



# STAT714

## Statistical Design

S1 Day 2019

*Dept of Mathematics and Statistics*

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#### **Disclaimer**

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## General Information

Unit convenor and teaching staff

Unit Convenor

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See iLearn

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Credit points

4

Prerequisites

Admission to MRes

Corequisites

Co-badged status

STAT814/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 and axb factorial treatment design, 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 be able to apply appropriate experimental or survey designs to real world studies and analyse data from each design with and without using a statistical software package.

## General Assessment Information

### LATE SUBMISSION OF ASSESSMENT TASKS (Assignments):

All assessment tasks must be submitted by its due date and time.

No marks will be given for late submission or work unless an extension has been granted following a successful application for Special Consideration via [ask.mq.edu.au](http://ask.mq.edu.au). Please contact the unit convenor for advice as soon as you become aware that you may have difficulty meeting any of the assessment (eg, assignment) deadlines.

### Final Examination:

If you apply for Special Consideration for the final examination, you must make yourself available for the Supplementary Examination as organised by the Faculty of Science & Engineering.

If you are not available at that time, there is no guarantee that an additional examination time will be offered. Specific examination dates and times will be determined at a later date.

## Assessment Tasks

Name	Weighting	Hurdle	Due
<u>Assignments</u>	40%	No	Tuesday (Week 6, 9 and 12)
<u>Examination</u>	60%	No	University Examination Period

## Assignments

Due: **Tuesday (Week 6, 9 and 12)**

Weighting: **40%**

**Three assignments** (10% for Assignment 1, 15% for each of the other two assignments) are set for students to complete independently, applying the knowledge gained from lectures and their own reading with or without using the statistical software, Minitab. They will be made available on iLearn.

Each of the three assignments are required to be submitted on the unit iLearn by its due date and time, which will be included in the assignment.

**For late submission, please refer to the information under General Assessment Information section in this unit guide.**

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 be able to apply appropriate experimental or survey designs to real world studies and analyse data from each design with and without using a statistical software package.

## Examination

Due: **University Examination Period**

Weighting: **60%**

There will be a two-hour written examination that will be timetabled within the official University Examination Timetable. The University Examination Timetable will be available in draft form approximately eight weeks before the commencement of the the University examinations and in final form approximately four weeks before the commencement of the examinations at:

[http://students.mq.edu.au/student\\_admin/exams/](http://students.mq.edu.au/student_admin/exams/)

The only excuse for not sitting an examination at the designated time is because of documented illness or unavoidable disruption. In these special circumstances you may apply for Special Consideration via [ask.mq.edu.au](http://ask.mq.edu.au).

**If you apply for the Special Consideration for the final examination, you must make yourself available for the Supplementary Examination as organised by the Faculty of**

**Science & Engineering. If you are not available at that time, there is no guarantee that an additional examination time will be offered. Specific examination dates and times will be determined at a later 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 be able to apply appropriate experimental or survey designs to real world studies and analyse data from each design with and without using a statistical software package.

## Delivery and Resources

### Classes

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 STGA 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](http://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.

**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.

### Course materials, recommended text and other references

Weekly lecture notes will be made available on the unit iLearn (<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.

**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 and the University library.

**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>). **Remember that any work or results produced via iLab in all computing labs on the University campus must be saved onto iLab desktop and then emailed to yourself.**

**Calculator:** An electronic calculator is required throughout this unit. Only calculators with no text retrieval capacity are permitted to be used in the examination.

**Unit Web Page and iLearn access:** The unit web page is available on iLearn under the 'STAT373 Design of Surveys and Experiments/STAT814\_STAT714 Statistical Design' link. Enrolment in STAT714 should automatically make this iLearn site available to you from the start of semester. To access it, log in at <https://ilearn.mq.edu.au/login/MQ/>. If this iLearn doesn't appear in your list of iLearn units although you enrolled in the unit more than 24 hours ago, please contact the Unit Convenor immediately. Note that you should visit this web site regularly for course materials including lecture slides, lecture recordings, tutorials and assignments, and also possible announcements placed by the Lecturer.

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

## Learning and Teaching activities

**Lectures:** Lectures begin in Week 1. Students are required to attend a 3-hour lecture each week. Topics for each week are set in the Unit Schedule in this unit guide. 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 on the unit iLearn (under ECHO360) soon after the lecture is completed.

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

**Assignments:** Three assignments 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 analysis of variance (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

### *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 (self study and exam preparation)	

## Policies and Procedures

Macquarie University policies and procedures are accessible from [Policy Central \(https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central\)](https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- [Academic Appeals Policy](#)
- [Academic Integrity Policy](#)
- [Academic Progression Policy](#)
- [Assessment Policy](#)
- [Fitness to Practice Procedure](#)
- [Grade Appeal Policy](#)
- [Complaint Management Procedure for Students and Members of the Public](#)
- [Special Consideration Policy](#) (**Note:** *The Special Consideration Policy is effective from 4 December 2017 and replaces the Disruption to Studies Policy.*)

Undergraduate students seeking more policy resources can visit the [Student Policy Gateway \(https://students.mq.edu.au/support/study/student-policy-gateway\)](https://students.mq.edu.au/support/study/student-policy-gateway). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

If you would like to see all the policies relevant to Learning and Teaching visit [Policy Central \(https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central\)](https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/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/study/getting-started/student-conduct>

## Results

Results published on platform other than [eStudent](#), (eg. iLearn, Coursera etc.) 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](https://ask.mq.edu.au) or if you are a Global MBA student contact [globalmba.support@mq.edu.au](mailto:globalmba.support@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](http://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](http://ask.mq.edu.au)

If you are a Global MBA student contact [globalmba.support@mq.edu.au](mailto:globalmba.support@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/](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.

## Graduate Capabilities

### 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 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 the assumptions and limitations of the statistical methods for each experimental or survey design, and be able to apply appropriate experimental or survey designs to real world studies and analyse data from each design with and without using a statistical software package.

## Assessment tasks

- Assignments
- Examination

## 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 be able to apply appropriate experimental or survey designs to real world studies and analyse data from each design with and without using a statistical software package.

## Assessment tasks

- Assignments
- Examination

## 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

- Understand general mathematical formulation and framework for commonly used experimental and survey designs, completely randomised, randomised block,  $a \times b$  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 be able to apply appropriate experimental or survey designs to real world studies and analyse data from each design with and without using a statistical software package.

## Assessment tasks

- Assignments
- Examination

## 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 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 be able to apply appropriate experimental or survey designs to real world studies and analyse data from each design with and without using a statistical software package.

## Assessment tasks

- Assignments
- Examination

## 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

- 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.

## Assessment tasks

- Assignments
- Examination

## 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:

## Assessment task

- Examination

## Changes from Previous Offering

The extra topics in previous offerings have been removed. As a result, the additional assignment

in the previous offerings is not in this offering. Note that this is the last offering of the unit (STAT714).