STAT814

Statistical Design

S1 Day 2013

Statistics

Contents

General Information

Unit convenor and teaching staff
Other Staff
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E4A 530
Monday 2 - 4 pm

Hassan Doosti
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Credit points
4

Prerequisites
Admission to MAppStat or PGDipAppStat or PGCertAppStat

Corequisites

Co-badged status
Co-badged with STAT714 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 theories 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
Assignments	30%	No	Week 6, 8 and 12
Additional assignment	15%	No	Week 10
Examination	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 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 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, and set ONLY for STAT814/STAT714 students to complete independently. It will be made available 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 11 to 28 June, 2013. 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 STAT814 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

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

Internal students are also required to attend three extra lectures for the additional topics that are specially designed for STAT814/STAT714 **from Week 6 to Week 8** (currently scheduled on Thursdays).

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.

There is **no** on-campus session for distance (external) students in this unit.

Teaching staff

Dr Kehui Luo will give all *normal* lectures in both experimental and survey designs from Week 1 to Week 13 for both STAT373 and STAT814/STAT714 students, and Dr Thomas Fung will give the three **additional** lectures on 2^k factorial and fractional factorial designs ONLY for STAT814/STAT714 students.

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.

For external students only, questions relating to **course administration** should be directed to the postgraduate administrator:

Ms Lesley Mooney

Room E4A 550, phone: +61 2 9850 8550, fax: +61 2 9850 7669

E-mail: lesley.mooney@mq.edu.au

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. The software is provided to students enrolled in this unit. ***Information on how to get it for home use will soon be available on the unit iLearn*** (https://iLearn.mq.edu.au/)***.***

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 **(echo360)**, will be made available on iLearn. Other course materials including assignments, tutorial exercises and their solutions, and relevant data files can also be downloaded from iLearn.

The **Discussion Forum** on the unit **iLearn** can be used for online discussion with other students enrolled in STAT373/STAT814/STAT714 and the Lecturer, on any problems or topics related to the unit.

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

An iLecture will be recorded for each lecture **when possible** and made available on the unit iLearn soon after the lecture. All students, particularly distance (ie, external) students, should visit the unit **iLearn** regularly as updated course materials, if any, would be soon put on this site (https://iLearn.mq.edu.au).

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 STAT814 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

No major differences from previous offering.

Unit Schedule

STAT 373/STAT 814/STAT714

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 and model checking	3, 4
4	Randomized block design (RBD); Factorial experiments: two-way ANOVA	4, 8
5	**No lecture/tutorial** (public holiday)	
6	Factorial experiments: two-way ANOVA (contd); Random effects – one-way	6, 5 , 11
7	Analysis of covariance	7, 17, 11
(6-8)	Three (3) extra lectures on 2^k factorial and fractional factorial designs for **STAT814/STAT714 ONLY from Week 6 to Week 8** (currently scheduled in EMC_G220 on Thursday 1-4 pm; double check the time and location on the University web site at: www.timetables.mq.edu.au)	

Survey design:

Week	Topic	Chapter (Lohr)
8	Introduction to surveys: sample survey and its principal steps, probability and non-probability sampling, and sources of error	1
9	Simple random sampling (SRS); Parameter estimation	2
10	SRS (contd): estimation of proportion; Stratified random sampling	2, 4
11	Stratified random sampling (contd); Choosing strata sample sizes; Ratio and regression estimators	4, 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://www.mq.edu.au/policy/docs/academic_honesty/policy.html

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

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

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

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

Special Consideration Policy http://www.mq.edu.au/policy/docs/special_consideration/policy.html

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

Student Support

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

UniWISE provides:

- Online learning resources and academic skills workshops http://www.students.mq.edu.au/support/learning_skills/
- Personal assistance with your learning & study related questions.
- The Learning Help Desk is located in the Library foyer (level 2).
- Online and on-campus orientation events run by Mentors@Macquarie.

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

Details of these services can be accessed at http://www.student.mq.edu.au/ses/.

IT Help

If you wish to receive IT help, we would be glad to assist you at 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 and it outlines what can be done.

Graduate Capabilities

PG - Discipline Knowledge and Skills

Our postgraduates will be able to demonstrate a significantly enhanced depth and breadth of knowledge, scholarly understanding, and specific subject content knowledge in their chosen fields.

This graduate capability is supported by:

Learning outcomes

- 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.

PG - Critical, Analytical and Integrative Thinking

Our postgraduates will be capable of utilising and reflecting on prior knowledge and experience, of applying higher level critical thinking skills, and of integrating and synthesising learning and knowledge from a range of sources and environments. A characteristic of this form of thinking is the generation of new, professionally oriented knowledge through personal or group-based critique of practice and theory.

This graduate capability is supported by:

Learning outcomes

- 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.

PG - Research and Problem Solving Capability

Our postgraduates will be capable of systematic enquiry; able to use research skills to create new knowledge that can be applied to real world issues, or contribute to a field of study or practice to enhance society. They will be capable of creative questioning, problem finding and problem solving.

This graduate capability is supported by:

Learning outcomes

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

PG - Effective Communication

Our postgraduates will be able to communicate effectively and convey their views to different social, cultural, and professional audiences. They will be able to use a variety of technologically supported media to communicate with empathy using a range of written, spoken or visual formats.

This graduate capability is supported by:

Learning outcome

- 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.

PG - Engaged and Responsible, Active and Ethical Citizens

Our postgraduates will be ethically aware and capable of confident transformative action in relation to their professional responsibilities and the wider community. They will have a sense of connectedness with others and country and have a sense of mutual obligation. They will be able to appreciate the impact of their professional roles for social justice and inclusion related to national and global issues

This graduate capability is supported by:

Learning outcome

- 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.

PG - Capable of Professional and Personal Judgment and Initiative

Our postgraduates will demonstrate a high standard of discernment and common sense in their professional and personal judgment. They will have the ability to make informed choices and decisions that reflect both the nature of their professional work and their personal perspectives.

This graduate capability is supported by:

Learning outcome

- 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.