



STAT306

Statistical Inference

S1 Day 2019

Dept of Mathematics and Statistics

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General Information

Unit convenor and teaching staff

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See iLearn

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Credit points

3

Prerequisites

6cp at 200 level including (STAT272 or STAT273)

Corequisites

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 of distributions from STAT272 and STAT273. 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 that there are 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 properties.

Be able to generate tests for various statistical hypotheses.

Assessment Tasks

Name	Weighting	Hurdle	Due
<u>Assignment 1</u>	15%	No	5th April
<u>Assignment 2</u>	15%	No	24th May
<u>SGTA Participation</u>	10%	No	Weeks 2 to 13
<u>Final Exam</u>	60%	No	Formal Examination Period

Assignment 1

Due: **5th April**

Weighting: **15%**

Submit a copy of your assignment solutions to your 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. All assignments must be submitted by the due date and time. No marks will be given for late submission unless an extension has been granted, for example through a successful special consideration request via “ask.mq.edu.au”.

On successful completion you will be able to:

- Be able to understand that there are 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 properties.

Assignment 2

Due: **24th May**

Weighting: **15%**

Submit a copy of your assignment solutions to your 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. All assignments must be submitted by the due date and time. No marks will be given for late submission unless an extension has been granted, for example through a successful special consideration request via “ask.mq.edu.au”.

On successful completion you will be able to:

- Be able to understand that there are 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 properties.
- Be able to generate tests for various statistical hypotheses.

SGTA Participation

Due: **Weeks 2 to 13**

Weighting: **10%**

Students will contribute to discussions in class.

On successful completion you will be able to:

- Be able to understand that there are 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 properties.
- Be able to generate tests for various statistical hypotheses.

Final Exam

Due: **Formal Examination Period**

Weighting: **60%**

The final Examination will be held during the mid-year Examination period. The final Examination is 2 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 or typed (but not photocopied)** on **BOTH** sides. Calculators will need to be used 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 excuse for not sitting an examination at the designated time is because of documented illness or unavoidable disruption. In these special circumstances you may apply for special consideration via ask.mq.edu.au

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/FSESupp) 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.

On successful completion you will be able to:

- Be able to understand that there are 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 properties.
- Be able to generate tests for various statistical hypotheses.

Delivery and Resources

There are four contact hours per week, comprised of three lectures and one SGTA class. Check the university timetable page for classes <https://timetables.mq.edu.au>.

Please consult iLearn or the Unit webpage 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

This course covers 6 topics listed below

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.

SGTA

One hour a week.

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 published on platform other than [eStudent](#), (eg. iLearn, Coursera etc.) 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 or if you are a Global MBA student contact globalmba.support@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) 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

If you are a Global MBA student contact globalmba.support@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

Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

Learning outcomes

- Be able to understand that there are 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 properties.

- Be able to generate tests for various statistical hypotheses.

Assessment tasks

- Assignment 1
- Assignment 2
- SGTA Participation
- Final Exam

Learning and teaching activities

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

Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

Learning outcomes

- Be familiar with the derivations of estimators and tests.
- Be able to derive estimators and their theoretical properties.
- Be able to generate tests for various statistical hypotheses.

Assessment tasks

- Assignment 1
- Assignment 2
- SGTA Participation
- Final Exam

Learning and teaching activities

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

Problem Solving and Research Capability

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative

in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

Learning outcomes

- Be familiar with the derivations of estimators and tests.
- Be able to derive estimators and their theoretical properties.
- Be able to generate tests for various statistical hypotheses.

Assessment tasks

- Assignment 1
- Assignment 2
- SGTA Participation
- Final Exam

Learning and teaching activities

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

Effective Communication

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

This graduate capability is supported by:

Assessment tasks

- SGTA Participation
- Final Exam

Learning and teaching activities

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

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. Particularly, the book by: 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 self-contained.