Contents

General Information ........................................ 2
Learning Outcomes ........................................ 3
Assessment Tasks .......................................... 3
Delivery and Resources ..................................... 5
Unit Schedule ............................................... 6
Policies and Procedures ..................................... 6
Graduate Capabilities ....................................... 8
Changes from Previous Offering ......................... 10

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**Unit guide** STAT810 Statistical Theory

## General Information

<table>
<thead>
<tr>
<th>Unit convenor and teaching staff</th>
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<tbody>
<tr>
<td><strong>Unit Convenor</strong></td>
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<tr>
<td>Ian Marschner</td>
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<tr>
<td><a href="mailto:ian.marschner@mq.edu.au">ian.marschner@mq.edu.au</a></td>
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<tr>
<td>Contact via <a href="mailto:ian.marschner@mq.edu.au">ian.marschner@mq.edu.au</a></td>
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<td>E4A 540</td>
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<td>11am Tuesday</td>
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<tr>
<td><strong>Tutor</strong></td>
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<td>Wenli Hu</td>
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<td><a href="mailto:wenli.hu@mq.edu.au">wenli.hu@mq.edu.au</a></td>
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| Credit points                   | 4 |

| Prerequisites                   | Admission to MAppStat or PGDipAppStat or PGCertAppStat or GradDipAppStat 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 [http://students.mq.edu.au/student_admin/enrolmentguide/academicdates/](http://students.mq.edu.au/student_admin/enrolmentguide/academicdates/)
Learning Outcomes

1. 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
2. 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
3. understand the principles and theory of estimation, including unbiasedness, consistency and relative efficiency, as well as the likelihood function and maximum likelihood estimation
4. understand the principles and theory of statistical hypothesis testing, including likelihood ratio tests, score tests and Wald tests
5. understand the principles of Bayesian inference

Assessment Tasks

<table>
<thead>
<tr>
<th>Name</th>
<th>Weighting</th>
<th>Due</th>
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<tbody>
<tr>
<td>Assignment 1</td>
<td>15%</td>
<td>24 March 2015</td>
</tr>
<tr>
<td>Assignment 2</td>
<td>15%</td>
<td>28 April 2015</td>
</tr>
<tr>
<td>Assignment 3</td>
<td>15%</td>
<td>19 May 2015</td>
</tr>
<tr>
<td>Mid-year examination</td>
<td>55%</td>
<td>To be determined</td>
</tr>
</tbody>
</table>

Assignment 1

Due: **24 March 2015**
Weighting: **15%**

Assignment 1

This Assessment Task relates to the following 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
Assignment 2
Due: 28 April 2015
Weighting: 15%
Assignment 2

This Assessment Task relates to the following 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

Assignment 3
Due: 19 May 2015
Weighting: 15%
Assignment 3

This Assessment Task relates to the following Learning Outcomes:

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

Mid-year examination
Due: To be determined
Weighting: 55%
Mid-year examination

This Assessment Task relates to the following 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

Delivery and Resources

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

TUTORIALS (Weeks 2-13)
W5A-105 on Thursday 5-6 p.m.
W5C-335 on Wednesday 6-7 p.m.
(note: the number of tutorials will depend on enrollment and may change)

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

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:


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 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
Disruption to Studies Policy 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/)

**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.

**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/](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 Enquiry Service**

For all student enquiries, visit Student Connect at ask.mq.edu.au

**Equity 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.

**IT Help**

Graduate Capabilities

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
- 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, 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
• Mid-year 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
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• understand the principles of Bayesian inference

Assessment tasks

• Assignment 1
• Assignment 2
• 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 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
• 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, 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
• Mid-year examination

Changes from Previous Offering

Compared to the last delivery, the probability component of the unit has been reduced and the statistical inference component of the unit has been increased.