STAT378 Statistical Computing
2008 (D1)

Year and Semester: 1st semester, 2008
Lecturer-in-charge: Dr Jun Ma
Prerequisites / Corequisites: STAT273(P) or STAT272(P) or STAT278(P)

Students in this unit should read this unit outline carefully at the start of semester. It contains important information about the unit. If anything in it is unclear, please consult one of the teaching staff in the unit.

ABOUT THIS UNIT

This is a 3 credit-point unit. This unit studies basic issues of computational statistics. Techniques discussed in this unit are absolutely necessary for modern statistical data analysis.

TEACHING STAFF

Convenor: Dr Jun Ma
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    Consulting hours: to be announced later.

Tutor: Mr Weihao Choo
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CLASSES

The timetable for classes can be found on the University web site at: http://www.timetables.mq.edu.au/
Lectures: You are required to attend 3 x 1 hour lectures each week, beginning in Week 1.
Tutorials: You are required to attend 1 x 1 hour tutorial each week, beginning in Week 2.

Change of tutorial classes
If you wish to change your current tutorial class, you can do so by sending the lecturer-in-charge (see the email address above) an email stating reasons for the change. If the class you wish to change to is full then your request will be denied. Please note that there will be no more change of tutorial classes after the second week of teaching.

REQUIRED AND RECOMMENDED TEXTS AND/OR MATERIALS

There is no assigned textbook for this unit. Students are expected to rely on the lecture notes and reference materials cited or handed out in the lectures.

UNIT WEB PAGE

The unit web page is available at the following address:
http://www.stat.mq.edu.au/ug/stat_units/stat_units300/stat378

Consult the web page frequently. You will find administrative updates, lecture notes, tutorials and assignments posted there.

LEARNING OUTCOMES

Our aims in this unit are:

1. To familiarize you with the computational procedures in statistical analysis, *especially simulation and modelling such as linear and nonlinear models*.

2. To obtain experiences with the MATLAB computing package. Students are also encouraged to use other data analysis software such as SAS, Splus, R and EXCEL.

In addition to the discipline-based learning objectives, all academic programs at Macquarie seek to develop students' generic skills in a range of areas. One of the aims of this unit is that students develop their skills in the following:

- *Foundation skills of literacy, numeracy and information technology;*
- *Problem-solving skills;*
- *Creative thinking skills.*

TEACHING AND LEARNING STRATEGY

This unit are taught by lectures and tutorials. Students are required to attend lecturers and tutorials, and in particular, the tutorial attendance comprises part of the assessment.

Week-by-week list of the topics are presented below.

Week	Topic
1&2	**Introduction and Review** 1. Introduction to statistical computing. 2. Review of probability distributions. 3. Quick introduction to MATLAB.
2&3	**Monte Carlo Simulation** 1. Introduction to Monte Carlo simulations. 2. Methods of random number generation: (1) Inversion method. (2) Acceptance-Rejection method.
4	**Bootstrapping** 1. Introduction to Bootstrap method. 2. Numerical examples. 3. Further discussion.
5	**Regression Computation I** 1. Simple linear regression. 2. Least-squares criterion and normal equations. 3. Matrices expression of linear regression.
6&7	**Regression Computation II** 1. Multiple linear regression. 2. Matrices expression, normal equations. 3. Solving linear system of equations. 4. Properties of the estimator.
7&8	**Regression Computation III** 1. Residual analysis. 2. Transformation and variance stabilizing. 3. Weighted regression. 4. Regression Diagnostics.
8&9	**Regression Computation IV** 1. Ridge regression. 2. Computer assisted model building: (1) Stepwise. (2) Best subset. (3) Cross-validation. (4) Cp and PRESS.
10	**Nonlinear regression** 1. Nonlinear Model and least-squares criterion. 2. Algorithm.
11&12	**Maximum Likelihood (ML) Estimation I** 1. Introduction to maximum likelihood estimation. 2. An example in medical imaging. 3. Algorithms for ML computing.
13	**Some other Models** 1. Binomial models (1) Logistic model (2) Probit model 2. Poisson models

It would be helpful if student could read the lecture materials before the lecture. All lecture materials will be posted on the unit web page. Generally, lecture notes will be posted half to one week before the lecture.

Final grades awarded to students will be based on their performance in tutorials, assignments and the final exam. Total marks will be made up as follows:

Tutorial   **5%**
Assignments   **20%**
Final exam   **75%**

In order to pass the unit you must demonstrate satisfactory performances in **all** the above four aspects of assessment.

