



STAT8111

Generalized Linear Models

Session 2, Fully online/virtual 2020

Department of Mathematics and Statistics

Contents

General Information	2
Learning Outcomes	2
General Assessment Information	3
Assessment Tasks	4
Delivery and Resources	6
Unit Schedule	8
Policies and Procedures	8

Disclaimer

Macquarie University has taken all reasonable measures to ensure the information in this publication is accurate and up-to-date. However, the information may change or become out-dated as a result of change in University policies, procedures or rules. The University reserves the right to make changes to any information in this publication without notice. Users of this publication are advised to check the website version of this publication [or the relevant faculty or department] before acting on any information in this publication.

Notice

As part of [Phase 3 of our return to campus plan](#), most units will now run tutorials, seminars and other small group learning activities on campus for the second half-year, while keeping an online version available for those students unable to return or those who choose to continue their studies online.

To check the availability of face-to-face and online activities for your unit, please go to [timetable viewer](#). To check detailed information on unit assessments visit your unit's iLearn space or consult your unit convenor.

General Information

Unit convenor and teaching staff

Convenor & Lecturer

Thomas Fung

thomas.fung@mq.edu.au

12 WW 6.26

Monday 3 - 5pm

Lecturer

Benoit Liquet-Weiland

benoit.liquet-weiland@mq.edu.au

Credit points

10

Prerequisites

((Admission to MAppStat or MSc or MScInnovationStat or GradCertAppStat or GradDipAppStat or MDataSc) and ((STAT806 or STAT810 or STAT6110) and STAT6175)) or (admission to MMarScMgt or MConsBiol or GradDipConsBiol and (STAT830(Cr) or STAT8830(Cr))) or (Admission to MBusAnalytics and BUSA8000 and ECON8040)) or (Admission to MActPrac and (STAT806 or STAT810 or STAT8310))

Corequisites

Co-badged status

STAT8111 is co-taught with STAT7111

Unit description

This unit starts with the classical normal linear regression model. The family of generalized linear models is then introduced, and maximum likelihood estimators are derived. Models for counted responses, binary responses, continuous non-normal responses and categorical responses; and models for correlated responses, both normal and non-normal, and generalised additive models, are studied. All models and methods are illustrated using data sets from disciplines such as biology, actuarial studies and medicine.

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:

ULO1: Formulate a generalized linear model and derive its maximum likelihood estimators.

ULO2: Answer research questions by exploring data graphically; selecting and applying appropriate modelling techniques; appraising underlying model assumptions and goodness of fit, and modifying the analysis if required.

ULO3: Perform model selection and test hypothesis.

ULO4: Apply the generalized additive model to incorporate nonlinear forms of the predictors and use random effects or generalized estimating equations to model correlated data.

ULO5: Use statistical software to create model output and interpret them.

General Assessment Information

ASSIGNMENT SUBMISSION: Assignment submission will be online through the iLearn page.

Submit assignments online via the appropriate assignment link on the iLearn page. A personalised cover sheet is not required with online submissions. Read the submission statement carefully before accepting it as there are substantial penalties for making a false declaration.

- Assignment submission is via iLearn. You should upload this as a single PDF file.
- Please note the quick guide on how to upload your assignments provided on the iLearn page.
- Please make sure that each page in your uploaded assignment corresponds to only one A4 page (do not upload an A3 page worth of content as an A4 page in landscape). If you are using an app like Clear Scanner, please make sure that the photos you are using are clear and shadow-free.
- It is your responsibility to make sure your assignment submission is legible.
- If there are technical obstructions to your submitting online, please email us to let us know.

You may submit as often as required prior to the due date/time. Please note that each submission will completely replace any previous submissions. It is in your interests to make frequent submissions of your partially completed work as insurance against technical or other problems near the submission deadline.

