STAT6191

Statistical Inference for Data Science

Session 1, In person-scheduled-weekday, North Ryde 2025

School of Mathematical and Physical Sciences

Contents

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General Information

Unit convenor and teaching staff
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Credit points
10

Prerequisites
STAT6190

Corequisites

Co-badged status

Unit description
Statistical inference allows us to draw meaningful conclusions about a population by analysing a representative sample. This unit covers the foundational concepts of probability, which form the statistical framework for using sample data to make inferences about the broader population. It then explores classical statistical inference techniques, enabling us to quantify uncertainty and make informed decisions. The unit also introduces the Bayesian approach, which combines prior knowledge with sample data for a more holistic, subjective analysis, especially useful in domains with limited data or significant prior knowledge. Throughout, the focus is on building a strong conceptual understanding, with practical examples to reinforce theory and demonstrate real-world relevance.

Learning in this unit enhances student understanding of global challenges identified by the United Nations Sustainable Development Goals (UNSDGs) Industry, Innovation and Infrastructure

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:

ULO1: Explain and use Probability Theory relevant to Statistical Inference.

ULO2: Demonstrate knowledge of the fundamental principles of inference.

ULO3: Estimate key population parameters of interest, test hypotheses about them and construct confidence regions.

ULO4: Evaluate and use likelihood-based inference methods.

ULO5: Evaluate and use elementary Bayesian inference methods.

ULO6: Analyse data using computing packages which implement the most common Inference procedures.

General Assessment Information

Requirements to Pass this Unit

To pass this unit you must:

- Achieve a total mark equal to or greater than 50% across all assessments.

Attendance and Participation

We strongly encourage all students to actively participate in all learning activities. Regular engagement is crucial for your success in this unit, as these activities provide opportunities to deepen your understanding of the material, collaborate with peers, and receive valuable feedback from instructors, to assist in completing the unit assessments. Your active participation not only enhances your own learning experience but also contributes to a vibrant and dynamic learning environment for everyone.

Late Assessment Submission and Penalties

Unless a Special Consideration request has been submitted and approved, a 5% penalty (of the total possible mark of the task) will be applied for each day a written report or assessment is not submitted, up until the 7th day (including weekends). After the 7th day, a grade of '0' will be awarded even if the assessment is submitted. The submission time for all uploaded assessments is 11:55 pm. A 1-hour grace period will be provided to students who experience a technical concern.

For any late submission of time-sensitive tasks, such as scheduled exams and/or assessments, please apply for Special Consideration.

Assessments where Late Submissions will be accepted

Statistical Inference Problem Set – YES, Standard Late Penalty applies.

Project Report – YES, Standard Late Penalty applies.

Final Exam – NO, unless Special Consideration is granted.

Special Consideration

The Special Consideration Policy aims to support students who have been impacted by short-term circumstances or events that are serious, unavoidable and significantly disruptive, and which may affect their performance in assessment. If you experience circumstances or events

that affect your ability to complete the assessments in this unit on time, please inform the convenor and submit a Special Consideration request through https://connect.mq.edu.au.

Assessment Tasks

Name	Weighting	Hurdle	Due
Statistical Inference Problem Set	20%	No	11/04/2025
Project Report	30%	No	30/05/2025
Final Exam	50%	No	Exam Period

Statistical Inference Problem Set

Assessment Type [1]: Quantitative analysis task
Indicative Time on Task [2]: 15 hours
Due: **11/04/2025**
Weighting: **20%**

Students will be given a set of problems to complete on their own as a take-home assessment. In this assessment, students will reinforce and apply the concepts covered in lectures, along with the skills developed in SGTA sessions.

On successful completion you will be able to:

- Explain and use Probability Theory relevant to Statistical Inference.
- Demonstrate knowledge of the fundamental principles of inference.
- Estimate key population parameters of interest, test hypotheses about them and construct confidence regions.

Project Report

Assessment Type [1]: Project
Indicative Time on Task [2]: 30 hours
Due: **30/05/2025**
Weighting: **30%**

A written report must be submitted, in which students will demonstrate their practical skills by applying statistical techniques to a simulation-based inference problem.

On successful completion you will be able to:

- Explain and use Probability Theory relevant to Statistical Inference.
- Demonstrate knowledge of the fundamental principles of inference.
- Estimate key population parameters of interest, test hypotheses about them and construct confidence regions.
- Evaluate and use likelihood-based inference methods.
- Evaluate and use elementary Bayesian inference methods.
- Analyse data using computing packages which implement the most common Inference procedures.

Final Exam

Assessment Type [1]: Examination
Indicative Time on Task [2]: 25 hours
Due: **Exam Period**
Weighting: **50%**

An invigilated examination held during the University's formal examination period.

