STAT375
Linear Models
S1 Day 2015
Dept of Statistics

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General Information

Unit convenor and teaching staff
Unit Convenor
Gillian Heller
gillian.heller@mq.edu.au
Contact via gillian.heller@mq.edu.au
E4A 533
Friday 10-12

Credit points
3

Prerequisites
6cp at 200 level including (STAT270(P) or STAT271(P) or BIOL235(P) or PSY222(P) 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://students.mq.edu.au/important-dates

Learning Outcomes

1. Define relevant terminology and describe the main concepts of linear models and simple generalized linear models.
2. Formulate and solve theoretical problems in linear modelling (using matrix notation when necessary).
3. Fit a linear model to obtain estimates together with their standard errors in applied problems.
4. Analyse the adequacy of a linear model and suggest appropriate modifications when
needed.
5. Formulate and solve applied problems using linear modelling.
6. Use standard statistics packages to carry out these analyses.
7. 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%.

Grading
The final Standardised Numerical Grade (SNG) in STAT375 will be based on students’ work during the semester and in the final examination. The determination of the final SNG will be based on performance of individual assessment tasks against criteria and standards as detailed in the Grading Policy (http://mq.edu.au/policy/docs/grading/policy.html). Final grades will be awarded on the basis of students’ overall performance and the extent to which they demonstrate fulfillment of the learning outcomes listed for this unit.

In order to pass the unit, students need to perform satisfactorily (i.e. achieve at least 50%) on all components of assessment, including the final examination.

Supplementary examinations
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 Disruption to Studies. A supplementary examination will only be granted if a student has satisfactory coursework (i.e. at least 25 marks out of 50). If a supplementary exam is granted as a result of the Disruption to Studies process, it will be scheduled after the conclusion of the official exam period.

Assessment Tasks

<table>
<thead>
<tr>
<th>Name</th>
<th>Weighting</th>
<th>Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignment 1</td>
<td>15%</td>
<td>23 March</td>
</tr>
<tr>
<td>Assignment 2</td>
<td>15%</td>
<td>4 May</td>
</tr>
<tr>
<td>Assignment 3</td>
<td>15%</td>
<td>25 May</td>
</tr>
<tr>
<td>Tutorials</td>
<td>5%</td>
<td>23 Feb - 1 June</td>
</tr>
<tr>
<td>Name</td>
<td>Weighting</td>
<td>Due</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
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</tr>
<tr>
<td>Examination</td>
<td>50%</td>
<td>TBA</td>
</tr>
</tbody>
</table>

Assignment 1
Due: 23 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.

This Assessment Task relates to the following 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.
- Communicate clearly their knowledge of the subject matter of linear models and their solutions to problems involving linear modelling.

Assignment 2
Due: 4 May
Weighting: 15%

As Assignment 1.

This Assessment Task relates to the following 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.
• Communicate clearly their knowledge of the subject matter of linear models and their solutions to problems involving linear modelling.

Assignment 3
Due: 25 May
Weighting: 15%

As Assignment 1.

This Assessment Task relates to the following 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.
• Communicate clearly their knowledge of the subject matter of linear models and their solutions to problems involving linear modelling.

Tutorials
Due: 23 Feb - 1 June
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.

This Assessment Task relates to the following 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.
• 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.

It is Macquarie University policy not to set early examinations for individuals or groups of students. You are expected to be available until the end of the teaching semester, that is the final day of the official examination period.

This Assessment Task relates to the following 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.
• 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: Monday 1 - 3 pm, E3B 117
Unit Schedule

<table>
<thead>
<tr>
<th>Date</th>
<th>Week</th>
<th>Topic</th>
<th>Text chapter</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>23 Feb</td>
<td>1</td>
<td>Simple linear regression</td>
<td>1,2</td>
<td></td>
</tr>
<tr>
<td>2 Mar</td>
<td>2</td>
<td>Simple linear regression contd, introduction to multiple linear regression</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>9 Mar</td>
<td>3</td>
<td>The model in matrix form, hypothesis tests, residuals, residual &amp; partial regression plots</td>
<td>3,4</td>
<td>Assignment 1 handed out</td>
</tr>
<tr>
<td>16 Mar</td>
<td>4</td>
<td>Diagnostics contd: extreme observations (leverage, DFBETAs, Cook’s distances); transformations</td>
<td>4, 6</td>
<td></td>
</tr>
<tr>
<td>23 Mar</td>
<td>5</td>
<td>Transformations contd; collinearity</td>
<td>6, 9</td>
<td>Assignment 1 handed in</td>
</tr>
</tbody>
</table>
### Policies and Procedures

Macquarie University policies and procedures are accessible from [Policy Central](https://www.mq.edu.au/policy/docs). Students should be aware of the following policies in particular with regard to Learning and Teaching:


In addition, a number of other policies can be found in the [Learning and Teaching Category](https://www.mq.edu.au/policy/docs) 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/](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](https://es.mq.edu.au). For more information visit [ask.m](https://ask.mq.edu.au/)

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**Unit guide** STAT375 Linear Models

<table>
<thead>
<tr>
<th>Date</th>
<th>Week</th>
<th>Topic</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 Mar</td>
<td>6</td>
<td>Polynomial regression; categorical covariates</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mid-semester break</td>
<td></td>
</tr>
<tr>
<td>20 Apr</td>
<td>7</td>
<td>Analysis of change</td>
<td>Assignment 2 handed out</td>
</tr>
<tr>
<td>27 Apr</td>
<td>8</td>
<td>Interaction and confounding</td>
<td></td>
</tr>
<tr>
<td>4 May</td>
<td>9</td>
<td>Variable selection, model building</td>
<td>Assignment 2 handed in</td>
</tr>
<tr>
<td>11 May</td>
<td>10</td>
<td>Introduction to generalized linear models; Logistic regression</td>
<td>Assignment 3 handed out</td>
</tr>
<tr>
<td>18 May</td>
<td>11</td>
<td>Logistic regression ; Poisson regression</td>
<td>Assignment 3 handed in</td>
</tr>
<tr>
<td>25 May</td>
<td>12</td>
<td>Poisson regression</td>
<td>Assignment 3 handed in</td>
</tr>
<tr>
<td>1 June</td>
<td>13</td>
<td>Revision</td>
<td>Assignment 3 handed back in tutorial</td>
</tr>
</tbody>
</table>
Graduate Capabilities

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

**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

**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**

- 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

**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.
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

**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