# STAT806

## Statistical Inference

S1 Day 2017

*Dept of Statistics*

## Contents

# General Information

Unit convenor and teaching staff
Unit Convenor
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Lecturer
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Credit points
4

Prerequisites

Corequisites
(Admission to MAppStat or GradDipAppStat and (MATH604 and STAT670 and STAT680 and STAT683)) or (admission to Msc or MActPrac)

Co-badged status

Unit description
This unit provides an introduction to likelihood-based statistical inference. After a brief discussion of the multivariable calculus concepts needed, students will study (multivariate) change of variable, the likelihood function and maximum likelihood estimation, using examples from a range of distributions. The theory of estimation and hypothesis testing will be discussed, including most powerful tests, large sample theory, the sufficiency principle, the likelihood ratio principle, and sequential probability ratio tests.

## 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 able to understand the theoretical reasons why various estimators and tests are used.
Be familiar with the derivations of estimators and tests.
Be able to derive estimators and their theoretical small sample and asymptotic properties.
Be able to generate tests for various statistical hypotheses, and establish their properties.

# Assessment Tasks

| Name | Weighting | Hurdle | Due |
|---|---|---|---|
| Assignment 1 | 10% | No | 17th March |
| Assignment 2 | 10% | No | 11th April |
| Assignment 3 | 10% | No | 23rd May |
| Tutorial Participation | 10% | No | Weeks 2 to 13 |
| Final Exam | 60% | No | TBA |

## Assignment 1

Due: **17th March**
Weighting: **10%**

Submit to the lecturer by 4pm on the due date. There is no “group work” assessment in this unit. All work is to be the student’s own. No extensions will be granted.  Students who have not submitted the assignment prior to the deadline will be awarded a mark of 0 for the assignment, except for cases in which an application for disruption to studies is made and approved.

On successful completion you will be able to:

- Be able to understand the theoretical reasons why various estimators and tests are used.
- Be familiar with the derivations of estimators and tests.
- Be able to derive estimators and their theoretical small sample and asymptotic properties.

## Assignment 2

Due: **11th April**
Weighting: **10%**

Submit to the lecturer by 4pm on the due date. There is no “group work” assessment in this unit. All work is to be the student’s own. No extensions will be granted.  Students who have not submitted the assignment prior to the deadline will be awarded a mark of 0 for the assignment, except for cases in which an application for disruption to studies is made and approved

On successful completion you will be able to:

- Be able to understand the theoretical reasons why various estimators and tests are used.
- Be familiar with the derivations of estimators and tests.
- Be able to derive estimators and their theoretical small sample and asymptotic properties.
- Be able to generate tests for various statistical hypotheses, and establish their properties.

## Assignment 3

Due: **23rd May**
Weighting: **10%**

Submit to the lecturer by 4pm on the due date. There is no “group work” assessment in this unit. All work is to be the student’s own. No extensions will be granted.  Students who have not submitted the assignment prior to the deadline will be awarded a mark of 0 for the assignment, except for cases in which an application for disruption to studies is made and approved.

On successful completion you will be able to:

- Be able to understand the theoretical reasons why various estimators and tests are used.
- Be familiar with the derivations of estimators and tests.
- Be able to derive estimators and their theoretical small sample and asymptotic properties.
- Be able to generate tests for various statistical hypotheses, and establish their properties.

## Tutorial Participation

Due: **Weeks 2 to 13**
Weighting: **10%**

Students will contribute to discussions and hand in at least one handwritten page of tutorial problem solutions per tutorial.

On successful completion you will be able to:

- Be able to understand the theoretical reasons why various estimators and tests are used.
- Be familiar with the derivations of estimators and tests.
- Be able to derive estimators and their theoretical small sample and asymptotic properties.
- Be able to generate tests for various statistical hypotheses, and establish their properties.

## Final Exam

Due: **TBA**
Weighting: **60%**

The final Examination will be held during the mid-year Examination period. The final Examination is 3 hours long (with an additional 10 minutes' reading time). It will cover all topics in the unit. The final examination is closed book. Students may take into the final Exam **TWO** A4 pages of notes **handwritten (not typed)** on **BOTH** sides. Calculators will be needed but must not be of the text/ programmable type.

The University Examination timetable will be available in Draft form approximately 8 weeks before the commencement of the examinations and in Final form approximately 4 weeks before the commencement of the examinations at: http://www.timetables.mq.edu.au/exam

The only exception to not sitting an examination on the designated date is because of documented illness or unavoidable disruption. In these circumstances you may wish to consider applying for disruption to studies.

If you notify the University of your disruption to studies 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.

On successful completion you will be able to:

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# Delivery and Resources

There are four contact hours per week, comprised of three lectures and one tutorial. Check the

timetable for classes.

Please consult iLearn or the Departmental webpages for details of consultation hours.

**Technologies used and required**

Lecture material will be placed on iLearn.

Students will need to use a calculator for the final examination and some of the other assessments.

# Unit Schedule

| Topic | Material covered |
|---|---|
| 1 | Probability, expectation, change of variable, moment generating functions, multivariate distributions, conditional expectation. |
| 2 | Estimation, the likelihood function, the maximum likelihood principle, properties of estimators, asymptotic properties of maximum likelihood estimators, the Cramér-Rao lower bound. |
| 3 | Statistics, sufficient statistics, completeness, minimum variance unbiased estimators, Rao-Blackwell theorem. |
| 4 | Hypothesis testing: simple, composite hypotheses, the Neyman-Pearson lemma, asymptotic properties. |
| 5 | The Sequential Probability Ratio Test |
| 6 | Confidence intervals and regions |

# Learning and Teaching Activities

## Lecture

Three hours a week.

## Tutorial

One hour a week.

# 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

Assessment Policy 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

Disruption to Studies Policy (in effect until Dec 4th, 2017): 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/

## 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.

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

# 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) 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

# IT Help

For help with University computer systems and technology, visit 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 - 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 able to understand the theoretical reasons why various estimators and tests are used.
- Be familiar with the derivations of estimators and tests.
- Be able to derive estimators and their theoretical small sample and asymptotic properties.
- Be able to generate tests for various statistical hypotheses, and establish their properties.

### Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
- Tutorial Participation
- Final Exam

### Learning and teaching activities

- Three hours a week.
- One hour a week.

## 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

- Be able to understand the theoretical reasons why various estimators and tests are used.

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## Learning and teaching activities

- Three hours a week.
- One hour a week.

# 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 able to understand the theoretical reasons why various estimators and tests are used.
- Be familiar with the derivations of estimators and tests.
- Be able to derive estimators and their theoretical small sample and asymptotic properties.
- Be able to generate tests for various statistical hypotheses, and establish their properties.

## Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
- Tutorial Participation

- Final Exam

### Learning and teaching activities

- Three hours a week.
- One hour a week.

## 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:

### Assessment tasks

- Tutorial Participation
- Final Exam

### Learning and teaching activities

- Three hours a week.
- One hour a week.

# Changes from Previous Offering

The Assignment 4 assessment task has been replaced by Tutorial Participation.

# Textbooks and other reference material

There is no prescribed textbook for the Unit. Any book with a title such as “Introduction to Mathematical Statistics” will be suitable as a reference. The reference for STAT273, Wackerly, D., Mendenhall W., and Scheaffer, R.L. Mathematical Statistics with Applications (4th, 5th or 6th Editions), would be useful. The lecture notes will be extensive and fairly self-contained.

# Changes since First Published

| Date | Description |
| --- | --- |
| 02/02/2017 | Added the requested info on supplementary exams - Anne Macmillan 27 January. |