STAT3001: Mathematical Statistics
Semester 1, 2006

Brief description of course content:

Point estimation with the focus on maximum likelihood (ML) estimators and their properties, including sufficiency and asymptotic efficiency; exponential families; computational aspects of ML estimation, including the EM algorithm; interval estimation; hypothesis tests; an introduction to the Bayesian approach to inference; multivariate normal distribution and the distribution of quadratic forms; basic distributional results for the general linear model.

Staff Lecturer and Course Coordinator: Professor Geoff McLachlan

- **Email**: gjm@maths.uq.edu.au
- **Phone**: +61 7 336 52150, +61 7 334 62623
- **Fax**: +61 7 336 51477
- **Postal address**: Department of Mathematics
  University of Queensland
  St. Lucia, Brisbane, Australia 4072
- **Office in Dept. of Mathematics**: Room 745, Priestley Building (No. 67)
- **Office in IMB**: Room 6.114, Queensland Bioscience Precinct (West Wing)

Consultation hours or Office hours:
In Maths Office:
Tuesday 2 – 3 p.m.
Wednesday 9 – 10 a.m.

**Web page** The course profile and course material can be found on the web at the following address: www.maths.uq.edu.au/courses/STAT3001

Class contact hours: 3L, 1T

Tuesday 9, Room 67-343 (Lecture)
Tuesday 10, Room 83-S437 (Lecture)
Friday 9, Room 83-C516 (Lecture)

Tuesday 2, Room 50-C203 (Tutorial)
Assumed background:

The students are expected to have a basic knowledge of probability and statistics that would enable them to complete the course STAT2004. That is, it is advantageous if students have some idea of the concept of a random variable and its distribution, and the use of statistical models to represent data on random phenomena in order to draw inferences from observed samples.

Course goals/rationale:

On completing this course students will:

- Have an understanding of how point estimators are formed and assessed in forming estimates from an observed random sample.
- Have an understanding of the use of confidence intervals and tests of hypotheses.
- Have an understanding of the distinction between the frequentist and Bayesian frameworks for statistical inference.
- Have knowledge of the extension of the univariate normal distribution to the multivariate case where more than one normal random variable is to be studied simultaneously.
- Have an understanding of the application of the general linear model to data.

Graduate Attributes:

The following graduate attributes will be developed in the course –

In-Depth Knowledge of the Field of Study

- A comprehensive and well-founded knowledge of the field of study.

Effective Communication

- The ability to collect, analyse, and organise information and ideas, and to convey those ideas clearly and fluently, in both written and spoken form – by working through regular assignment problems and a final examination.
- The ability to engage effectively and appropriately with information and communication Technologies – by working through assignment problems.

Independence and Creativity

- The ability to work and learn independently – by learning the relevant techniques and explaining solutions to problems in your own way.
- The ability to generate ideas - in order to solve assignment problems.
- The ability to identify problems, create solutions – through evaluating the lecture and assignment material.
Critical Judgement

- The ability to define and analyse problems - by working through the lecture and assignment material.
- The ability to apply critical reasoning to issues through independent thought and informed judgement – by working through assignment and examination problems.
- The ability to evaluate opinions, make decisions and to reflect critically on the justifications for decisions - by working on assignment problems.

Ethical And Social Understanding

- An appreciation of the philosophical and social contexts of the discipline – through in-class discussions.

Textbook and references:

Reference texts:


Library contact:
The liaison librarian for the physical sciences disciplines is located in the Physical Sciences and Engineering Library in the Hawken Building and may be consulted for assistance in the course:

Leith Woodall
Email: l.woodall@library.uq.edu.au
Extension: 52367
University Learning Resources:

Additional course resources, past examination papers, and subject area FindIts are available on the Library website (http://www.library.uq.edu.au/eres/).

The University offers a range of resources and services to support student learning. Details are available on the myServices website (https://student.my.uq.edu.au/).

Teaching and Learning Methods:

There will be three lectures each week, where the basic material and ideas will be presented. Assignments will be set at regular intervals, five in all, and will involve using the techniques developed in lectures to solve problems motivated by applications. The lecturer will be present at the tutorials to offer help and hints for solving the problems.

