STAT306

Statistical Inference

S1 Day 2015

Dept of Statistics

Contents

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General Information

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Credit points
3

Prerequisites
6cp at 200 level including (STAT272(P) or STAT273(P))

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	Due
Assignment 1	10%	19th March
Assignment 2	10%	30th April
Assignment 3	10%	28th May
Tutorial Participation	10%	Week 2 to 13
Final Exam	60%	TBA

Assignment 1

Due: **19th March**
Weighting: **10%**

Submit to your lecturer by 3pm 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 special consideration is made and approved.

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: **30th April**
Weighting: **10%**

Submit to your lecturer by 3pm 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 special consideration is made and approved.

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.

Assignment 3

Due: **28th May**
Weighting: **10%**

Submit to your lecturer by 3pm 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 special consideration is made and approved.

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.

Tutorial Participation

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

To obtain full marks you must participate in every tutorial.

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: **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.

Students MUST perform satisfactorily in the final examination in order to pass the unit regardless of their performance throughout the semester.

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 forspecial consideration.

Your final grade in STAT306 will be based on your work during the semester and in the final examination. You need to achieve the same standards both during the semester assessments and the final exam to be awarded a particular grade as set out in the Grading Policy (http://www.mq.edu.au/policy/docs/grading/policy.html).

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 tutorial. Check the timetable for classes.

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

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.html

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

Grade Appeal Policy http://mq.edu.au/policy/docs/gradeappeal/policy.html

Grievance Management Policy http://mq.edu.au/policy/docs/grievance_management/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/

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://informatics.mq.edu.au/help/.

When using the University's IT, you must adhere to the Acceptable Use 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
- Assignment 3
- Tutorial 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
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- 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
- Assignment 3
- Tutorial 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

- Tutorial Participation
- Final Exam

Learning and teaching activities

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

Grading in this unit

Your final SNG and grade in STAT306 will be based on your work during semester and in the final examination as specified in the 'Assessment' section. The determination of your final SNG and Grade will be based on an assessment of your performance on individual assessment tasks against identified criteria and standards as set out in the section titled 'Assessment Criteria', and an assessment of overall performance in the unit. Final grades will be awarded on the basis of your overall performance and the extent to which you demonstrate fulfilment of the learning outcomes listed for this unit.

The relationship between SNGs and Final Grades is shown in the table below:

SNG.Range	Grade	Standard
85 - 100	High Distinction (HD)	Provides consistent evidence of deep and critical understanding in relation to the learning outcomes. There is substantial originality and insight in identifying, generating and communicating competing arguments, perspectives or problemsolving approaches; critical evaluation of problems, their solutions and their implications; creativity in application as appropriate to the discipline.
75 - 84	Distinction (D)	Provides evidence of integration and evaluation of critical ideas, principles and theories, distinctive insight and ability in applying relevant skills and concepts in relation to learning outcomes. There is demonstration of frequent originality in defining and analysing issues or problems and providing solutions; and the use of means of communication appropriate to the discipline and the audience.
65 - 74	Credit (Cr)	Provides evidence of learning that goes beyond replication of content knowledge or skills relevant to the learning outcomes. There is demonstration of substantial understanding of fundamental concepts in the field of study and the ability to apply these concepts in a variety of contexts; convincing argumentation with appropriate coherent justification; communication of ideas fluently and clearly in terms of the conventions of the discipline.
50 - 64	Pass (P)	Provides sufficient evidence of the achievement of learning outcomes. There is demonstration of understanding and application of fundamental concepts of the field of study; routine argumentation with acceptable justification; communication of information and ideas adequately in terms of the conventions of the discipline. The learning attainment is considered satisfactory or adequate or competent or capable in relation to the specified outcomes.
0 - 49	Fail (F)	Does not provide evidence of attainment of learning outcomes. There is missing or partial or superficial or faulty understanding and application of the fundamental concepts in the field of study; missing, undeveloped, inappropriate or confusing argumentation; incomplete, confusing or lacking communication of ideas in ways that give little attention to the conventions of the discipline.

Please note that a student must meet the performance standard outlined above in **both** the coursework **and** the examination sections of this unit in order to be awarded a particular grade.

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.