On successful completion you will be able to:

- Explain and use Probability Theory relevant to Statistical Inference.
- Demonstrate knowledge of the fundamental principles of inference.
- Estimate key population parameters of interest, test hypotheses about them and construct confidence regions.
- Evaluate and use likelihood-based inference methods.
- Evaluate and use elementary Bayesian inference methods.
- Analyse data using computing packages which implement the most common Inference procedures.

[1] If you need help with your assignment, please contact:

- the academic teaching staff in your unit for guidance in understanding or completing this type of assessment
- the Writing Centre for academic skills support.

[2] Indicative time-on-task is an estimate of the time required for completion of the assessment task and is subject to individual variation

Delivery and Resources

Classes

Lectures (beginning in Week 1): A one-hour lecture each week.

SGTA classes (beginning in Week 2): A two-hour SGTA class each week. Students must register for the SGTA class.

Students can use the Class Finder tool in eStudent to see when and where classes are being held via Publish: https://publish.mq.edu.au/.

Computing and Software

R, RStudio, and Quarto are freely available for download and will be used in the SGTA sessions and assessment tasks for this unit.

Suggested Textbooks

- Wasserman, Larry. *All of Statistics: A Concise Course in Statistical Inference.* Springer Texts in Statistics, Springer New York, 2004.
- Casella, George, and Roger L. Berger. *Statistical Inference*. 2nd ed., Duxbury, 2002.

Methods of Communication

We will communicate with you via your university email and through announcements on iLearn. Queries to convenors can either be placed on the iLearn discussion board or sent to the unit convenor via the contact email on iLearn.

Unit Schedule

Week 1: Introduction to statistical inference; fundamental concepts of probability; basic set theory.

Week 2: Random variables; discrete and continuous probability distributions; joint, marginal and conditional probabilties; independence.

Week 3: Common probability distributions; expectations and other key moments.

Week 4: Sequences of random variables; modes of convergence.

Week 5: Statistical models and estimation; sampling; properties of estimators; introductory estimation methods.

Week 6: Introduction to likelihood; key likelihood concepts.

Week 7: Maximum likelihood estimation (MLE); computation, properties and inference with MLE.

Week 8: Additional properties of estimators; miminum variance estimators; confidence intervals.

Week 9: Standard hypothesis testing.

Week 10: Likelihood-based hypothesis testing.

Week 11: The Bayesian paradigm; Bayes' theorem; Bayesian inference.

Week 12: Prior Specification; conjugate priors; maximum posteriori estimates; credible intervals.

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://policies.mq.edu.au). 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
- Assessment Procedure
- Complaints Resolution Procedure for Students and Members of the Public
- Special Consideration Policy

Students seeking more policy resources can visit Student Policies (https://students.mq.edu.au/support/study/policies). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

To find other policies relating to Teaching and Learning, visit Policy Central (https://policies.mq.edu.au) and use the search tool.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/admin/other-resources/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 connect.mq.edu.au or if you are a Global MBA student contact globalmba.support@mq.edu.au

Academic Integrity

At Macquarie, we believe academic integrity – honesty, respect, trust, responsibility, fairness and courage – is at the core of learning, teaching and research. We recognise that meeting the expectations required to complete your assessments can be challenging. So, we offer you a range of resources and services to help you reach your potential, including free online writing and maths support, academic skills development and wellbeing consultations.

Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

Academic Success

Academic Success provides resources to develop your English language proficiency, academic writing, and communication skills.

- Workshops
- Chat with a WriteWISE peer writing leader
- Access StudyWISE
- Upload an assignment to Studiosity
- Complete the Academic Integrity Module

The Library provides online and face to face support to help you find and use relevant information resources.

- Subject and Research Guides
- Ask a Librarian

Student Services and Support

Macquarie University offers a range of Student Support Services including:

- IT Support
- Accessibility and disability support with study
- Mental health support
- Safety support to respond to bullying, harassment, sexual harassment and sexual assault
- Social support including information about finances, tenancy and legal issues
- Student Advocacy provides independent advice on MQ policies, procedures, and processes

Student Enquiries

Got a question? Ask us via the Service Connect Portal, or contact Service Connect.

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.

Changes from Previous Offering

We value student feedback to be able to continually improve the way we offer our units. This new unit has been designed based on feedback from similar units, and we will continue to adapt it based on future input. Therefore, we encourage students to provide constructive feedback via student surveys, to the teaching staff directly, or via the FSE Student Experience & Feedback link on the iLearn page.

To enable students more time to focus on learning, understanding and reflecting on the content of our unit, we have developed the following assessment structure consisting of three components: a statistical inference problem set, a project report, and a final exam. Although no marks are associated with attendance, all activities provide you with key content designed to help you understand content and complete the assessments.

Unit information based on version 2025.05 of the Handbook