



# STAT810

## Statistical Theory

S1 Evening 2014

*Statistics*

### Contents

---

<u>General Information</u>	2
<u>Learning Outcomes</u>	3
<u>Assessment Tasks</u>	3
<u>Delivery and Resources</u>	5
<u>Unit Schedule</u>	6
<u>Policies and Procedures</u>	6
<u>Graduate Capabilities</u>	7
<u>Changes since First Published</u>	10

---

#### **Disclaimer**

Macquarie University has taken all reasonable measures to ensure the information in this publication is accurate and up-to-date. However, the information may change or become out-dated as a result of change in University policies, procedures or rules. The University reserves the right to make changes to any information in this publication without notice. Users of this publication are advised to check the website version of this publication [or the relevant faculty or department] before acting on any information in this publication.

## General Information

Unit convenor and teaching staff

Other Staff

Thomas Fung

[thomas.fung@mq.edu.au](mailto:thomas.fung@mq.edu.au)

Contact via [thomas.fung@mq.edu.au](mailto:thomas.fung@mq.edu.au)

E4A 530

Monday 2 - 4 pm

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)

E4A 540

11am Wednesday

Credit points

4

Prerequisites

Admission to MAppStat or PGDipAppStat or PGCertAppStat or (ACST601 and ACST602 and ACST604)

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 techniques to calculate probabilities, expected values and probability, moment and cumulant generating functions for discrete, continuous and multivariate random variables and know how to apply these concepts in practical problems
- understand fundamental limit theorems of Probability and Statistics and be able to apply them in practical problems
- understand three modes of convergence of random variables and be able to apply them to get practical large sample approximations
- understand and know how to use the Delta Method in practical problems
- understand the principles and theory of estimation
- understand the principles and theory of statistical hypothesis testing

## Assessment Tasks

Name	Weighting	Due
<a href="#"><u>Assignment 1</u></a>	15%	25 March 2014
<a href="#"><u>Assignment 2</u></a>	15%	29 April 2014
<a href="#"><u>Assignment 3</u></a>	15%	20 May 2014
<a href="#"><u>Mid-year examination</u></a>	55%	To be determined

### Assignment 1

Due: **25 March 2014**

Weighting: **15%**

Assignment 1

On successful completion you will be able to:

- be familiar with techniques to calculate probabilities, expected values and probability, moment and cumulant generating functions for discrete, continuous and multivariate random variables and know how to apply these concepts in practical problems
- understand fundamental limit theorems of Probability and Statistics and be able to apply them in practical problems

## Assignment 2

Due: **29 April 2014**

Weighting: **15%**

Assignment 2

On successful completion you will be able to:

- understand three modes of convergence of random variables and be able to apply them to get practical large sample approximations
- understand and know how to use the Delta Method in practical problems

## Assignment 3

Due: **20 May 2014**

Weighting: **15%**

Assignment 3

On successful completion you will be able to:

- understand the principles and theory of estimation
- understand the principles and theory of statistical hypothesis testing

## Mid-year examination

Due: **To be determined**

Weighting: **55%**

Mid-year examination

On successful completion you will be able to:

- be familiar with techniques to calculate probabilities, expected values and probability, moment and cumulant generating functions for discrete, continuous and multivariate random variables and know how to apply these concepts in practical problems
- understand fundamental limit theorems of Probability and Statistics and be able to apply them in practical problems
- understand three modes of convergence of random variables and be able to apply them to get practical large sample approximations
- understand and know how to use the Delta Method in practical problems
- understand the principles and theory of estimation
- understand the principles and theory of statistical hypothesis testing

## Delivery and Resources

### LECTURES

Tuesday 6-9 p.m. in W5C-320.

### TUTORIALS (Weeks 2-13)

E5A-150 on Wednesday 6-7 p.m.

E5A-130 on Wednesday 7-8 p.m.

E5A-230 on Wednesday 8-9 p.m.

(note: the number of tutorials will depend on enrollment and may change)

### SOFTWARE

The R software package will be used for simulation and graphics. This software is freely available to be downloaded at [www.r-project.org](http://www.r-project.org)

### TEXTBOOK

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

This textbook will provide additional readings and problems, to supplement the lecture and tutorial material.

### 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 listed on the doors of the Statistics staff located on E4A level 5.

## ASSIGNMENT SUBMISSION

Students may submit assignments during the lecture or via the iLearn website.

## CHANGES SINCE LAST DELIVERY

No substantive changes since last delivery

## Unit Schedule

Week 1: Introduction to Probability and Statistics. Discrete random variables and their probability distributions.

Week 2: Continuous random variables and their probability distributions. Probability, Moment and Cumulant Generating Functions.

Week 3: Multivariate probability distributions. Functions of random variables.

Weeks 4 – 7: Laws of Large Numbers, Central Limit Theorem, Asymptotic Theory.

Weeks 8 – 10: Estimation, properties of estimators, likelihood theory.

Week 11 – 13: Hypotheses testing, properties of tests, likelihood-based inference methods, Bayesian inference.

## 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.html>

Grading Policy <http://mq.edu.au/policy/docs/grading/policy.html>

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

Grievance Management Policy [http://mq.edu.au/policy/docs/grievance\\_management/policy.html](http://mq.edu.au/policy/docs/grievance_management/policy.html)

Disruption to Studies Policy [http://www.mq.edu.au/policy/docs/disruption\\_studies/policy.html](http://www.mq.edu.au/policy/docs/disruption_studies/policy.html) *The Disruption to Studies Policy is effective from March 3 2014 and replaces the Special Consideration Policy.*

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/)

### 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 special consideration 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://informatics.mq.edu.au/help/>.

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

## Graduate Capabilities

### 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 techniques to calculate probabilities, expected values and probability, moment and cumulant generating functions for discrete, continuous and multivariate random variables and know how to apply these concepts in practical problems
- understand fundamental limit theorems of Probability and Statistics and be able to apply them in practical problems
- understand three modes of convergence of random variables and be able to apply them to get practical large sample approximations
- understand and know how to use the Delta Method in practical problems
- understand the principles and theory of estimation
- understand the principles and theory of statistical hypothesis testing

## Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
- Mid-year 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
- understand the principles and theory of statistical hypothesis testing

## Assessment tasks

- Assignment 3
- Mid-year 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 techniques to calculate probabilities, expected values and probability, moment and cumulant generating functions for discrete, continuous and multivariate random variables and know how to apply these concepts in practical problems
- understand fundamental limit theorems of Probability and Statistics and be able to apply them in practical problems
- understand three modes of convergence of random variables and be able to apply them to get practical large sample approximations
- understand and know how to use the Delta Method in practical problems

## **Assessment tasks**

- Assignment 1
- Assignment 2
- Mid-year 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
- understand the principles and theory of statistical hypothesis testing

## **Assessment tasks**

- Assignment 3
- Mid-year examination

## **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
- understand the principles and theory of statistical hypothesis testing

## Assessment tasks

- Assignment 3
- Mid-year examination

## Changes since First Published

Date	Description
16/01/2014	The Prerequisites was updated.