STAT8150

Bayesian Data Analysis

Session 1, Special circumstances 2021

Archive (Pre-2022) - Department of Mathematics and Statistics

Contents

Notice

As part of Phase 3 of our return to campus plan, most units will now run tutorials, seminars and other small group activities on campus, and most will keep an online version available to those students unable to return or those who choose to continue their studies online.

To check the availability of face-to-face 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
Unit Convenor and Lecturer
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TBA

Unit Convenor and Lecturer
Houying Zhu
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Credit points
10

Prerequisites
((Admission to MAppStat or GradCertAppStat or GradDipAppStat or MDataSc or MActPrac) and (STAT806 or STAT810 or STAT6110 or STAT8310)) or (Admission to BMathScMAppStat and permission by special approval)

Corequisites

Co-badged status

Unit description
This unit introduces main concepts and methods of Bayesian analysis with a clear comparison with frequentist statistical methods. Both single-parameter and multi-parameter models are derived. Bayesian computation techniques and Bayesian regression models, which include linear, GLM and hierarchical models, are studied in the unit. This unit highlights and exploits computational aspects of Bayesian data analysis including Markov Chain Monte Carlo (MCMC) methods (Gibbs sampling, Hastings-Metropolis) using the latest computational tools.

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: Explain and communicate to a non-expert audience the fundamentals of the Bayesian approach to Statistics
ULO2: Construct conjugate families of prior distributions for common sampling distributions
ULO3: Formulate and carry out Bayesian inference procedures such as point and interval estimation and hypothesis testing, for common sampling distributions
ULO4: Develop, analytically describe, and implement both single and multiparameter probability models in the Bayesian framework
ULO5: Solve real world problems using Bayesian Methods and state-of-art software tools
ULO6: Design hierarchical models exploiting Markov chain Monte Carlo (MCMC) simulation methods, and apply them to common statistical models including Generalised Linear Models

Assessment Tasks

Name	Weighting	Hurdle	Due
Report 1	30%	No	Week 5
Report 2	30%	No	Week 8
Report 3	30%	No	Week 12
Media presentation	10%	No	Week 13

Report 1

Assessment Type [1]: Quantitative analysis task
Indicative Time on Task [2]: 20 hours
Due: **Week 5**
Weighting: **30%**

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

On successful completion you will be able to:

- Explain and communicate to a non-expert audience the fundamentals of the Bayesian approach to Statistics
- Construct conjugate families of prior distributions for common sampling distributions
- Formulate and carry out Bayesian inference procedures such as point and interval estimation and hypothesis testing, for common sampling distributions

Report 2

Assessment Type [1]: Quantitative analysis task
Indicative Time on Task [2]: 20 hours
Due: **Week 8**
Weighting: **30%**

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

On successful completion you will be able to:

- Explain and communicate to a non-expert audience the fundamentals of the Bayesian approach to Statistics
- Construct conjugate families of prior distributions for common sampling distributions
- Formulate and carry out Bayesian inference procedures such as point and interval estimation and hypothesis testing, for common sampling distributions
- Develop, analytically describe, and implement both single and multiparameter probability models in the Bayesian framework
- Solve real world problems using Bayesian Methods and state-of-art software tools

Report 3

Assessment Type [1]: Quantitative analysis task
Indicative Time on Task [2]: 20 hours
Due: **Week 12**
Weighting: **30%**

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

On successful completion you will be able to:

- Explain and communicate to a non-expert audience the fundamentals of the Bayesian approach to Statistics

- Construct conjugate families of prior distributions for common sampling distributions
- Formulate and carry out Bayesian inference procedures such as point and interval estimation and hypothesis testing, for common sampling distributions
- Develop, analytically describe, and implement both single and multiparameter probability models in the Bayesian framework
- Solve real world problems using Bayesian Methods and state-of-art software tools
- Design hierarchical models exploiting Markov chain Monte Carlo (MCMC) simulation methods, and apply them to common statistical models including Generalised Linear Models

Media presentation

Assessment Type [1]: Media presentation
Indicative Time on Task [2]: 13 hours
Due: **Week 13**
Weighting: **10%**

Students are required to produce a media presentation demonstrating a unit topic of their choice. This demonstration needs to be a brief and accessible to other students that haven't studied the specific topic but have similar Mathematics/Statistics background.

On successful completion you will be able to:

- Explain and communicate to a non-expert audience the fundamentals of the Bayesian approach to Statistics
- Construct conjugate families of prior distributions for common sampling distributions
- Formulate and carry out Bayesian inference procedures such as point and interval estimation and hypothesis testing, for common sampling distributions
- Develop, analytically describe, and implement both single and multiparameter probability models in the Bayesian framework
- Solve real world problems using Bayesian Methods and state-of-art software tools
- Design hierarchical models exploiting Markov chain Monte Carlo (MCMC) simulation methods, and apply them to common statistical models including Generalised Linear Models

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[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

Lectures

All lectures are online. They will be delivered as a combination of live zoom classes and prerecorded video recordings. Please refer to iLearn for more details.

Small-Group Teaching Activities (SGTAs)

Teaching Activities (SGTAs) SGTA classes will start in week 2.

Recommended text

- Peter Hoff, *A First Course in Bayesian Statistical Methods*, Springer Texts in Statistics

- Lambert B. *A Student's Guide to Bayesian Statistics.* SAGE Publications Ltd, 2018.

- Kruschke JK. *Doing Bayesian Data Analysis: A Tutorial with R, JAGS and Stan.* Academic Press / Elsevier, 2015.

- McElreath R. Statistical Rethinking: *A Bayesian Course with Examples in R and Stan,* CRC Press / Taylor and Francis / Chapman and Hall, 2016.

- Gelman A, Carlin JB, Stern HS, Dunson DB, Vehtari A, Rubin DB. *Bayesian Data Analysis (3rd Edition)*. CRC Press / Taylor and Francis / Chapman and Hall, 2014.

Computing and Software

R and Rstudio: These are freely available to download from the Web, and they will be used for data analysis in this unit

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://policies.mq.edu.au). 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

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

To find other policies relating to Teaching and Learning, visit Policy Central (https://policies.mq.edu.au) and use the search tool.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/admin/other-resources/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.