STAT375

Linear Models

S1 Day 2017

Dept of Statistics

Contents

General Information	2
Learning Outcomes	3
General Assessment Information	3
Assessment Tasks	4
Delivery and Resources	7
Unit Schedule	8
Policies and Procedures	8
Graduate Capabilities	10

General Information

Unit convenor and teaching staff
Unit Convenor
Gillian Heller
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Room 6.19, 12 Wally's Walk
Wednesday 11-12

Lecturer
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Thursday 3-5pm

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Credit points
3

Prerequisites
6cp at 200 level including (STAT270 or STAT271 or BIOL235(P) or PSY222 or PSY248(P))

Corequisites

Co-badged status

Unit description
This unit discusses statistical modelling in general and in particular demonstrates the wide applicability of linear and generalised linear models. Topics include multiple linear regression, logistic regression and Poisson regression. The emphasis is on practical issues in data analysis with some reference to the theoretical background. Statistical packages are used for both model fitting and diagnostic testing.

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:

Define relevant terminology and describe the main concepts of linear models and simple generalized linear models.

Formulate and solve theoretical problems in linear modelling (using matrix notation when necessary).

Fit a linear model to obtain estimates together with their standard errors in applied problems.

Analyse the adequacy of a linear model and suggest appropriate modifications when needed.

Formulate and solve applied problems using linear modelling.

Use standard statistics packages to carry out these analyses.

Communicate clearly their knowledge of the subject matter of linear models and their solutions to problems involving linear modelling.

General Assessment Information

Extensions

Extensions to assignments are at the discretion of the lecturer. It is the responsibility of the student to prove that there has been Disruption to Studies. If no extension has been given, 5% of the earned mark for an assignment will be deducted for each day that an assignment is late, up to a maximum of 50%.

Disruption to Studies

The only exception to not sitting an examination at the designated time is because of documented illness or unavoidable disruption. In this case, you may notify the University of your disruption to studies by providing required documentation through https://ask.mq.edu.au/. Please see **Disruption to Studies policy** at http://www.mq.edu.au/policy/docs/disruption_studies/policy.html for further information.

If you notify the University of your disruption to studies for your examination, you must make yourself available for the week of July 24 – 28 2017. If you are not available at that time, there is no guarantee an additional examination time will be offered. Specific examination dates and times will be determined at a later date.

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/

Assessment Tasks

Name	Weighting	Hurdle	Due
Test of prerequisite knowledge	0%	No	26 March
Assignment 1	15%	No	28 March
Assignment 2	15%	No	2 May
Assignment 3	15%	No	30 May
Tutorials	5%	No	-
Examination	50%	No	TBA

Test of prerequisite knowledge

Due: **26 March**
Weighting: **0%**

This quiz is available from Week 1, and is intended as a check on your assumed level of knowledge of linear models. If you do not score well, you are advised to consider withdrawal from the unit before the census date.

On successful completion you will be able to:

- Define relevant terminology and describe the main concepts of linear models and simple generalized linear models.

Assignment 1

Due: **28 March**
Weighting: **15%**

There are three assignments, worth 15% each. They should be submitted to the lecturer, by the due time and date. They give you an opportunity to reinforce and apply the concepts covered in lectures and the skills learned in tutorial sessions.

On successful completion you will be able to:

- Define relevant terminology and describe the main concepts of linear models and simple generalized linear models.
- Formulate and solve theoretical problems in linear modelling (using matrix notation when necessary).
- Fit a linear model to obtain estimates together with their standard errors in applied

problems.
- Analyse the adequacy of a linear model and suggest appropriate modifications when needed.
- Formulate and solve applied problems using linear modelling.
- Use standard statistics packages to carry out these analyses.
- Communicate clearly their knowledge of the subject matter of linear models and their solutions to problems involving linear modelling.

Assignment 2

Due: **2 May**
Weighting: **15%**

As Assignment 1.

On successful completion you will be able to:
- Define relevant terminology and describe the main concepts of linear models and simple generalized linear models.
- Formulate and solve theoretical problems in linear modelling (using matrix notation when necessary).
- Fit a linear model to obtain estimates together with their standard errors in applied problems.
- Analyse the adequacy of a linear model and suggest appropriate modifications when needed.
- Formulate and solve applied problems using linear modelling.
- Use standard statistics packages to carry out these analyses.
- Communicate clearly their knowledge of the subject matter of linear models and their solutions to problems involving linear modelling.