ASSESSMENT

Required assessment tasks

Advise students how performance in the course will be assessed; this includes:

- There will be 5 assignments during the course, at 2-3 weekly intervals.
- Each assignment is worth 7% of the final assessment.
- Each assignment will be marked and returned after 1-2 weeks.
- The 5 assignments together with a 2-hour final examination worth 65% make up the total assessment for the course.

Assessment criteria

List the assessment criteria by which the student’s level of achievement in the course will be judged.

- The extent to which they demonstrate the student’s understanding of the methods and techniques outlined in lectures.
- Their ability to apply these methods and techniques successively in new situations.
- Their ability to apply their conclusions in a clear and cogent form.
- Their ability to interpret the meaning of the results obtained.
Criteria for the award of grades

Your grade for this course will be determined by which of the following levels of achievement that you consistently display in the items of summative assessment.

Grade of 7: (86% - 100%) the student demonstrates an excellent understanding of the theory of the topics listed in the course outline and is highly proficient in applying the techniques to solve both theoretical and practical problems.

Grade of 6: (75% - 85%) the student demonstrates a comprehensive understanding of the theory of the topics listed in the course outline and is proficient in applying the techniques to solve both theoretical and practical problems.

Grade of 5: (65% - 74%) the student demonstrates a good understanding of the theory of the topics listed in the course outline and can apply the techniques to solve problems.

Grade of 4: (50 – 64%) the student demonstrates an understanding of the theory of the topics listed in the course outline and demonstrates a knowledge of the techniques used to solve problems.

Grade of 3: (45% - 49%) the student demonstrates some understanding of the theory of the topics listed in the course outline and demonstrates a knowledge of the techniques used to solve problems.

Grade of 2: (25 – 44%) the student demonstrates limited understanding of the theory of the topics listed in the course outline and demonstrates limited knowledge of the techniques used to solve problems. This includes attempts at expressing their deductions and explanations and attempts to answer a few questions accurately.

Grade of 1: (1 – 24%) the student demonstrates very limited understanding of the theory of the topics listed in the course outline and of the basic concepts in the course material. This includes attempts at answering some questions but demonstrating very limited understanding of the key concepts.

Assessment Related Policies and Guidelines:

An overview of the University’s assessment-related policies can be found on myAdvisor (link to: http://www.uq.edu.au/myadvisor/index.html?page=2910). Students should refer to section 3.30 Assessment in the University Handbook of Policies and Procedures (link to: http://www.uq.edu.au/hupp/index.html?page=25108&pid=25075) for full details on all assessment-related policies.

Academic Integrity & Plagiarism

It is the University's task to encourage ethical scholarship and to inform students and staff about the institutional standards of academic behaviour expected of them in learning, teaching and research. Students have a responsibility to maintain the highest standards of academic
integrity in their work. Students must not cheat in examinations or other forms of assessment and must ensure they do not plagiarise.

The University has adopted the following definition of plagiarism:

Plagiarism is the act of misrepresenting as one's own original work the ideas, interpretations, words or creative works of another. These include published and unpublished documents, designs, music, sounds, images, photographs, computer codes and ideas gained through working in a group. These ideas, interpretations, words or works may be found in print and/or electronic media.

The following are examples of plagiarism where appropriate acknowledgement or referencing of the author or source does not occur:

- Direct copying of paragraphs, sentences, a single sentence or significant parts of a sentence;
- Direct copying of paragraphs, sentences, a single sentence or significant parts of a sentence with an end reference but without quotation marks around the copied text;
- Copying ideas, concepts, research results, computer codes, statistical tables, designs, images, sounds or text or any combination of these;
- Paraphrasing, summarising or simply rearranging another person's words, ideas, etc without changing the basic structure and/or meaning of the text;
- Offering an idea or interpretation that is not one's own without identifying whose idea or interpretation it is;
- A 'cut and paste' of statements from multiple sources;
- Presenting as independent, work done in collaboration with others;
- Copying or adapting another student's original work into a submitted assessment item.

You are encouraged to read the UQ Academic Integrity and Plagiarism policy (http://www.uq.edu.au/hupp/index.html?page=25128) which makes a comprehensive statement about the University's approach to plagiarism, the consequences and the principles associated with preventing plagiarism.

**Supplementary examinations**

A supplementary examination may be awarded in one course to students who obtain a grade of 2 or 3 in the final semester of their program and require this course to finish their degree. You should check the rules for your degree program for information on the possible award of supplementary examinations. Applications for supplementary examinations must be made to the Director of Studies in the Faculty.

