STAT714

Statistical Design

S1 Day 2016

Dept of Statistics

Contents

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General Information

Unit convenor and teaching staff
Unit Convenor
Kehui Luo
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Contact via kehui.luo@mq.edu.au
Level 2 AHH
Tuesday 10-12pm

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	Due
Assignments	30%	Tuesday (Week 6, 8 and 12)
Additional assignment	15%	Week 10
Examination	55%	University Examination Period

Assignments

Due: **Tuesday (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 and perform satisfactorily** (ie, achieve pass standard) in order to pass this unit. Students who are unable to submit any assignment on time, because of illness or other

unavoidable disruption, must report the circumstances in writing to the lecturer in charge and may consider applying for *Disruption to Studies*. A web link to the *Disruption to Studies* policy is given under *Policies and Procedures* in this unit guide. Students who have not submitted an assignment prior to the deadline will be awarded a mark of 0 for the assignment, except for cases in which an application for *Disruption to Studies* is made and approved.

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.

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

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 (**Assignment 4**) 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 university examination period that runs from 14 June to 1 July 2016. 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**, **typed or 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 other unavoidable disruption. In these circumstances you may wish to consider applying for *Disruption to Studies*. A web link to the *Disruption to Studies* policy is given under *Policies and Procedures* in this unit guide. *Disruption to Studies* **may be granted to students whose performance in all parts of the coursework is satisfactory.**

If a Supplementary Examination is granted as a result of the *Disruption to Studies*, 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 as specified in the *Assessment Tasks*. 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*. Your final result will include one of the grades plus a standard numerical grade (SNG).

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

Internal students are required to attend a 3-hour lecture per week (together with STAT373 and STAT814 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 study the three sets of lecture slides and listen to its related lecture recordings (previously recorded by Dr Thomas Fung) on the additional topics that are specially designed for STAT814/STAT714 **from Week 6 to Week 8**. These will be made available after Week 5 on the unit iLearn (https://iLearn.mq.edu.au/). Assignment 4 is based on these three

additional 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 (https://iLearn.mq.edu.au/) at least one day before the lecture. Internal students should print out and bring the relevant lecture notes into the lecture.

The recommended text:

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. 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/ for home use. Students can also use Minitab online via iLab **(**https://wiki.mq.edu.au/display/iLab/About**)**.

We are currently using version 17 (or newer). It is available via iLab in all E4B computing labs on campus. **Remember that any work or results produced via iLab in these labs must be saved to the iLab desktop and then emailed to yourself.**

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, where course materials will be made available.

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: Internal students are required to attend all lectures, starting from Week 1. Topic(s) for each week are set in the Unit Schedule. All students are encouraged to read the relevant chapter(s) recommended before each 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 after Week 5.**

Tutorial Exercises: Each week a set of tutorial exercises will be available on iLearn for students to practice. Its solution will be discussed during the STAT373 tutorial class in the following week and also made available on iLearn after then.

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

Unit Schedule

STAT714/STAT 814

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; 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 lecures and notes of additional topics on 2^k factorial and fractional factorial designs will be made availble **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

New Assessment Policy in effect from Session 2 2016 http://mq.edu.au/policy/docs/assessment/policy_2016.html. For more information visit http://students.mq.edu.au/events/2016/07/19/new_assessment_policy_in_place_from_session_2/

Assessment Policy prior to Session 2 2016 http://mq.edu.au/policy/docs/assessment/policy.html

Grading Policy prior to Session 2 2016 http://mq.edu.au/policy/docs/grading/policy.html

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

Complaint Management Procedure for Students and Members of the Public http://www.mq.edu.au/policy/docs/complaint_management/procedure.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/

Results

Results shown in *iLearn*, or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit ask.mq.edu.au.

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://www.mq.edu.au/about_us/ offices_and_units/information_technology/help/.

When using the University's IT, you must adhere to the Acceptable Use of IT Resources Policy. The policy applies to all who connect to the MQ network including students.

Changes from Previous Offering

No major differences from previous offering.