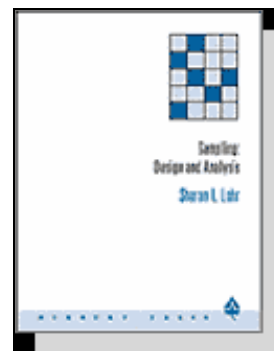# Division of Economic and Financial studies

STAT 814: Statistical Design

First Semester 2007

Unit Outline

Unit Convenor: Julian Leslie/Kehui Luo

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 modules. The first module is concerned with the design of experiments. Many of the standard designs are discussed, including completely randomised design, complete block design, factorial treatment design and nested factor designs. The second is devoted to survey design. Questionnaire construction, the theory of sampling, stratified sampling, systematic sampling, cluster sampling are all discussed.

TEACHING STAFF

Convenor: A/Prof Julian Leslie
Room E4A 544, phone: 9850 8593
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Dr Kehui Luo
Room E4A 532, phone: 9850 8563
E-mail: kluo@efs.mq.edu.au

Dr Kehui Luo will give all normal lectures in both experimental and survey designs from Week 1 to Week 13, and A/Prof Julian Leslie will give three additional lectures on 2^k Factorial and fractional factorial designs (Weeks 6-8, at a different time and location).

You are welcome to contact the lecturers by telephone, e-mail or fax with questions regarding course content.

Note: Only the **university official email address** may be used to communicate with staff. Staff consultation times for this unit will be advised at the first lecture of the semester.

Questions relating to *course administration* should be directed to the postgraduate administrator:

Ms Lesley Mooney
Room E4A 518, phone: +61 2 9850 8550, fax: +61 2 9850 7669
E-mail: lmooney@efs.mq.edu.au
Ms Mooney currently works on Tuesdays, Wednesdays and Thursdays only, so in the event of an urgent query this may be directed to the Statistics Departmental Administrator:
Ms Sandra Ticehurst
Room E4A 536, phone: +61 2 9850 8555, fax: +61 2 9850 7669
E-mail: stice@efs.mq.edu.au

CLASSES

Experimental Design will run in the first six weeks and Survey Design in Weeks 7-12. Week 13 will be used for revision. This unit runs in parallel with the undergraduate unit Stat373, with the additional topic of 2^k factorial and fractional factorial designs. Lectures for these latter topics will be given by A/Prof Julian Leslie, in weeks 6 to 8 on Thursdays 6pm – 9 pm at a location to be announced. For each week's study, you will be provided with images of PowerPoint slides, additional explanatory notes and tutorial exercises.

Internal students are required to attend a 3-hour lecture per week beginning in Week 1. You may attend (not compulsory) a 1-hour tutorial class designed for STAT373 students beginning in Week2. Times and locations are as follows:

	Time	*Venue*
Lectures	Tuesdays 6-9 pm	E5A 119
Tutorials	Tuesdays 4-5 pm	C5A 226
	Thursdays 6-7 pm	W6B 286

REQUIRED AND RECOMMENDED TEXTS AND/OR MATERIALS

The prescribed text for Experimental Design is
Kuehl, R.O. (2000). Statistical Principles of Research Design and Analysis, Second edition, Duxbury Press
and for Survey Design is
Lohr, S.L. (1999). Sampling: Design and Analysis, Duxbury Press.
These are available from the Co-Op Bookshop.

Other useful references (available in library Reserve):
Lindman H. R. (1992). Analysis of variance in Experimental Design.
Montgomery, D.C. Design and Analysis of Experiments, 5th or 4th Edition.
Neter J, Wasserman W and Kutner M. Applied Linear Statistical Models.
Scheaffer R.L., Mendenhall W and Ott R.L. (1996). Elementary Survey Sampling, 5th (or newer) Edition.
Cochran WG, Sampling Techniques.
Moser CA, Kalton G, Survey Methods in Social Investigations
Barnett V, Elements of Sampling Theory.

Weekly lecture notes will be handed out at the beginning of the lecture.

