# DIVISION OF ECONOMIC AND FINANCIAL STUDIES

# STAT320: MODELLING AND QUALITY MANAGEMENT

## First Semester, 2006 – D1

## UNIT OUTLINE

**Unit convenor:** Dr Tania Prvan

**Prerequisites:** STAT270(P) or STAT271(P) or BIOL235(P) or PSY222(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 unit consists of two separate modules.

The first module discusses statistical modelling in general and in particular demonstrates the wide applicability of linear models. The emphasis is on practical issues in data analysis using multiple regression models demonstrated by the use of statistical packages for modelling and diagnostic testing.

The second module, Quality Management is concerned with aiding management of organisations to ensure that their process output meets customer requirements. To manage and improve the processes, it is essential that the quality of output be measured, and that the measurements be analysed and interpreted to provide information and process performance. This section will primarily consider statistical methods and techniques that aid in detection of changes in the quality of output brought about, either by unintentional changes in the process, or by a deliberate attempt to improve the process. These will include some or all of the following: control charts, process capability, acceptance sampling, reliability and experimental design.

**Software**
Minitab & Microsoft Word.

## TEACHING STAFF

**Convenor:** Dr Tania Prvan, E4A 510, ph: 9850-8561, tprvan@efs.mq.edu.au
**Other lecturers:** Ms Pamela Shaw, E4A 519A, ph: 9850-4768, pshaw@efs.mq.edu.au

Please note that any communication with staff via email will only be conducted using your official university email address. Other teaching staff and times for consultation hours will be finalised at the end of Week 1. These will be posted on the web site.

Ms Pamela Shaw will be teaching the first six weeks and Dr Tania Prvan will be teaching the next six weeks. The last week of lectures is revision.

## CLASSES

**Lectures**
Lectures begin in Week 1. Lectures are held on Wednesdays between 2:00pm and 4:00pm in room W6B 336 and Thursdays between 9am and 10am in room E7B 264.

**Tutorials**
1 x 1 hour tutorial. Tutorials will start in the second week. Weeks 8 to 13 are in the computer laboratory E4B 208. In weeks 2 to 7 you will be required to prepare material for tutorials and this work will count towards your assessment. In weeks 8 to 12 you will be required to submit the laboratory at the end of the tutorial and this work will also count towards your assessment.

The timetable for classes can be found on the University web site at:
http://www.timetables.mq.edu.au/

## REQUIRED AND RECOMMENDED TEXTS AND/OR MATERIALS

**Prescribed texts**
**Quality Management:** Montgomery, D. C. (2005) *Introduction to Statistical Quality Control, 5th Edition.* Wiley, New York; Chichester.
**Linear Models**: Chatterjee, S.; Hadi,A.S. & Price,B. (2000) *Regression Analysis by Example (3rd Ed).* Wiley
**General**: Anderson,J. & Poole,M. (1994) *Thesis and assignment writing*. Wiley.

**Recommended texts:**
**Quality Management:** Mitra, A. (2000) Fundamentals of Quality Control and Improvement, Second Edition. Pearson Education, Upper Saddle River, New Jersey. (TS156.M54/1998)
**Linear Models:** Kleinbaum,D.G., Kupper,L.C., Muller,K.E.& Nizam,A. (1998) *Applied Regression Analysis and other Multivariable Methods.* Duxbury Press, Pacific Grove. (QA278.A665/1998)

## UNIT WEB PAGE

The web page for this unit can be found at: http://www.stat.mq.edu.au/units/stat320/.

## LEARNING OUTCOMES

The learning outcomes of this unit are to

- understand the principles underlying linear modelling in data analysis and quality management;
- choose the appropriate statistical analysis, for a given data set, from a wide range of methods based on the linear model;
- choose appropriate statistical techniques for use in quality management;
- use a statistical computer package to carry out chosen analyses and interpret the results with understanding; present the results of analyses in a form which is suitable for publication.

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:

- problem solving skills;
- written communication skills, particularly report writing;
- critical analysis skills.

## TEACHING AND LEARNING STRATEGY

The unit is taught in traditional mode; that is, on campus in standard semesters with weekly lectures and tutorials (some of which are in the computer laboratory).