LATE SUBMISSION OF WORK: All assessment tasks must be submitted by the official due date and time. In the case of a late submission for a non-timed assessment (e.g. an assignment), if special consideration has NOT been granted, 20% of the earned mark will be deducted for each 24-hour period (or part thereof) that the submission is late for the first 2 days (including weekends and/or public holidays). For example, if an assignment is submitted 25 hours late, its mark will attract a penalty equal to 40% of the earned mark. After 2 days (including weekends

and public holidays) a mark of 0% will be awarded. Timed assessment tasks (e.g. tests, examinations) do not fall under these rules.

FINAL EXAM POLICY: 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 semester, that is, the final day of the official examination period. 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.

If you receive special consideration for the final exam, a supplementary exam will be scheduled in the interval between the regular exam period and the start of the next session. By making a special consideration application for the final exam you are declaring yourself available for a resit during this supplementary examination period and will not be eligible for a second special consideration approval based on pre-existing commitments. Please ensure you are familiar with the policy prior to submitting an application.

You can check the supplementary exam information page on FSE101 in iLearn (bit.ly/FSESupp) for dates, and approved applicants will receive an individual notification one week prior to the exam with the exact date and time of their supplementary examination.

Assessment Tasks

Name	Weighting	Hurdle	Due
Assignment 1	20%	No	Week 4
Assignment 2	20%	No	Week 8
Assignment 3	20%	No	Week 11
Final Examination	40%	No	Examination Period

Assignment 1

Assessment Type ¹: Quantitative analysis task

Indicative Time on Task ²: 10 hours

Due: **Week 4**

Weighting: **20%**

The assignment will focus mainly on the material covered in Lecture Weeks 1-3.

On successful completion you will be able to:

- Formulate a generalized linear model and derive its maximum likelihood estimators.

- Answer research questions by exploring data graphically; selecting and applying appropriate modelling techniques; appraising underlying model assumptions and goodness of fit, and modifying the analysis if required.
- Perform model selection and test hypothesis.
- Use statistical software to create model output and interpret them.

Assignment 2

Assessment Type ¹: Quantitative analysis task

Indicative Time on Task ²: 10 hours

Due: **Week 8**

Weighting: **20%**

The assignment will focus mainly on the material covered in Lecture Weeks 4-6.

On successful completion you will be able to:

- Formulate a generalized linear model and derive its maximum likelihood estimators.
- Answer research questions by exploring data graphically; selecting and applying appropriate modelling techniques; appraising underlying model assumptions and goodness of fit, and modifying the analysis if required.
- Perform model selection and test hypothesis.
- Use statistical software to create model output and interpret them.

Assignment 3

Assessment Type ¹: Quantitative analysis task

Indicative Time on Task ²: 10 hours

Due: **Week 11**

Weighting: **20%**

The assignment will focus mainly on the material covered in Lecture Weeks 7-10.

On successful completion you will be able to:

- Formulate a generalized linear model and derive its maximum likelihood estimators.
- Answer research questions by exploring data graphically; selecting and applying appropriate modelling techniques; appraising underlying model assumptions and goodness of fit, and modifying the analysis if required.

- Perform model selection and test hypothesis.
- Apply the generalized additive model to incorporate nonlinear forms of the predictors and use random effects or generalized estimating equations to model correlated data.
- Use statistical software to create model output and interpret them.

Final Examination

Assessment Type ¹: Examination

Indicative Time on Task ²: 2 hours

Due: **Examination Period**

Weighting: **40%**

The Final Examination will be a two-hour, open-booked online exam (plus ten minutes of reading time).

On successful completion you will be able to:

- Formulate a generalized linear model and derive its maximum likelihood estimators.
- Answer research questions by exploring data graphically; selecting and applying appropriate modelling techniques; appraising underlying model assumptions and goodness of fit, and modifying the analysis if required.
- Perform model selection and test hypothesis.
- Apply the generalized additive model to incorporate nonlinear forms of the predictors and use random effects or generalized estimating equations to model correlated data.
- Use statistical software to create model output and interpret them.

¹ If you need help with your assignment, please contact:

- the academic teaching staff in your unit for guidance in understanding or completing this type of assessment
- the [Writing Centre](#) for academic skills support.

