STAT878

Modern Computational Statistical Methods

S1 Evening 2019

Dept of Mathematics and Statistics

Contents

General Information

Unit convenor and teaching staff
Unit Convenor
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Tuesday 10am - 12noon

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Credit points
4

Prerequisites

Corequisites
((Admission to MAppStat or GradCertAppStat or GradDipAppStat or MActPrac or MDataSc or MSc) and (STAT806 or STAT810)) or (admission to MInfoTech)

Co-badged status
Co-badged with STAT778.

Unit description
This unit offers students the opportunity to study some modern computational methods in statistics. The first half of the unit covers maximum likelihood computations, Bayesian computations using Monte Carlo methods, missing data and the EM algorithm. The second half considers Kernel density estimation, Kernel regression, quantile regression and inferences using Monte-Carlo and bootstrapping methods.

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:

Ability to compute maximum likelihood and Bayesian estimates

Ability to make inferences using these estimates

Know how to deal with missing data and use the EM algorithm

Compute nonparametric estimators of probability density function

Compute nonparametric estimators of regression function and smoothed quantile regression

Understand Monte-Carlo inferential statistics and understand bootstrappping estimates of bias, variance and CI computations

Gain proficiency in Matlab and R

Assessment Tasks

Name	Weighting	Hurdle	Due
Assignment 1	20%	No	week 4
Mid-Semester Test	10%	No	week 7
Assignment 2	20%	No	week 10
Final exam	50%	No	Formal Examination Period

Assignment 1

Due: **week 4**
Weighting: **20%**

Assignments must be completed individually and submitted via *iLearn*. Discussions are allowed but the final work must be your personal effort. *Assignments should be word-processed.*

All assignments and assessment tasks must be submitted by the official due date and time. No marks will be given for late work unless an extension has been granted following a successful application for Special Consideration. Please contact the unit convenor for advice as soon as you become aware that you may have difficulty meeting any of the assignment deadlines.

On successful completion you will be able to:

- Ability to compute maximum likelihood and Bayesian estimates
- Ability to make inferences using these estimates
- Know how to deal with missing data and use the EM algorithm

- Understand Monte-Carlo inferential statistics and understand bootstrappping estimates of bias, variance and CI computations
- Gain proficiency in Matlab and R

Mid-Semester Test

Due: **week 7**
Weighting: **10%**

During Week 7, a test will be made available on the iLearn site of the unit. The test's due date is Friday 11.59pm in week 7. Students are allowed a maximum of two hours and one attempt to complete the test until the deadline.

The only excuse for not completing the mid-semester test at the designated time period is because of documented illness or unavoidable disruption. In these special circumstances you may apply for special consideration via ask.mq.edu.au.

On successful completion you will be able to:

- Ability to compute maximum likelihood and Bayesian estimates
- Ability to make inferences using these estimates
- Gain proficiency in Matlab and R

Assignment 2

Due: **week 10**
Weighting: **20%**

Assignments must be completed individually and submitted via *iLearn*. Discussions are allowed but the final work must be your personal effort. *Assignments should be word-processed.*

All assignments and assessment tasks must be submitted by the official due date and time. No marks will be given for late work unless an extension has been granted following a successful application for Special Consideration. Please contact the unit convenor for advice as soon as you become aware that you may have difficulty meeting any of the assignment deadlines.

On successful completion you will be able to:

- Compute nonparametric estimators of probability density function
- Compute nonparametric estimators of regression function and smoothed quantile regression
- Understand Monte-Carlo inferential statistics and understand bootstrappping estimates of bias, variance and CI computations
- Gain proficiency in Matlab and R

Final exam

Due: **Formal Examination Period**
Weighting: **50%**

There will be a 2-hour (supervised) exam during the University Examination Period. The second half of the semester will be more emphasised (because the first half will have been tested in the mid-semester test), but the entire unit will be considered examinable in this exam.

Students are expected to present themselves for examination at the time and place designated in the University Examination Timetable. The 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.

You are advised that 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 the 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.

On successful completion you will be able to:

- Ability to compute maximum likelihood and Bayesian estimates
- Ability to make inferences using these estimates
- Know how to deal with missing data and use the EM algorithm
- Compute nonparametric estimators of probability density function
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- Understand Monte-Carlo inferential statistics and understand bootstrappping estimates of bias, variance and CI computations
- Gain proficiency in Matlab and R

Delivery and Resources

Lectures

You are required to attend one 3-hour combined lecture and practical class each week. Please consult the university timetables for the exact time and location of the class.