EPSA Faculty policy on the award of supplementary exams may be found via the Faculty Guidelines on Examinations from the EPSA student page http://www.epsa.uq.edu.au/index.html?page=7640&pid=7563
Special examinations

If a student is unable to sit a scheduled examination for medical or other adverse reasons, she/he can and should apply for a special examination. Applications made on medical grounds should be accompanied by a medical certificate; those on other grounds must be supported by a personal declaration stating the facts on which the application relies.

Applications for special examinations for central and end-of-semester exams must be made through the Student Centre. Applications for special examinations in school exams are made to the course coordinator.

More information on the University’s assessment policy may be found

EPSA Faculty policy on the award of special exams may be found via the Faculty Guidelines on Examinations from the EPSA student page

Feedback on Assessment

Feedback is essential to effective learning and students can expect to receive appropriate and timely feedback on all assessment.

For a detailed explanation of the feedback you are entitled to, you should consult the policy on Student Access to Feedback on Assessment. (link to:

As a student you have a responsibility to incorporate feedback into your learning; make use of the assessment criteria that you are given; be aware of the rules, policies and other documents related to assessment; and provide teachers with feedback on their assessment practices.

There are certain steps you can take if you feel your result does not reflect your performance. Please refer to the myAdvisor web site (link to:

Students with a Disability:

Any student with a disability who may require alternative academic arrangements, including assessment, in the course/program is encouraged to seek advice at the commencement of the semester from a Disability Adviser at Student Support Services. Refer to the University policy, Students with a Disability (Disability Action Plan) (link to:
http://www.uq.edu.au/hupp/index.html?page=25122&pid=25075) and to the policy on Special Arrangements for Examinations for Students with a Disability (link to:

Where an adjustment is made to an accredited program, it is the responsibility of the relevant Faculty to liaise with professional and registration bodies regarding the acceptability of the change/s.
Assistance for Students:

Students with English language difficulties should contact the course coordinator or tutors for the course.

Students with English language difficulties who require development of their English skills should contact the Institute for Continuing and TESOL Education on extension 56565.

The Learning Assistance Unit located in the Relaxation Block in Student Support Services. You may consult learning advisers in the unit to provide assistance with study skills, writing assignments and the like. Individual sessions are available. Student Support Services also offers workshops to assist students. For more information, phone 51704 or on the web http://www.sss.uq.edu.au/index.html.

Student Liaison Officer:

The School of Physical Sciences has a Student Liaison Officer as an independent source of advice to assist students with resolving academic difficulties.

The Student Liaison officer during 2006 will be Professor Peter Adams, Room 547 Priestley Building, (email pa@maths.uq.edu.au)

Working with Children:

Students whose studies include a professional/work placement, internship, clinical practice, teaching practice or other similar activity which involves them in regular contact with children should refer to the University policy, Working with Children Check - "Suitability Card" (link to: http://www.uq.edu.au/hupp/index.html?page=25004&pid=24963) to find out how to apply for a ‘working with children check’.

Occupational Health and Safety:

Undergraduate Students (link to: http://www.uq.edu.au/hupp/index.html?page=25055&pid=25015) and Postgraduate Students (link to: http://www.uq.edu.au/hupp/index.html?page=25057&pid=25015) should be familiar with the University policies on occupational health and safety in the laboratory.

Placement Courses:

Students on a placement course – also known as a work placement, internship, industry study, industry experience, clinical practice, clinical placement, practical work, practicum, fieldwork, teaching practice – should refer to the University policy, Placement Courses (link to: http://www.uq.edu.au/hupp/index.html?page=25120&pid=25075) for information on course administration, assessment, dispute resolution, expectations and responsibilities.
Program of work for the semester:

The frequentist approach to estimation; point estimation; desirable properties of estimators, including sufficiency and efficiency; uniformly minimum variance unbiased estimators; minimum variance bound estimators; maximum likelihood (ML) theory; asymptotic properties of ML estimators; computation of ML estimates including via the EM algorithm; some alternatives to ML estimation; interval estimation; tests of hypotheses including the score test, Wald's test, and the likelihood ratio test; an introduction to the Bayesian approach to inference; multivariate normal distribution and the distribution of quadratic forms; basic distributional results for the general linear model.