STAT806
Statistical Inference
S1 Day 2015
Dept of Statistics

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# General Information

<table>
<thead>
<tr>
<th>Unit convenor and teaching staff</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit Convenor</strong></td>
</tr>
<tr>
<td>Barry Quinn</td>
</tr>
<tr>
<td><strong><a href="mailto:barry.quinn@mq.edu.au">barry.quinn@mq.edu.au</a></strong></td>
</tr>
<tr>
<td>Contact via <a href="mailto:barry.quinn@mq.edu.au">barry.quinn@mq.edu.au</a></td>
</tr>
<tr>
<td>E4A535</td>
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<tr>
<td><strong>Lecturer</strong></td>
</tr>
<tr>
<td>Thomas Fung</td>
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<td><strong><a href="mailto:thomas.fung@mq.edu.au">thomas.fung@mq.edu.au</a></strong></td>
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<tr>
<td>E4A530</td>
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</table>

**Credit points**
4

**Prerequisites**
Admission to MAppStat or PGDipAppStat or PGCertAppStat or GradDipAppStat or (ACST601 and ACST602 and ACST604)

**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 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 [http://students.mq.edu.au/student_admin/enrolmentguide/academicdates/](http://students.mq.edu.au/student_admin/enrolmentguide/academicdates/)

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

Assessment Tasks

<table>
<thead>
<tr>
<th>Name</th>
<th>Weighting</th>
<th>Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignment 1</td>
<td>10%</td>
<td>19th March</td>
</tr>
<tr>
<td>Assignment 2</td>
<td>10%</td>
<td>30th April</td>
</tr>
<tr>
<td>Assignment 3</td>
<td>10%</td>
<td>28th May</td>
</tr>
<tr>
<td>Assignment 4</td>
<td>10%</td>
<td>4th June</td>
</tr>
<tr>
<td>Final Exam</td>
<td>60%</td>
<td>TBA</td>
</tr>
</tbody>
</table>

Assignment 1
Due: **19th March**
Weighting: **10%**

Submit to the 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.

This Assessment Task relates to the following 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.

Assignment 2
Due: **30th April**
Weighting: **10%**

Submit to the 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.

This Assessment Task relates to the following 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.

Assignment 3
Due: 28th May
Weighting: 10%

Submit to the 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.

This Assessment Task relates to the following 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.

Assignment 4
Due: 4th June
Weighting: 10%

The assignment will be available in week 3 and is not due until week 13, and will consist of questions on one set of models using the methodology of several of the topics.

Submit to the 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.
This Assessment Task relates to the following 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.

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 for special consideration.

Your final grade in STAT806 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).

This Assessment Task relates to the following 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.

**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

<table>
<thead>
<tr>
<th>Topic</th>
<th>Material covered</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Probability, expectation, change of variable, moment generating functions, multivariate distributions, conditional expectation.</td>
</tr>
<tr>
<td>2</td>
<td>Estimation, the likelihood function, the maximum likelihood principle, properties of estimators, asymptotic properties of maximum likelihood estimators, the Cramér-Rao lower bound.</td>
</tr>
<tr>
<td>4</td>
<td>Hypothesis testing: simple, composite hypotheses, the Neyman-Pearson lemma, asymptotic properties.</td>
</tr>
<tr>
<td>5</td>
<td>The Sequential Probability Ratio Test</td>
</tr>
<tr>
<td>6</td>
<td>Confidence intervals and regions</td>
</tr>
</tbody>
</table>

### 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:


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/](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](http://ask.mq.edu.au).


Student Support

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

Learning Skills

Learning Skills ([mq.edu.au/learningskills](http://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
Graduate Capabilities

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.
- 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
- Assignment 4
- 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 task

- Final Exam

Learning and teaching activity

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

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
- Assignment 4
- Final Exam
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
• Assignment 4
• 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:

<table>
<thead>
<tr>
<th>SNG.Range</th>
<th>Grade</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>85 - 100</td>
<td>High Distinction (HD)</td>
<td>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.</td>
</tr>
<tr>
<td>75 - 84</td>
<td>Distinction (D)</td>
<td>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.</td>
</tr>
<tr>
<td>65 - 74</td>
<td>Credit (Cr)</td>
<td>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.</td>
</tr>
<tr>
<td>50 - 64</td>
<td>Pass (P)</td>
<td>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.</td>
</tr>
<tr>
<td>0 - 49</td>
<td>Fail (F)</td>
<td>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.</td>
</tr>
</tbody>
</table>
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.