Software: Minitab is used in this course. We are currently using version 14. It is available in all E4B computing labs. If you want to have a copy for home

use, you may choose to rent it from the following web site, http://www.e-academy.com. To find out more information about Minitab, please visit their web site at http://www.minitab.com/.

Calculator: An electronic calculator is required throughout this unit. Only non-text returnable calculators are permitted to be used in the final examination.

UNIT WEB PAGE

The unit web page is at http://www.stat.mq.edu.au/units/stat814/, having links to unit outline, course materials (including iLectures) on WebCT and some useful web sites.

Course Materials and Online Discussion:

All course materials including lecture notes, iLectures, assignments and their solutions, and data files can be downloaded from STAT814 Statistical Design web page on WebCT at http://online.mq.edu.au/webct/homearea/homearea?.

To login into WebCT, you will be asked for the user name and password. You should read the information about user name and password above the login box if you use it for the first time. After you are in WebCT, click STAT814 Statistical Design. There are a number of things on this page. You may click the Discussions (ie, Bulletin Board) button on the web page for online discussion with other students enrolled STAT373/814 and lecturers. Note that you should visit this web site regularly for updated course materials, and also possible announcements or updates placed on the Discussion board from the Lecturers.

For distance students only, questions relating to course administration should be directed to the Distance MAppStats Co-ordinator:
Ms Lesley Mooney
Room E4A 518, phone: +61 2 9850 8550, fax: +61 2 9850 7669
Email: lmooney@efs.mq.edu.au

LEARNING OUTCOMES
By completion of STAT814, students should

- understand the basic principles of research design;
- understand commonly used experimental designs and be able to apply appropriate statistical method(s) for the analysis of data arising from each design;

- be able to analyse data from an experiment using Minitab and to interpret the results;
- understand the role of fractional designs and confounding in designs;
- be able to analyse 2^{k-p} fractional factorial designs;
- understand basic survey sampling, know how to obtain a representative sample, be familiar with concepts such as sampling bias, sampling and non-sampling errors;
- know the basics of questionnaire design and question construction;
- understand commonly used survey designs and sampling methods, including simple random sampling, systematic sampling, cluster sampling and quota sampling;
- be able to use appropriate statistical technique(s) to estimate population parameters based on a sample from any one of the commonly used sampling methods;
- have generally improved their problem solving ability;
- have improved their ability to use computing software (Minitab) in solving practical problems.

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;
> Communication skills;
> Critical analysis skills;
> Problem-solving skills;

TEACHING AND LEARNING STRATEGY

Lectures: Lectures begin in Week 1. Students are required to attend a 3-hour lecture each week. Topic(s) for each week are set in the Unit Schedule at the end of this unit outline. Students are encouraged to read the relevant chapter(s) in the text before coming to the lecture. Notes containing lecture slides will be handed out to internal students at the beginning of each lecture. External students will get pre-printed course materials in several separate mailouts. A set of homework (tutorial) exercises will be given out at the end of each lecture or made available on the unit web site. The iLecture will be recorded each week and made available on the STAT814 WebCT site soon after each lecture.

Assignments: Four assignments are set in this unit for students to complete independently, as part of unit assessment. To assist with further learning, solutions to assignments will be made available to students later on the unit WebCT.

Tutorial Exercises: Each week a set of tutorial exercises will be made available for you to work on.

The only way to gain a thorough understanding of the material delivered in lectures is to work on one's own, through the tutorial exercises and assignments. Also it is essential to attempt exercises given at the end of relevant chapters in the course texts.

RELATIONSHIP BETWEEN ASSESSMENT AND LEARNING OUTCOMES

Four assignments are set for students to apply the knowledge gained from lecture(s) and from their own reading. Questions and tasks have been designed to assess a student's level in relation to the unit learning outcomes. Students will be further evaluated in relation to the unit learning outcomes in the final examination.

This unit will be assessed according to the following components:

Assignments	40%
Examination	60%

Note carefully:

In order to pass STAT814 students must satisfy each of the following requirements:

* Submit all assignments (on time).
* Perform satisfactorily (ie, achieve pass standard) in both modules of the final examination, viz. Experimental Design and Survey Design.
* Perform satisfactorily (ie, achieve pass standard) in the overall assessment.