² Indicative time-on-task is an estimate of the time required for completion of the assessment task and is subject to individual variation

Delivery and Resources

Classes

There is no on-campus component for external students. External students are expected to study the course notes and attempt the SGTAs, weekly. They are also welcome to optionally attend

the weekly lectures and SGTAs.

Course notes

Course notes are available on iLearn, prior to the lecture. SGTA solutions are posted on iLearn.

Required and recommended resources

There is no prescribed text for this unit. The following are useful references:

1. Fahrmeir, L., Kneib, T., Lang, S. and Marx, B. (2013). **Regression: Models, Methods and Applications**, Springer.
2. Faraway, J. J. (2016). **Extending the linear model with R: generalized linear, mixed effects and nonparametric regression models**. CRC Press.
3. De Jong, P. and Heller, G.Z. (2008). **Generalized Linear Models for Insurance Data**, Cambridge University Press.
4. Wood, Simon N. (2017). **Generalized additive models: an introduction with R**, 2nd edition. CRC Press.
5. Stasinopoulos M. D., Rigby R. A., Heller G. Z., Voudouris V., De Bastiani F. (2017). **Flexible Regression and Smoothing: Using GAMLSS in R**. CRC Press.
6. Dobson, A. J. and Barnett, A. G. (2018). **An Introduction to Generalized Linear Models**, 4th edition, Chapman & Hall.
7. Lindsey, J.K. (1997). **Applying Generalized Linear Models**, Springer.
8. McCullagh, P. and Nelder, J.A. (1989). **Generalized Linear Models**, 2nd edition, Chapman & Hall.

Recommended web sites

A comprehensive list of online resources for self-learning R, is given on iLearn.

www.gamlss.com

www.statsci.org/glm/

en.wikipedia.org/wiki/Generalized_linear_model

Technology used

We will be using R, which is freely downloadable from the [CRAN](http://cran.r-project.org) website. We recommend use of the [RStudio](https://www.rstudio.com) interface, also freely downloadable.

iLearn

We will be using iLearn for posting of course notes, assignments, solutions and data sets, and online discussions. You are encouraged to use the forums for discussions on the course material. Remember that if you are confused about something, the chances are that other students are also confused. Everybody benefits from the discussions, and you should not be

embarrassed to admit that you do not understand a concept.

Audio recordings of lectures

Audio recordings of the lectures (Echo) will be available on the iLearn site.

Unit Schedule

Week	Topics	
1	The classical normal linear model	
2	Introduction to GLMs: The framework of generalized linear models is introduced, and the theory behind maximum likelihood estimation of the parameters started.	
3	Maximum likelihood estimation of the parameters; Poisson regression for count data	
4	Inference; comparison of models The deviance as a measure of fit; hypothesis testing	Assignment 1 due
5	Model checking: Definition of residuals in GLMs; checking for violation of model assumptions	
6	Model selection; overdispersion: Selection of models via AIC; the phenomenon of overdispersion; compound Poisson models to overcome it; the negative binomial model for counts	
7	Binary responses: logistic regression	
	Session 2 Break	
8	Logistic regression contd; Zero-inflated models; Generalized additive models	Assignment 2 due
9	Regression models for ordinal and categorical responses	
10	Correlated data: Models for longitudinal data, and other data structures in which there is clustering or correlation between observations	
11	Correlated data	Assignment 3 due
12	Correlated data	
13	No lecture	

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-centr) (<https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-centr>)

al). 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.*)

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](http://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central) (<http://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 or if you are a Global MBA student contact 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) provides academic writing resources and study strategies to help you improve your marks and take control of your study.

- [Getting help with your assignment](#)
- [Workshops](#)
- [StudyWise](#)
- [Academic Integrity Module](#)

The Library provides online and face to face support to help you find and use relevant information resources.

- [Subject and Research Guides](#)
- [Ask a Librarian](#)

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

If you are a Global MBA student contact 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/.

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.