Assignment 3

Due: **30 May**
Weighting: **15%**

As Assignment 1.

On successful completion you will be able to:
- Define relevant terminology and describe the main concepts of linear models and simple generalized linear models.
- Formulate and solve theoretical problems in linear modelling (using matrix notation when

necessary).
- Fit a linear model to obtain estimates together with their standard errors in applied problems.
- Analyse the adequacy of a linear model and suggest appropriate modifications when needed.
- Formulate and solve applied problems using linear modelling.
- Use standard statistics packages to carry out these analyses.
- Communicate clearly their knowledge of the subject matter of linear models and their solutions to problems involving linear modelling.

Tutorials

Due: **-**
Weighting: **5%**

A mark worth 5% of your final mark, will be given for your participation in the laboratory tutorials, on the basis of collected laboratory sheets.

On successful completion you will be able to:
- Define relevant terminology and describe the main concepts of linear models and simple generalized linear models.
- Formulate and solve theoretical problems in linear modelling (using matrix notation when necessary).
- Fit a linear model to obtain estimates together with their standard errors in applied problems.
- Analyse the adequacy of a linear model and suggest appropriate modifications when needed.
- Formulate and solve applied problems using linear modelling.
- Use standard statistics packages to carry out these analyses.
- Communicate clearly their knowledge of the subject matter of linear models and their solutions to problems involving linear modelling.

Examination

Due: **TBA**
Weighting: **50%**

The examination will cover the material studied in the whole unit and address all the unit outcomes. You may take one A4 sheet, handwritten on both sides, into the final examination.

On successful completion you will be able to:

- Define relevant terminology and describe the main concepts of linear models and simple generalized linear models.
- Formulate and solve theoretical problems in linear modelling (using matrix notation when necessary).
- Fit a linear model to obtain estimates together with their standard errors in applied problems.
- Analyse the adequacy of a linear model and suggest appropriate modifications when needed.
- Formulate and solve applied problems using linear modelling.
- Use standard statistics packages to carry out these analyses.
- Communicate clearly their knowledge of the subject matter of linear models and their solutions to problems involving linear modelling.

Delivery and Resources

You should attend the following classes each week:

· 2 hour lecture: Wednesday 8 - 10am, 12 Second Way (C5A), room 315

· 2 hour laboratory tutorial: Wednesday 12 - 2pm, 6 Eastern Rd (E4B), room 104 OR Thursday 9 - 11am, 6 Eastern Rd (E4B), room 206

Lectures begin in Week 1. Students should print off the course notes from iLearn, and bring them to lectures.

Tutorials begin in week 1 and are based on work from the current week's lecture. Tutorials are held in computing labs and allow you to practise techniques learnt in lectures. We will mainly use SPSS, but we will supplement this with other statistical software. You will complete worksheets as part of the learning process. SPSS is installed in the computing labs in E4B, and will be used in tutorial sessions and for assignments. Assignments may be completed in these rooms. It is most convenient to bring a memory stick when using these computers.

Text book The recommended text (available from the Co-op Bookshop) is: Chatterjee S & Hadi AS (2012). **Regression Analysis By Example**, 5th Revised edition, Wiley.

Calculator You will need a calculator with statistical mode for the final examination.

Software The statistical software SPSS will be the main package used. In addition, we will be demonstrating applications using other statistical software such as Minitab and Arc. All of this software is available in the computer labs in E4B.

- You may wish to buy a copy of SPSS for home use. The Co-op Bookshop has SPSS Grad Pack, a full version with a one-year licence.
- You may also access SPSS remotely, at no cost, via iLab: https://wiki.mq.edu.au/display/

iLab/About

Staff consultation hours Members of the Statistics Department have consultation hours each week when they are available to help students. These consultation hours are available on iLearn.

Unit Schedule

Week	Topic	Text chapter	Assessment
1	Simple linear regression	1,2	
2	Simple linear regression contd, introduction to multiple linear regression	2	
3	The model in matrix form, hypothesis tests, residuals, residual & partial regression plots	3,4	
4	Diagnostics contd: extreme observations (leverage, DFBETAs, Cook's distances); transformations		
5	Transformations contd; collinearity	4, 6	Assignment 1 due
6	Polynomial regression; categorical covariates	6, 9	
7	Analysis of change	5	
	Mid-semester break		
8	Interaction and confounding	-	Assignment 2 due
9	Variable selection, model building	5	
10	Introduction to generalized linear models; Logistic regression	11	
11	Logistic regression ; Poisson regression	12	
12	Poisson regression; Gamma regression	12, 13	Assignment 3 due
13	Gamma regression; revision	13	

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_2016.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 (in effect until Dec 4th, 2017): http://www.mq.edu.au/policy/docs/disruption_studies/policy.html

Special Consideration Policy (in effect from Dec 4th, 2017): https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policies/special-consideration

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.

