



STAT714

Statistical Design

S1 Day 2014

Statistics

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General Information

Unit convenor and teaching staff

Unit Convenor

Kehui Luo

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E4A532

Thursday 10-12pm

Hassan Doosti

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Credit points

4

Prerequisites

Admission to MRes

Corequisites

Co-badged status

Co-badged with STAT814; Co-taught with STAT373

Unit description

This unit consists of two modules. The first module is concerned with the design of experiments. Many of the standard designs and their mathematical formulation are discussed, including completely randomised design, complete block design, random effects model, axb factorial treatment design, and 2 to the K factorial and fractional factorial designs, and extensive use is made of Minitab. The second module of the unit is devoted to survey designs. Questionnaire construction, and the theory of sampling, stratified sampling, systematic sampling, ratio and regression estimators, cluster sampling and multistage sampling are all discussed.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at <https://www.mq.edu.au/study/calendar-of-dates>

Learning Outcomes

On successful completion of this unit, you will be able to:

Understand general mathematical formulation and framework for commonly used

experimental and survey designs, completely randomised, randomised block, axb factorial designs, random effects models, and simple random sampling, stratified sampling, clustering sampling and systematic sampling designs.

Demonstrate a good understanding of contrast, orthogonal contrasts, orthogonal contrast set and their statistical and practical implications in experimental designs, and the capability of formulating appropriate ones for answering specific research questions of studies.

Have extensive knowledge of the principles of experimental and survey designs, and the statistical properties of various parameter estimates.

Demonstrate a good understanding of the assumptions and limitations of the statistical methods for each experimental or survey design, and competence in choosing and applying appropriate experimental or survey designs to real world studies.

Have extensive knowledge of complex experimental designs including the fractional factorial design and its mathematical formulation, and use it to tackle real world problems.

Be competent in applying complex statistical methods including Yate's algorithm, design resolution and defining contrast algorithm to analyse data from 2k-p fractional factorial designs.

Have high level ability to use computing software to solve practical problems.

Assessment Tasks

Name	Weighting	Hurdle	Due
<u>Assignments</u>	30%	No	Week 6, 8 and 12
<u>Additional assignment</u>	15%	No	Week 10
<u>Examination</u>	55%	No	University Examination Period

Assignments

Due: **Week 6, 8 and 12**

Weighting: **30%**

Three normal assignments are set for students to complete independently, applying the knowledge gained from lecture(s) and their own reading, with and/or without using the statistical software, Minitab.

Note:

The three assignments will be made available on the unit **iLearn**. **Details about due date and submission for each assignment will be included in the assignment.** Students must submit

all assignments **on-time**. Students who are unable to submit any assignment on time, because of illness or some other causes, must report the circumstances in writing to the lecturer in charge and may consider applying for Special Consideration. Request for Special Consideration should be lodged via MQ Student Admin at <https://ask.mq.edu.au/index.php>. **No extensions will be granted unless satisfactory documentation outlining illness or misadventure is submitted.**

Marked assignments will be handed back to the student within two to three weeks after the due date.

Students must keep a soft or hard copy of any assignment that they submit. In the event of their assignment being misplaced, a replacement will be requested.

On successful completion you will be able to:

- Understand general mathematical formulation and framework for commonly used experimental and survey designs, completely randomised, randomised block, axb factorial designs, random effects models, and simple random sampling, stratified sampling, clustering sampling and systematic sampling designs.
- Demonstrate a good understanding of contrast, orthogonal contrasts, orthogonal contrast set and their statistical and practical implications in experimental designs, and the capability of formulating appropriate ones for answering specific research questions of studies.
- Have extensive knowledge of the principles of experimental and survey designs, and the statistical properties of various parameter estimates.
- Demonstrate a good understanding of the assumptions and limitations of the statistical methods for each experimental or survey design, and competence in choosing and applying appropriate experimental or survey designs to real world studies.
- Have high level ability to use computing software to solve practical problems.

Additional assignment

Due: **Week 10**

Weighting: **15%**

This additional assignment is based on the three additional lectures on 2^k factorial and fractional factorial designs available under Weeks 6-8 sections on the unit iLearn, and specifically designed for STAT814/STAT714 students to complete independently. It will be made available under the Assignments section on the unit iLearn. **Details about its due date and submission will be included in the assignment.** Students must submit the assignment **on-time and perform satisfactorily** (ie, achieve pass standard) in order to pass this unit.

Students must keep a soft or hard copy of any assignment that they submit. In the event of their assignment being misplaced, a replacement will be requested.

On successful completion you will be able to:

- Have extensive knowledge of complex experimental designs including the fractional factorial design and its mathematical formulation, and use it to tackle real world problems.
- Be competent in applying complex statistical methods including Yate's algorithm, design resolution and defining contrast algorithm to analyse data from 2k-p fractional factorial designs.

Examination

Due: **University Examination Period**

Weighting: **55%**

The final examination is used to assess students' understanding of the material presented in the unit.

