



# STAT710

## Statistical Theory

S1 Evening 2017

*Dept of Statistics*

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## General Information

Unit convenor and teaching staff

Tutor

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E7A Room 643

Credit points

4

Prerequisites

Admission to MRes

Corequisites

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

## Assessment Tasks

Name	Weighting	Hurdle	Due
<a href="#"><u>Assignment 1</u></a>	15%	No	04 April 2017
<a href="#"><u>Assignment 2</u></a>	15%	No	16 May 2017
<a href="#"><u>Assignment 3</u></a>	15%	No	06 June 2017
<a href="#"><u>Final examination</u></a>	55%	No	To be determined

### Assignment 1

Due: **04 April 2017**

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: **16 May 2017**

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: **06 June 2017**

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

LECTURES

Thursday 6-8 p.m. in W6B Room 336.

## TUTORIALS (Weeks 2-13)

The number of tutorials will depend on enrollment and will be chosen from the available times on Thursday evening (8 pm to 9 pm) and another time to be determined. Final details will be announced by Week 1.

## TEXTBOOKS

The material and lecture notes are heavily based on the recent 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 HOURS

Members of the Statistics Department have consultation hours each week when they are available to help students. These consultation hours are available from the Statistics Department in Level 6 of E7A.

## ASSIGNMENT SUBMISSION

Students must submit assignments via the iLearn website.

## Unit Schedule

Weeks 1-12 will involve the study of 9 topics, each of which will be consist of 1-2 lectures.

Week 13 will involve revision.

The 9 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

**Topic 9:** Introduction to some further inference topics

## Policies and Procedures

Macquarie University policies and procedures are accessible from [Policy Central](#). Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy [http://mq.edu.au/policy/docs/academic\\_honesty/policy.html](http://mq.edu.au/policy/docs/academic_honesty/policy.html)

Assessment Policy [http://mq.edu.au/policy/docs/assessment/policy\\_2016.html](http://mq.edu.au/policy/docs/assessment/policy_2016.html)

Grade Appeal Policy <http://mq.edu.au/policy/docs/gradeappeal/policy.html>

Complaint Management Procedure for Students and Members of the Public [http://www.mq.edu.au/policy/docs/complaint\\_management/procedure.html](http://www.mq.edu.au/policy/docs/complaint_management/procedure.html)

Disruption to Studies Policy (in effect until Dec 4th, 2017): [http://www.mq.edu.au/policy/docs/disruption\\_studies/policy.html](http://www.mq.edu.au/policy/docs/disruption_studies/policy.html)

Special Consideration Policy (in effect from Dec 4th, 2017): <https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policies/special-consideration>

In addition, a number of other policies can be found in the [Learning and Teaching Category](#) of 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/support/student\\_conduct/](https://students.mq.edu.au/support/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](#).

### Disruption to Study for Final Examination

If you apply for Disruption to Study for your final examination, you must make yourself available for the week of July 24 – 28, 2017. If you are not available at that time, there is no guarantee an additional examination time will be offered. Specific examination dates and times will be determined at a later date.

### Policy on Late submission of Assignments

No extensions will be granted. Students who have not submitted an assignment prior to the deadline will be awarded a mark of 0 for the task, except for cases in which an application for Disruption to Studies is made and approved.

## 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

## Changes from Previous Offering

The 2017 offering of STAT810 has similar content to the 2016 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.