Students are expected to

- attend all the lectures and the tutorials;
- hand in at the tutorial their solutions to weekly practical exercises for weeks 2 to 7;
- hand in laboratory exercises at the conclusion of the tutorial in weeks 8 to 13;
- contact one of the teaching staff in advance if for any reason, students cannot hand in their assessment tasks on time;
- hand in the assignment and project to ERIC (Economic Resource & Information Centre) E4B 106;
- Collect their marked assessment from ERIC (Economic Resource & Information Centre) E4B 106.

Refer to end of handout for week-by-week list of topics to be covered.

## RELATIONSHIP BETWEEN ASSESSMENT AND LEARNING OUTCOMES

While attendance at classes is important it is only a small proportion of the total workload for the unit: reading, working with other students in groups, completing assignments, using the computer and private study are all part of the work involved. At Macquarie it is expected that the average student should spend four hours per week per credit point.

The assessment is based on the projects, performance in the tutorials (including homework), class test, assignment, and the final examination.

| **Assessment** | **Weighting** | **Due** |
|---|---|---|
| Quality Management Project Proposal | 2% | 4:00pm Friday 17th March |
| Linear Models Assignment | 5% | 4:00pm Friday 19th May |
| Quality Management Project | 13% | 4:00pm Friday 2nd June |
| Linear Models Test | 10% | Week 13 tutorials |
| Homework and Tutorial Participation | 10% | Each weeks tutorial |
| Final Examination | 60% | As timetabled |

Marked assessment will be available for collection from ERIC (Economic Resource & Information Centre) E4B 106 approximately two weeks after the due date.

**Project:** As part of the project in quality management, you are required to collect daily records over a period of 42 days and analyse them using methods taught in this course.

See the Web site for STAT320 http://www.stat.mq.edu.au/units/stat320/index.htm as to how the 42 days includes

**i) 21 days measuring whether the system is in control**
**ii) implementing a change in the process**
**iii) a further 21 days to see if the change has affected the process.**

The project is designed to give you practical experience in collecting suitable data and analysing and reporting on that data in a fashion that can be understood by management. The intention is that you firstly see whether or not the system is in control, and then see whether it is possible to change the parameters of the system to ones that are more favourable to the intended outcome. Details of further work relating to the project will be given in the course. The report is to be handed in to ERIC (Economic Resource & Information Centre) E4B 106 by 4pm, Friday 2 June.

*Suggestions for suitable data*

1. Daily measurements of electricity used
2. Daily measurements of water usage.
3. Amount of liquid consumed every day.
4. Time to run 2000m.
5. Daily sales in a shop before and during a birthday sale
6. Comparison of car usage between cricket and off seasons.
7. Internet usage as result of typing emails before logging in rather than after logging in.
8. Change in number of phone calls taken in 10 minute period with two different introductory lines: "Good morning, Ashfield Council, how can I help you" and "Good morning, Ashfield Council."

**Your report should be no longer than three pages with all computing output included in an Appendix. Your name, student ID and tutor's name are to appear on the top right hand corner of the cover page.**

You should refer to the book by Anderson and Poole mentioned above for the setting out of your report.

Late assessments will only be accepted with the agreement of the lecturer and may be subject to the deduction of some marks.

**NOTE: To obtain a passing grade, both coursework and exam performance must be satisfactory.**

The University Examination period in First Half Year 2006 is from 14th June to 30th June.

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. (Individual Divisions may wish to signal when the Division's Supplementaries are normally scheduled.)

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, that 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.

## COMPUTER LABS AND CONDITIONS OF USE

**Location:**
All EFS Student Computing Labs are located in Building E4B. As some labs have restricted access, students may find the following table a helpful guide:

| Room | Capacity | Access |
|---|---|---|
| 102 | 24 PCs + 1 Printer | All students |
| 104 | 24 PCs + 1 Printer | All students |
| 111 | 35 PCs + 1 Printer | All students |
| 118 | 80 PCs + 2 Printers | All students |
| 206 | 36 PCs + 1 Printer | Postgraduate Students only |
| 208 | 35 PCs + 1 Printer | All students |
| 214 | 80 PCs + 2 Printers | All students |
| 306 | 36 PCs + 1 Printer | Postgraduate Students only |

Students should be aware that classes will be scheduled intermittently in these rooms. During these times, students not involved in the relevant classes must immediately vacate the rooms, and refrain from taking any action that may disrupt a class in progress. Students may occupy rooms for individual coursework when no classes are scheduled, subject to both the access restriction listed above, and the Conditions of Use stated below.