Prescribed texts

Students should obtain the lecture overheads from iLearn prior to the lecture. The lecture overheads are available module by module.

The following are recommended reading books for this unit:

- Computational Statistics Handbook with MATLAB®, W. L. Martinez and A. R. Martinez, Chapman & Hall. (QA276.4.M272)
- Local regression and likelihood, C. Loader, Springer-Verlag, 1999. QA276.8 .L6/1999.
- Quantile Regression, Roger Koenker, Cambridge University Press 2005,

Unit webpage

Unit webpage is located on iLearn at https://ilearn.mq.edu.au.

You can only access the material on iLearn if you are formally enrolled in the unit. All lecturing materials are available at this webpage.

Teaching and Learning Strategy

The unit is taught in both traditional mode and external mode. In traditional mode, students are on campus in standard semesters with weekly lectures. In external mode, students access all teaching material from iLearn and do not attend lectures on campus.

Students are expected to

· attend all the lectures if enrolled internally;

· have read through the material to be covered using the lecture notes provided on iLearn;

· submit assignments on time via iLearn;

· participate the mid-semester test at the designated time;

· contact the unit convenor in advance if for any reason, you cannot hand in your assessment tasks on time;

Refer to the next section for a week-by-week list of topics to be covered in this unit.

Software used in teaching

We are using MATLAB, R and JAGS/WinBUGS in teaching this unit. R, JAGS/WinBUGS are free software and are widely used nowadays by statisticians. More information about R can be

found at http://www.r-project.org/, JAGS at "http://mcmc-jags.sourceforge.net" and WinBUGS at “http://www.mrc-bsu.cam.ac.uk/bugs/”. Matlab is commercial software, but is available for Macquarie students and staff: https://web.science.mq.edu.au/it/matlab/.

Unit Schedule

Week	Topic
1	Likelihood and maximum likelihood estimates (MLE)
2	Iterative methods for computing MLE
3	Iterative methods for computing MLE (cont.) & Prior and posterior distributions
4	Prior and posterior distributions (cont.) & Bayesian Estimation
5	Asymptotic distribution: ML & Bayesian Estimates
6	Missing data mechanism, incomplete data and its inference and the Expectation and Maximisation (EM) algorithm
7	Histogram & density estimation
8	Kernel density estimation
9	Kernel regression
10	Quantile regression
11	Monte-Carlo method for hypothesis testing
12	Bootstrapping
13	(Self) Revision

Students should read the lecture notes, which will be available at the unit web page, before the 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-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). 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).

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 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

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.

Graduate Capabilities

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

- Ability to compute maximum likelihood and Bayesian estimates
- Ability to make inferences using these estimates
- Know how to deal with missing data and use the EM algorithm
- Compute nonparametric estimators of probability density function
- Compute nonparametric estimators of regression function and smoothed quantile regression
- Understand Monte-Carlo inferential statistics and understand bootstrappping estimates of bias, variance and CI computations
- Gain proficiency in Matlab and R

Assessment tasks

- Assignment 1
- Mid-Semester Test
- Assignment 2
- Final exam

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

- Ability to compute maximum likelihood and Bayesian estimates
- Ability to make inferences using these estimates
- Know how to deal with missing data and use the EM algorithm
- Compute nonparametric estimators of probability density function
- Compute nonparametric estimators of regression function and smoothed quantile regression
- Understand Monte-Carlo inferential statistics and understand bootstrappping estimates of bias, variance and CI computations
- Gain proficiency in Matlab and R

Assessment tasks

- Assignment 1
- Mid-Semester Test
- Assignment 2
- Final exam

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

- Ability to compute maximum likelihood and Bayesian estimates
- Ability to make inferences using these estimates
- Know how to deal with missing data and use the EM algorithm
- Compute nonparametric estimators of probability density function
- Compute nonparametric estimators of regression function and smoothed quantile regression
- Understand Monte-Carlo inferential statistics and understand bootstrappping estimates of bias, variance and CI computations
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Assessment tasks

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Changes from Previous Offering

The Take-home Exam has been replaced by some new assessment tasks.