1. Tutorials

Students are required to attend a one-hour tutorial class each week. The tutorial mark (5% of the total) is determined by each student's <u>attendance and performance</u> in the tutorial classes.

2. Assignments

Assignments comprise a major part of the learning process. They give each student the opportunity to review his/her understanding of the course material. <u>Assignments are compulsory</u>. Failure to submit any assignment will be taken as an evidence of non-participation in the course and may lead to exclusion from the course. Late submission of assignments will be penalized at the rate of 30% deduction per day. Assignments must be each student's own work. Discussions are allowed but the final work must be your personal effort. It requires that all assignments are word-processed.

In answering assignment questions, a careful discussion of the problem and its solution is required. Any computer output used should be extracted, clearly headed and placed in the assignment or in an Appendix of the assignment.

There will be FOUR assignments. They are due **in tutorials** on the dates indicated below:

	Posted on web	**Due In**
Assignment 1	March 11	March 28
Assignment 2	March 26	April 1
Assignment 3	May 6	May 13
Assignment 4	May 27	June 3

3. Final Exam

A non-programmable calculator and <u>two</u> A4 sheets of notes (must be <u>hand written</u> and possibly on both sides) may be taken in to the examination room. The final exam will cover <u>all the materials</u> discussed in this unit.

The University Examination period in the First Half Year 2008 is from June 11 2007 to June 27 2007. You are expected to present yourself for examination at the time and place designated in the University Examination Timetable. The timetable will be available in Draft form approximately eight weeks before the commencement of the examinations and in Final form approximately four weeks before the commencement of the examinations.
http://www.timetables.mq.edu.au/exam

The only exception to not sitting an examination at the designated time is because of documented illness or unavoidable disruption. In these circumstances you may wish to consider applying for Special Consideration. Information about unavoidable disruption and the special consideration process is available at http://www.reg.mq.edu.au/Forms/APSCon.pdf

If a Supplementary Examination is granted as a result of the Special Consideration process the examination will be scheduled after the conclusion of the official examination period.

You are advised that it is Macquarie University policy not to set early examinations for individuals or groups of students. All students are expected to ensure that they are available until the end of the teaching semester, which is the final day of the official examination period.

PLAGIARISM

The University defines plagiarism in its rules: "Plagiarism involves using the work of another person and presenting it as one's own." Plagiarism is a serious breach of the University's rules and carries significant penalties. You must read the University's practices and procedures on plagiarism. These can be found in the *Handbook of Undergraduate Studies* or on the web at:
http://www.student.mq.edu.au/plagiarism/

The policies and procedures explain what plagiarism is, how to avoid it, the procedures that will be taken in cases of suspected plagiarism, and the penalties if you are found guilty. Penalties may include a deduction of marks, failure in the unit, and/or referral to the University Discipline Committee.

UNIVERSITY POLICY ON GRADING

Academic Senate has a set of guidelines on the distribution of grades across the range from fail to high distinction. Your final result will include one of these grades plus a standardised numerical grade (SNG).

On occasion your raw mark for a unit (i.e., the total of your marks for each assessment item) may not be the same as the SNG which you receive. Under the Senate guidelines, results may be scaled to ensure that there is a degree of comparability across the university, so that units with the same past performances of their students should achieve similar results.

It is important that you realise that the policy does not require that a minimum number of students are to be failed in any unit. In fact it does something like the opposite, in requiring examiners to explain their actions if more than 20% of students fail in a unit.

The process of scaling does not change the order of marks among students. A student who receives a higher raw mark than another will also receive a higher final scaled mark.

For an explanation of the policy see http://www.mq.edu.au/senate/MQUonly/Issues/Guidelines2003.doc or http://www.mq.edu.au/senate/MQUonly/Issues/detailedguidelines.doc.

STUDENT SUPPORT SERVICES

Macquarie University provides a range of Academic Student Support Services. Details of these services can be accessed at http://www.student.mq.edu.au.

REFERENCES

The following books are useful references for this unit.

Jennrich, Robert I. An Introduction to Computational Statistics – regression analysis. (QA278.2.J46 1995).

Maindonald, J.H. Statistical Computation. (QA276.4.M25)

Gentle, James E. Elements of Computational Statistics. (QA276.4.G455)

Chatterjee and Price. (1977). Regression Analysis by Example. (QA278.2.C5)

Kleijnen, Jack. Simulation: a statistical perspective. (QA76.9.C65.K5913)

Draper and Smith. Applied Regression Analysis. 2nd edition. (QA278.2.D7)

Dobson. Intro to Statistical Modelling (GLIM reference). (QA276.D59)