STAT878

Modern Computational Statistical Methods

S1 Evening 2014

Statistics

Contents

General Information

Unit convenor and teaching staff
Unit Convenor
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Other Staff
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Credit points
4

Prerequisites
Admission to MAppStat or PGDipAppStat or PGCertAppStat

Corequisites
STAT806 or STAT810

Co-badged status
No co-baged units

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 non-parametric curve estimation. The computing software MATLAB is used.

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:

Perform maximum likelihood and Bayesian computations

Make inferences using these estimates

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

Compute nonparametric estimators of probability density function and nonparametric curve estimation

Compute nonparametric estimators of regression function and smoothed quantile regression

Understand Monte-Carlo inferential statistics and understand bootstrap bias, variance and CI computations

Program in Matlab (or R)

Assessment Tasks

Name	Weighting	Due
Assignment 1	20%	6pm, April 10th
Assignment 2	20%	6pm, June 5th
Take home exam 1	30%	10am, April 14th
Take home exam 2	30%	TBA

Assignment 1

Due: **6pm, April 10th**
Weighting: **20%**

This assignment covers weeks 1 - 6 materials. Assignments comprise a major part of the learning process. Assignments are compulsory**.** Failure to submit any assignment will be taken as an evidence of non-participation in the course and may lead to exclusion from the course. Late submission without approval will be penalized at the rate of 20% deduction per day. Assignments must be each student's own work. Discussions are allowed but the final work must be your personal effort. *We prefer that assignments are word-processed.*

On successful completion you will be able to:

- Perform maximum likelihood and Bayesian computations
- Make inferences using these estimates
- Know how to deal with missing data and use the EM algorithm
- Program in Matlab (or R)

Assignment 2

Due: **6pm, June 5th**
Weighting: **20%**

This assignment covers weeks 7 - 12 materials. For policy on later submission and other issues please see Assignment 1 description.

On successful completion you will be able to:

- Compute nonparametric estimators of probability density function and nonparametric curve estimation
- Compute nonparametric estimators of regression function and smoothed quantile regression
- Understand Monte-Carlo inferential statistics and understand bootstrap bias, variance and CI computations
- Program in Matlab (or R)

Take home exam 1

Due: **10am, April 14th**
Weighting: **30%**

This first take home eaxm covers the teaching materials from week 1 to week 6 and it will be available from iLearn at 10am on Friday 11 April 2014. Your answers to this test must be submitted electronically to A/Prof Jun Ma by 10am Monday 14 April 2014. Your answers should be word processed. Matlab/R and WinBUGS codes written to answer the exam questions should also be included as an attachment. This take home exam must be submitted on time. Any later submissions without approval will NOT be accepted and no special consideration will be given.

On successful completion you will be able to:

- Perform maximum likelihood and Bayesian computations
- Make inferences using these estimates
- Know how to deal with missing data and use the EM algorithm
- Program in Matlab (or R)

Take home exam 2

Due: **TBA**
Weighting: **30%**

This take home exam will cover the lecture materials from week 7 to week 13. Its date will be

within the university Examination Period. The date of availability and submission will be advised before the end of week 13 of lectures. The solutions should be word processed and submitted electronically to Dr Maurizio Manuguerra. This test will have the same duration and policy on late submission as Take Home Exam 1.

On successful completion you will be able to:

- Compute nonparametric estimators of probability density function and nonparametric curve estimation
- Compute nonparametric estimators of regression function and smoothed quantile regression
- Understand Monte-Carlo inferential statistics and understand bootstrap bias, variance and CI computations
- Program in Matlab (or R)

Delivery and Resources

Lectures

You are required to attend a 3-hour lecture (and practice) each week; the time and room are:

Thursday	6.00 – 9.00pm	E4B 206 Faculty PC Lab

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 Moodle at https://ilearn.mq.edu.au.

You can only access the material on Moodle if you are 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 due in weeks 6 and 12 to the appropriate lecturer;

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

· collect their marked assessment from the lecturer during the lecture if enrolled internally. External students will have their marked assessment sent to them.

Refer to end of this handout for a week-by-week list of topics to be covered in this unit.

SOFTWARE USED IN TEACHING

We are using MATLAB (or R) and WinBUGS in teaching this unit. R and WinBUGS are free software and are widely used nowadays by statisticians. More information about R can be found at http://www.r-project.org/, and WinBUGS at "http://www.mrc-bsu.cam.ac.uk/bugs/".

CHANGES FROM PREVIOUS OFFERINGS

None

Technologies used and required

None

Unit Schedule

Unit Schedule

Week	Topic	Software	Assignment	
			Out	Due
1	Likelihood and maximum likelihood estimates (MLE)	Matlab		
2	Iterative methods for computing MLE	Matlab		
3	Iterative methods for computing MLE (cont.) Prior and posterior distributions	Matlab		

4	Prior and posterior distributions (cont.) Bayesian estimates Bayesian computation: posterior mean Bayesian computation: posterior mode WinBUGS	Matlab, WinBUGS	**Ass 1**	
5	Asymptotic distribution: MLE Asymptotic distribution: posterior mode	Matlab		
6	Missing data mechanism Complete data and incomplete data Inference based on incomplete data The EM algorithm	Matlab		**Ass 1**
7	Examples of the EM algorithm Histogram & density estimation	Matlab		
	A TWO-WEEK BREAK			
8	Kernel density estimation			
9	Kernel regression			
10 11	Quantile regression Monte-Carlo method for inferential statistics Basic procedure Monte-Carlo hypothesis testing		**Ass 2**	
12 13	Bootstrap methods Bootstrap method of bias Bootstrap estimate of variance Bootstrap confidence intervals Review			**Ass 2**

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. 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.html

Grading Policy http://mq.edu.au/policy/docs/grading/policy.html

Grade Appeal Policy http://mq.edu.au/policy/docs/gradeappeal/policy.html

Grievance Management Policy http://mq.edu.au/policy/docs/grievance_management/policy.html

Disruption to Studies Policy http://www.mq.edu.au/policy/docs/disruption_studies/policy.html *The Disruption to Studies Policy is effective from March 3 2014 and replaces the Special Consideration Policy.*

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/

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://informatics.mq.edu.au/hel

p/.

When using the University's IT, you must adhere to the Acceptable Use 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 outcome

- Perform maximum likelihood and Bayesian computations

Assessment tasks

- Assignment 1
- Assignment 2
- Take home exam 1
- Take home exam 2

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:

Assessment tasks

- Assignment 1
- Assignment 2
- Take home exam 1
- Take home exam 2

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:

Assessment tasks

- Assignment 1
- Assignment 2
- Take home exam 1
- Take home exam 2

PG - Effective Communication

Our postgraduates will be able to communicate effectively and convey their views to different social, cultural, and professional audiences. They will be able to use a variety of technologically supported media to communicate with empathy using a range of written, spoken or visual formats.

This graduate capability is supported by:

Assessment tasks

- Assignment 1
- Assignment 2
- Take home exam 1
- Take home exam 2