with probability concepts, including random variables and probability distributions for discrete, continuous and multivariate situations and know how to apply these concepts in the context of statistical inference and sampling
- understand fundamental large sample concepts in probability, including modes of convergence and the central limit theorem and be able to apply these concepts to practical problems
- understand the principles and theory of estimation, including unbiasedness, consistency and relative efficiency, as well as the likelihood function and maximum likelihood estimation
- understand the principles and theory of statistical hypothesis testing, including likelihood ratio tests, score tests and Wald tests
- understand the principles of Bayesian inference

## **Assessment tasks**

- Assignment 1
- Assignment 2
- Assignment 3
- Final examination

## **PG - Critical, Analytical and Integrative Thinking**

Our postgraduates will be capable of utilising and reflecting on prior knowledge and experience, of applying higher level critical thinking skills, and of integrating and synthesising learning and knowledge from a range of sources and environments. A characteristic of this form of thinking is the generation of new, professionally oriented knowledge through personal or group-based critique of practice and theory.

This graduate capability is supported by:

## **Learning outcomes**

- understand the principles and theory of estimation, including unbiasedness, consistency and relative efficiency, as well as the likelihood function and maximum likelihood estimation
- understand the principles and theory of statistical hypothesis testing, including likelihood ratio tests, score tests and Wald tests

- understand the principles of Bayesian inference

## Assessment tasks

- Assignment 3
- Final examination

## PG - Research and Problem Solving Capability

Our postgraduates will be capable of systematic enquiry; able to use research skills to create new knowledge that can be applied to real world issues, or contribute to a field of study or practice to enhance society. They will be capable of creative questioning, problem finding and problem solving.

This graduate capability is supported by:

### Learning outcomes

- be familiar with probability concepts, including random variables and probability distributions for discrete, continuous and multivariate situations and know how to apply these concepts in the context of statistical inference and sampling
- understand fundamental large sample concepts in probability, including modes of convergence and the central limit theorem and be able to apply these concepts to practical problems

## Assessment tasks

- Assignment 1
- Assignment 2
- Final examination

## PG - Effective Communication

Our postgraduates will be able to communicate effectively and convey their views to different social, cultural, and professional audiences. They will be able to use a variety of technologically supported media to communicate with empathy using a range of written, spoken or visual formats.

This graduate capability is supported by:

### Learning outcomes

- understand the principles and theory of estimation, including unbiasedness, consistency and relative efficiency, as well as the likelihood function and maximum likelihood estimation
- understand the principles and theory of statistical hypothesis testing, including likelihood ratio tests, score tests and Wald tests

- understand the principles of Bayesian inference

## Assessment tasks

- Assignment 3
- Final examination

## PG - Engaged and Responsible, Active and Ethical Citizens

Our postgraduates will be ethically aware and capable of confident transformative action in relation to their professional responsibilities and the wider community. They will have a sense of connectedness with others and country and have a sense of mutual obligation. They will be able to appreciate the impact of their professional roles for social justice and inclusion related to national and global issues

This graduate capability is supported by:

## Learning outcomes

- understand the principles and theory of estimation, including unbiasedness, consistency and relative efficiency, as well as the likelihood function and maximum likelihood estimation
- understand the principles and theory of statistical hypothesis testing, including likelihood ratio tests, score tests and Wald tests
- understand the principles of Bayesian inference

## Assessment tasks

- Assignment 3
- Final examination

## Changes from Previous Offering

The 2018 offering of STAT810 has similar content to the 2017 offering.

## Master of Actuarial Practice Students

Master of Actuarial Practice (MAP) students who are seeking an exemption for the Institute of Actuaries subject CT3 will need to obtain at least a Credit (65%) in STAT810. In addition, MAP students will need to complete an additional assessment task covering some of the content from STAT680 and STAT683. MAP students will be given access to the iLearn websites for STAT680 and STAT683 to enable them to prepare for the additional assessment task. The additional assessment task will be a 75-minute test in Week 12. Further information about the additional assessment task will be made available on the STAT810 iLearn site by the end of Week 5.

Eligibility for exemption from Subject CT3 will be determined based on the final result awarded in STAT810 (85%) and the mark on the additional assessment task in Week 12 (15%). An aggregate of 65% or higher will be required in order for an exemption from Subject CT3 to be

recommended.

## Changes since First Published

Date	Description
26/04/2018	Update unit convenor details
27/02/2018	Updated unit convenor details