Assignments: Four assignments will be made available on the unit WebCT, or handed out in lectures and mailed to distance students. On-time submission for each assignment is compulsory. The following are the hand-out and hand-in weeks, and assessment percentage:

Assignment	Hand out	Hand in	% in total assessment
1	Week 4	Week 6	10
2	Week 6	Week 9	10
3	Week 10	Week 12	10
4 (2^k Factorial)	Week 7	Week 10	10

Note: Details about due date and submission for each assignment will be included in the assignment. Students must submit all assignments in order to pass this unit, regardless of their performance in the final examination. Students who are unable to submit any assignment on time, because of illness or some other cause, must report the circumstances in writing to the lecturer, and documentation must also be provided to the Registrar. Marked assignments will be handed back to the student about two to three weeks after the due date.

Examination: The final examination will examine any material covered in the unit. You may bring into the examination an A4 size sheet of notes, formulas, etc, written on both sides. Any other materials such as lecture notes and text books are not permitted. Calculators (non text returnable) should be brought into the exam. The right to bring an A4 sheet into the examination may be forfeited in any supplementary examination, on the grounds that extra preparation time will have been available to the candidate.

The University Examination period in First Half Year 2007 is from 13 to 29 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 in the event 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. Please note that this form and relevant documentation **must** be submitted before the end of the examination period.
Note that there is a Division policy on the web site, http://www.efs.mq.edu.au/services/policies_consid.htm, regarding requests for special consideration for examinations and the granting of supplementary examinations.

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.

Grading in STAT814: Your final grade will be based on your performance in various parts specified in the Assessment section. The grades are awarded according to rules set out in the Bachelor Degree Rules 10 (2) as follows:

HD – High Distinction: Denotes a performance that meets all unit objectives in such an exceptional way and with such marked excellence that it deserves the highest level of recognition.

D – Distinction: Denotes performance that clearly deserves a very high level of recognition as an excellent achievement in the unit.

C – Credit: Denotes performance that is substantially better than would normally be expected of competent students in the unit.

P – Pass: Denotes performance that satisfies unit objectives.

PC – Conceded Pass: Denotes performance that meets unit objectives only marginally.

F – Fail: Denotes performance which does not meet unit objectives.

Once your final grade has been decided, on the basis of your performance in the unit, you are given a *standardized numerical grade* (SNG). SNG is not a mark but a ranking of students.

The SNGs awarded in a particular unit are designed to indicate that the students in each performance band, from HD to F, have satisfied the criteria for inclusion in that band and ranks them by their performance within that band. Since the ranges of SNGs differ from band to band the relationship between raw marks and SNGs may differ from band to band even within the same unit. The relationship between raw marks and SNGs would almost always differ between units.

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.

Visit regularly the unit WebCT site at http://online.mq.edu.au/webct/homearea/homearea?, for possible announcements and updates. Assignment Solution will also be made available here in the due course.

Seek help from your lecturers or tutors sooner by seeing them in their office hours or make an appointment to see a staff at other times.

Course Schedule

Experimental design:

Week	Topic	Chapter (Kuehl)
1	Designed experiments vs observational studies, completely randomized design: one-way ANOVA	1, 2
2	One-way ANOVA contd, contrasts	2, 3
3	Contrasts contd, multiple comparisons, model checking	3, 4
4	Randomized block design (RBD), Cross-over designs	4, 8
5	Factorial experiments: two-way ANOVA, random effects – one-way	6, 5 , 11
6	Nested designs; Analysis of covariance, fractional factorial designs and confounding (and this will continue into Week 7, Thursday evenings)	7, 17, 11

Survey design:

Week	Topic	Chapter (Lohr)
7	Introduction to surveys: a historical perspective, probability and non-probability sampling, sources of error, simple random sampling (SRS)	1
8	SRS: infinite population, finite population	2
9	SRS: estimation of proportion, stratified random sampling	2, 4
10	Stratified random sampling contd, ratio estimation	4, 3
11	Ratio and regression estimators	3
12	Cluster sampling	5
13	Revision	