



STAT710

Statistical Theory

S1 Evening 2019

Dept of Mathematics and Statistics

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General Information

Unit convenor and teaching staff

Unit Convenor

Ian Marschner

ian.marschner@mq.edu.au

Contact via Email

12 Wally's Walk Office 5.25

1-3pm Monday

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

General Assessment Information

Late submission of assignments

All assignments and assessment tasks must be submitted by the official due date and time.

The only exception for not handing in an assignment on time is documented illness or unavoidable disruption. In these special circumstances you may apply for [special consideration](#) via ask.mq.edu.au.

No marks will be given for late work unless an extension has been granted following a successful application for Special Consideration.

Please contact the unit convenor for advice as soon as you become aware that you may have difficulty meeting any of the assignment deadlines.

Special Consideration for examinations

The only exception for not sitting an examination at the designated time is documented illness or unavoidable disruption. In these special circumstances you may apply for special consideration via ask.mq.edu.au.

FINAL EXAM POLICY: You are advised that it is Macquarie University policy not to set early examinations for individuals or groups of students. All students are expected to ensure that they are available until the end of the teaching semester, that is, the final day of the official examination period. 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

Assessment Tasks

Name	Weighting	Hurdle	Due
Assignment 1	15%	No	01/04/2019
Assignment 2	15%	No	13/5/2019
Assignment 3	15%	No	03/06/2019
Final examination	55%	No	Formal Examination Period

Assignment 1

Due: **01/04/2019**

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: **13/5/2019**

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: **03/06/2019**

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: **Formal Examination Period**

Weighting: **55%**

Final examination

The University Examination timetable will be available in draft form approximately eight weeks before the commencement of the examinations and in final form approximately four weeks before the commencement of the examinations at: <http://www.timetables.mq.edu.au/>

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

You should attend the following classes each week:

- one 2 hour lecture
- one 1 hour practical class

Times and locations for all classes can be found on the University website at <https://timetables.mq.edu.au/2019> and should be regularly checked especially at the start of semester.

Please contact the unit convenor as soon as possible if you have difficulty attending and participating in any classes.

There may be alternatives available to make up the work. If there are circumstances that mean you miss a class or assignment deadline, you can apply for a Special Consideration.

LECTURES: begin in Week 1. Lecture notes are available on iLearn prior to the lecture.

PRACTICALS: begin in Week 2. Problems sets are available on iLearn prior to the practical.

TEXTBOOKS

The material and lecture notes are heavily based on the 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 Department of Mathematics and Statistics have consultation hours each week when they are available to help students. These consultation hours are available from the department in Level 6 of 12WW (formerly E7A).

Unit Schedule

Weeks 1-12 will involve the study of 8 topics, each of which will be consist of 1-2 lectures.

Week 13 will involve revision.

The 8 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

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

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

PG - Engaged and Responsible, Active and Ethical Citizens

Our postgraduates will be ethically aware and capable of confident transformative action in relation to their professional responsibilities and the wider community. They will have a sense of connectedness with others and country and have a sense of mutual obligation. They will be able to appreciate the impact of their professional roles for social justice and inclusion related to national and global issues

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