The final examination will be a three hour written exam (plus ten minutes reading time) and will be held during the examination period which runs from 16 June to 4 July, 2014. It will examine any materials covered in the unit. Relevant statistical tables will be attached to the final examination. Students will be permitted to take **Two A4 sheets, handwritten on both sides**, into the final examination. The right to bring two A4 sheets into the examination may be forfeited in any supplementary examination, on the grounds that extra preparation time will have been available to the candidate. **Calculators (non text returnable)** should be brought into the exam. No other electronic devices (e.g. mobile phones, mp3 players) are allowed during the exam.

The University Examination 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 at: <http://www.timetables.mq.edu.au/exam>

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 session, which is the final day of the official examination period.

Attendance at the examination is compulsory. 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 and policy is available at: http://www.mq.edu.au/policy/docs/special_consideration/policy.html. Student Request for Special Consideration should be lodged via MQ Student Admin at <https://ask.mq.edu.au/index.php>.

Special Consideration will only be granted to students whose performance in all parts of the coursework is satisfactory. In particular, you must have obtained at least 22.5 out of the total 45 marks in the coursework.

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.

Note carefully:

Your final grade in STAT714 will be based on your work during the semester and in the final examination. You need to achieve the same standards in the assessment tasks during the semester and the final examination to be awarded a particular grade as set out in the Grading Policy.

On successful completion you will be able to:

- Understand general mathematical formulation and framework for commonly used experimental and survey designs, completely randomised, randomised block, axb factorial designs, random effects models, and simple random sampling, stratified sampling, clustering sampling and systematic sampling designs.
- Demonstrate a good understanding of contrast, orthogonal contrasts, orthogonal contrast set and their statistical and practical implications in experimental designs, and the capability of formulating appropriate ones for answering specific research questions of studies.
- Have extensive knowledge of the principles of experimental and survey designs, and the statistical properties of various parameter estimates.
- Demonstrate a good understanding of the assumptions and limitations of the statistical methods for each experimental or survey design, and competence in choosing and applying appropriate experimental or survey designs to real world studies.
- Have extensive knowledge of complex experimental designs including the fractional factorial design and its mathematical formulation, and use it to tackle real world problems.
- Be competent in applying complex statistical methods including Yate's algorithm, design resolution and defining contrast algorithm to analyse data from 2k-p fractional factorial designs.

Delivery and Resources

Classes

Students are required to attend a 3-hour lecture per week (together with STAT373 students) beginning in Week 1, and may also attend **(not compulsory)** a 1-hour tutorial class designed for STAT373 students beginning in Week 2.

Times and locations for all classes can be found on the University web site at: www.timetables.mq.edu.au. In the case of changing classes, time and/or location, you will be informed at the lecture and/or on the unit iLearn in advance.

You are also required to read the three sets of lecture slides and related pre-recorded lectures (iLectures by Dr Thomas Fung) on the additional topics that are specially designed for STAT814/STAT714 **from Week 6 to Week 8**, which will be available

after Week 5 on the unit iLearn (<https://iLearn.mq.edu.au/>). Assignment 4 is based on these three lectures.

Note: You are welcome to come to see the lecturer during staff consultation time with questions related to the unit. You could also contact the lecturer by e-mail or telephone. Only the **Macquarie University student e-mail accounts** may be used to communicate with staff.

Recommended Texts and/or Materials

Weekly lecture notes will be made available on the unit iLearn at <https://iLearn.mq.edu.au/> at least one day before the lecture. Students should print out and bring the relevant lecture notes into the lecture.

The recommended text is

Kuehl, R.O. (2000 or newer). *Statistical Principles of Research Design and Analysis*, Second edition, Duxbury Press, *for Experiment Design*; Lohr, S.L. (2010). *Sampling: Design and Analysis*, Duxbury Press, *for Survey Design*.

These are available from the Co-Op Bookshop.

Other useful references (available in library Reserve):

Lindman HR (1992). *Analysis of Variance in Experimental Design*.

Montgomery DC. *Design and Analysis of Experiments*, 5th or 4th Edition.

Neter J, Wasserman W and Kutner M. *Applied Linear Statistical Models*.

Scheaffer RL, Mendenhall W and Ott RL (1996). *Elementary Survey Sampling*, 5th (or newer) Edition.

Cochran WG (1977). *Sampling Techniques*.

Moser CA & Kalton G (1971). *Survey Methods in Social Investigations*.

Barnett V (1974). *Elements of Sampling Theory*.

Technology Used and Required

Software: Minitab is used in this unit. We are currently using version 16 (or newer). It is available in all E4B computing labs on campus. Information about Minitab can be found on its web site at <http://www.minitab.com>. This software is provided for free to Macquarie students, and can be downloaded from the student portal at <http://students.mq.edu.au/home/>.

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 and iLearn access: The unit web page is available on iLearn and can be accessed at: <http://ilearn.mq.edu.au>, under the 'STAT373 Design of Surveys and Experiments /STAT814_STAT714 Statistical Design' link.