Graduate Capabilities

Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

Learning outcomes

- Formulate and solve theoretical problems in linear modelling (using matrix notation when necessary).
- Fit a linear model to obtain estimates together with their standard errors in applied problems.
- Analyse the adequacy of a linear model and suggest appropriate modifications when needed.
- Formulate and solve applied problems using linear modelling.

Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
- Tutorials
- Examination

Capable of Professional and Personal Judgement and Initiative

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement. They will exercise initiative as needed. They will be capable of risk assessment, and be able to handle ambiguity and complexity, enabling them to be adaptable in diverse and changing environments.

This graduate capability is supported by:

Learning outcomes

- Formulate and solve theoretical problems in linear modelling (using matrix notation when necessary).
- Analyse the adequacy of a linear model and suggest appropriate modifications when needed.
- Formulate and solve applied problems using linear modelling.
- Communicate clearly their knowledge of the subject matter of linear models and their solutions to problems involving linear modelling.

Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
- Tutorials
- Examination

Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

Learning outcomes

- Define relevant terminology and describe the main concepts of linear models and simple generalized linear models.
- Formulate and solve theoretical problems in linear modelling (using matrix notation when necessary).
- Fit a linear model to obtain estimates together with their standard errors in applied problems.
- Analyse the adequacy of a linear model and suggest appropriate modifications when needed.
- Formulate and solve applied problems using linear modelling.
- Use standard statistics packages to carry out these analyses.

Assessment tasks

- Test of prerequisite knowledge
- Assignment 1
- Assignment 2
- Assignment 3
- Tutorials
- Examination

Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

Learning outcomes

- Define relevant terminology and describe the main concepts of linear models and simple generalized linear models.
- Formulate and solve theoretical problems in linear modelling (using matrix notation when necessary).
- Fit a linear model to obtain estimates together with their standard errors in applied problems.
- Analyse the adequacy of a linear model and suggest appropriate modifications when needed.
- Formulate and solve applied problems using linear modelling.
- Use standard statistics packages to carry out these analyses.

Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
- Tutorials
- Examination

Problem Solving and Research Capability

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and

they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

Learning outcomes

- Formulate and solve theoretical problems in linear modelling (using matrix notation when necessary).
- Fit a linear model to obtain estimates together with their standard errors in applied problems.
- Analyse the adequacy of a linear model and suggest appropriate modifications when needed.
- Formulate and solve applied problems using linear modelling.
- Use standard statistics packages to carry out these analyses.

Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
- Tutorials
- Examination

Effective Communication

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

This graduate capability is supported by:

Learning outcomes

- Define relevant terminology and describe the main concepts of linear models and simple generalized linear models.
- Communicate clearly their knowledge of the subject matter of linear models and their solutions to problems involving linear modelling.

Assessment tasks

- Assignment 1
- Assignment 2

- Assignment 3
- Tutorials
- Examination

Engaged and Ethical Local and Global citizens

As local citizens our graduates will be aware of indigenous perspectives and of the nation's historical context. They will be engaged with the challenges of contemporary society and with knowledge and ideas. We want our graduates to have respect for diversity, to be open-minded, sensitive to others and inclusive, and to be open to other cultures and perspectives: they should have a level of cultural literacy. Our graduates should be aware of disadvantage and social justice, and be willing to participate to help create a wiser and better society.

This graduate capability is supported by:

Learning outcomes

- Formulate and solve applied problems using linear modelling.
- Communicate clearly their knowledge of the subject matter of linear models and their solutions to problems involving linear modelling.

Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
- Tutorials
- Examination

Socially and Environmentally Active and Responsible

We want our graduates to be aware of and have respect for self and others; to be able to work with others as a leader and a team player; to have a sense of connectedness with others and country; and to have a sense of mutual obligation. Our graduates should be informed and active participants in moving society towards sustainability.

This graduate capability is supported by:

Learning outcomes

- Formulate and solve applied problems using linear modelling.
- Communicate clearly their knowledge of the subject matter of linear models and their solutions to problems involving linear modelling.

Assessment tasks

- Assignment 1
- Assignment 2

- Assignment 3
- Tutorials
- Examination