**Opening Hours:**
Normally, Student Computing Labs will be open during the following times:

| | |
|---|---|
| <u>During Term:</u> | |
| 8:00am – 10:00pm | Mon – Fri |
| 9:00am – 5:00pm | Sat & Sun |
| <u>Outside of Term:</u> | |
| 9:00am – 7:00pm | Mon – Fri |
| 9:00am – 5:00pm | Sat & Sun |

Term times include normal semester teaching periods, including exam periods; periods outside of this include mid-semester, mid-year, start and end-of-year breaks. Specific labs may be closed when demand is low, or for maintenance purposes.

**Method of Access:**
Access to these facilities will be via individual student user accounts. Login usernames are students ID numbers. Passwords for these accounts are synchronised with students' MyMQ passwords; this is the one used to access the Student Portal. Students who have changed their password via the Student Portal should use their current password. For new students, and those who have not changed their password via the student portal, it will be the two characters supplied at enrolment followed by their date of birth. As a safety net, generic accounts will be available until the mid-semester break to assist students who may experience initial login problems.

Student Computing Laboratory Demonstrators will be available to assist students with computing related problems. However, they will not respond to course related, or other academic or administrative, issues.

Undergraduate access will be granted on a semester basis for students enrolled in current approved units only.

Students will be provided with a Home Directory (Q:) to store files related to coursework for approved units. At the end of each semester, undergraduate accounts will be disabled, and all data will be removed.

*Students should keep external copies of all files stored on their Home Directories (Q:). The University will not be liable for any loss of data.*

**Conditions of Use:**
The University has limited resources with which to provide for the IT requirements of its students. To best guard the interests of all of our students, our aim is to maintain high availability and functional consistency of equipment. However, this can be compromised by student misuse. Hence, students are expected to act responsibly at all times when utilising University IT facilities. In particular, they are expected to comply with the following:

- These facilities are provided for use exclusively for coursework in units offered by the Division of Economic and Financial Studies, and other specified units that have been authorised to use these rooms.

- Student ID cards must be displayed at all times.

- These facilities must be used in accordance with University and Division policies and rules relevant at the time.

- The University reserves the right to monitor all student activities from these facilities.

- Use of mass storage devices, such as USB memory sticks, is strictly prohibited.

- Attempting to alter the normal function, tampering with or removing any equipment or consumables will be deemed an act of vandalism, and will be dealt with accordingly.

- Accessing inappropriate web sites, or downloading inappropriate material, are not permitted. Material that is not related to coursework in units authorised to use these facilities is deemed to be inappropriate.

- Students must adhere to all instructions from Demonstrators and other officers of the University given in the course of their duty.

Non-compliance with these conditions may result in disciplinary action without further notice.

## Unit Schedule

| WEEK | TOPIC AND SUGGESTED READING | WORK DUE |
|---|---|---|
| 1 (27 Feb) | Q: Introduction<br>Discussion of project<br>Variation, Common causes and special causes<br>Control charts for variables. | |
| 2 (6 Mar) | Q: Deming's paradigm<br>Pareto diagrams<br>Control charts for variables | |
| 3 (13 Mar) | Q: Control charts for attributes. | **Project Proposal (2%)** |
| 4 (20 Mar) | Q: Process capability<br>Guest speaker | |
| 5 (27 Mar) | Q: Acceptance sampling/Reliability | |
| 6 (3 April) | Q: Reliability | |
| 7 (10 April) | LM: Review of simple and multiple regression including matrix algebra<br>Chap1,2, beginning of 3 | |
| | MIDSEMESTER BREAK – 14 APRIL – 30 APRIL | |
| 8 (1 May) | LM: Hypothesis tests<br>Correlations<br>Chapter 3, §11.1-11.10 | |
| 9 (8 May) | LM: Confounding and interaction<br>Diagnostics | |
| 10 (15 May) | LM: Diagnostics ctd<br>4.12<br>Categorical Predictors | **Assignment (5%)** |
| 11 (22 May) | LM: Analysis of Covariance<br>Introduction to Logistic regression | |
| 12 (29 May) | LM: Logistic regression ctd | **Project (13%)** |
| 13 (5 June) | LM & Q: Summary and revision | **Test (10%)** |

Homework and tutorial participation: Weeks 2 - 13

LM: Modelling component
Q: Quality management component
Chapters in LM. refer to Chatterjee et al.