Weekly lecture notes, including power point slides and iLectures will be made available at **echo360** on the unit iLearn, as well as other course materials including assignments, tutorial exercises and their solutions, and relevant data files. The **three pre-recorded lectures and related lecture notes** on the additional topics are available under Weeks 6 to 8 sections on the unit iLearn.

The **Discussion Forum** on the unit **iLearn** can be used for online discussion with other students enrolled in STAT373/STAT814/STAT714 on any problems or topics related to the unit. The lecturer will visit the place from time to time.

To login into iLearn, you will be asked for your **Macquarie OneID number** and **myMQ Portal password**. If you have any problem accessing this website, you should visit Student Help web site at www.mq.edu.au/iLearn/help-pages/students.htm. **Note** that you should visit this web site regularly for updated course materials, and also possible announcements placed by the Lecturer.

If **iLearn** site is down, students can send an e-mail to the lecturer, using their Macquarie University student e-mail accounts. Furthermore, students should check and read their Macquarie University student e-mail account on a regular basis.

Learning and Teaching activities

Lectures:

Students are required to attend all lectures. Topic(s) for each week are set in the Unit Schedule. Students are encouraged to read the relevant chapter(s) recommended before coming to the lecture.

An iLecture will be recorded for each lecture **when possible** and made available at **echo360** on the unit iLearn soon after the lecture. **The three pre-recorded lectures on the additional topics will also be made available on the unit iLearn (under Weeks 6-8 sections) after Week 5.**

Tutorial Exercises: Each week a set of tutorial exercises will be made available for students to practice, and its solution will be made available on iLearn one to two weeks later.

Assignments: Three *normal* assignments and one additional assignment are set in this unit for students to complete independently. To assist with further learning, solutions to the assignments (when possible) will be made available to students later on iLearn.

Grading

Your final grade in STAT714 will be based on your work during semester and in the final examination as specified in the Assessment Tasks. The grades allocated are as set out in the Grading Policy at <http://www.mq.edu.au/policy/docs/grading/policy.html>. Your final result will include one of these grades plus a standardised numerical grade (SNG).

Changes

Three extra lectures for internal students in STAT814 and STAT714 (with no external offering) on the additional topics are replaced with three pre-recorded iLectures for both internal and external students.

Unit Schedule

STAT 373/STAT 814/STAT714

Experimental design:

Week	Topic	Chapter (Kuehl)
1	Designed experiments vs observational studies; Completely randomized design (CRD): one-way ANOVA	1, 2
2	One-way ANOVA (contd); Contrasts	2, 3
3	Contrasts (contd), multiple comparisons and model checking	3, 4
4	More on CRD; Randomized block design (RBD)	4, 8
5	Factorial experiments: two-way ANOVA; Random effects – one-way	6, 5, 11
6	Analysis of covariance	7, 17, 11
(6-8)	For STAT814/STAT714 ONLY , three (3) extra pre-recorded lectures (iLectures) and notes of additional topics on 2^k factorial and fractional factorial designs will be made available under Weeks 6-8 sections on the unit iLearn .	

Survey design:

Week	Topic	Chapter (Lohr)
7	Introduction to surveys: sample survey and its principal steps, probability and non-probability sampling, and sources of error	1
8	Simple random sampling (SRS); Parameter estimation	2
9	SRS (contd): estimation of proportion; Stratified random sampling	2, 4

10	Stratified random sampling (contd); Choosing strata sample sizes	4, 3
11	Ratio and regression estimators	3
12	Cluster sampling; Systematic sampling	5
13	Revision	

Note: *There may be minor deviations from this timetable if insufficient time is available for some topics.*

Policies and Procedures

Macquarie University policies and procedures are accessible from [Policy Central](#). Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy http://mq.edu.au/policy/docs/academic_honesty/policy.html

Assessment Policy <http://mq.edu.au/policy/docs/assessment/policy.html>

Grading Policy <http://mq.edu.au/policy/docs/grading/policy.html>

Grade Appeal Policy <http://mq.edu.au/policy/docs/gradeappeal/policy.html>

Grievance Management Policy http://mq.edu.au/policy/docs/grievance_management/policy.html

Disruption to Studies Policy http://www.mq.edu.au/policy/docs/disruption_studies/policy.html *The Disruption to Studies Policy is effective from March 3 2014 and replaces the Special Consideration Policy.*

In addition, a number of other policies can be found in the [Learning and Teaching Category](#) of Policy Central.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/support/student_conduct/

Student Support

Macquarie University provides a range of support services for students. For details, visit <http://students.mq.edu.au/support/>

Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study

strategies to improve your marks and take control of your study.

- [Workshops](#)
- [StudyWise](#)
- [Academic Integrity Module for Students](#)
- [Ask a Learning Adviser](#)

Student Services and Support

Students with a disability are encouraged to contact the [Disability Service](#) who can provide appropriate help with any issues that arise during their studies.

Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

IT Help

For help with University computer systems and technology, visit <http://informatics.mq.edu.au/help/>.

When using the University's IT, you must adhere to the [Acceptable Use Policy](#). The policy applies to all who connect to the MQ network including students.