Brief description of course content (e.g. handbook description)
Coverage of variants of the expectation-maximization (EM) algorithm and their applications to ML estimation for the $t$-distribution and in factor analysis; model-based clustering; robust methods of estimation and clustering, including the use of the $t$-distribution; methods for the analysis of high-dimensional data, including mixtures of factor analyzers; multiple hypothesis testing; applications to real high-dimensional data sets.
Staff Lecturer and Course Coordinator: Professor Geoff McLachlan

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- **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/STAT4402](http://www.maths.uq.edu.au/courses/STAT4402)

**Class contact hours**: **3L**

Tuesday 10, Room 67-641

Thursday 9-11, Room 67-641
Assumed background:

It will be assumed that students will have successfully completed a third year or equivalent courses in Statistical Inference. Students are encouraged to talk to the lecturer if they are unclear as to whether they have the appropriate background.

Course goals/rationale:

Students will have obtained knowledge on advanced topics in multivariate analysis, covering variants of the EM algorithm and their applications, including methods for robust estimation and clustering. They will also acquire knowledge on the use of classification methods for both supervised and unsupervised data with particular emphasis on a model-based approach using finite mixture models modified to handle high-dimensional data sets and on the carrying out of tests of multiple hypotheses with bounds on the error rates.

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.

For more information on the University policy on development of graduate attributes in courses, refer to the web http://www.uq.edu.au/hupp/contents/view.asp?s1=3&s2=20&s3=5.

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.

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. One assessment will involve the presentation of a 20 minute seminar on a topic of choice in the field of multivariate analysis.

- The 5 assignments will 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 policy

Students should be familiar with the rules which relate to assessment in their degrees as well as general university policy such as found in the General Award Rules. These are all set out on the myAdvisor page on the UQ website


Plagiarism:

The University has adopted the following definition of plagiarism:
“Plagiarism is the action or practice of taking and using as one’s own the thoughts or writings of another, without acknowledgment. The following practices constitute acts of plagiarism and are a major infringement of the University's academic values:

- Where paragraphs, sentences, a single sentence or significant parts of a sentence are copied directly, and are not enclosed in quotation marks and appropriately footnoted;

- Where direct quotations are not used, but are paraphrased or summarised, and the source of the material is not acknowledged either by footnoting or other simple reference within the text of the paper; and

- Where an idea which appears elsewhere in printed, electronic or audio-visual material is used or developed without reference being made to the author or the source of that material.”

When a student knowingly plagiarises someone’s work, there is intent to gain an advantage and this may constitute misconduct.

Students are encouraged to study together and to discuss ideas, but this should not result in students handing in the same or similar assessment work. Do not allow another student to copy your work. While students may discuss approaches to tackling a tutorial problem, care must be taken to submit individual and different answers to the problem. Submitting the same or largely similar answers to an assignment or tutorial problem may constitute misconduct.

For more information on the University policy on plagiarism, please refer to http://www.uq.edu.au/hupp/index.html?page=25128&pid=25075

**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 http://www.uq.edu.au/hupp/index.html?page=25113&pid=25075
EPSA Faculty policy on the award of special 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

**Feedback on assessment:**

You may request feedback on assessment in this course progressively throughout the semester from the course coordinator. Feedback on assessment may include discussion, written comments on work, model answers, lists of common mistakes and the like.

Students may peruse examinations scripts and obtain feedback on performance in a final examination provided that the request is made within six months of the release of final course results. After a period of six months following the release of results, examination scripts may be destroyed.

Information on the University’s policy on access to feedback on assessment may be found at http://www.uq.edu.au/hupp/index.html?page=25114&pid=25075

EPSA Faculty policy on assessment feedback and re-marking may be found at http://www.epsa.uq.edu.au/index.html?page=7674&pid=7564
Textbook and references

There is no set text. A list of reference books will be distributed in the first lecture.

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

Students with disabilities:

Any student with a disability who may require alternative academic arrangements in the course is encouraged to seek advice at the commencement of the semester from a Disability Adviser at Student Support Services.

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 2005 will be Dr Peter Adams, Room 547 Priestley building, (email pa@maths.uq.edu.au)
Program of work for the semester:

Variants of the EM algorithm, including the ECM, ECME, and AECM extensions; examples of their use covering ML estimation for the $t$-distribution and factor analysis models; robust estimation and cluster analysis; methods for high-dimensional supervised and unsupervised classification; support vector machine; nearest-shrunken classifiers; mixtures of factor analysers; multiple hypothesis testing and concept of the false discovery rate (FDR); applications of multivariate techniques to actual data sets, including microarray gene-expression data sets.