STAT822

Time Series

S2 Evening 2016

Dept of Statistics

Contents

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General Information

Unit convenor and teaching staff
Lecturer
Barry Quinn
barry.quinn@mq.edu.au
Contact via 9850 6475
Room 12, Level 2, Australian Hearing Hub

Credit points
4

Prerequisites
Admission to MAppStat or PGDipAppStat or PGCertAppStat or GradDipAppStat

Corequisites
STAT806 or STAT810

Co-badged status
STAT722 STAT822 External

Unit description
This unit is an introduction to the statistical theory and practice of Time Series Analysis. A Time Series is a set of data indexed by time. A time series is modelled as a single 'realisation' or sample of a stochastic process, i.e. a collection of (possibly) dependent random variables. The unit looks at suitable models for time series, examines the estimation of parameters in these models, hypothesis testing (and alternatively estimating the number of parameters), prediction of future values of the time series (forecasting), models for multivariate time series and the estimation of periodicity. There will also be a limited look at modelling stochastic volatility. Emphasis in this unit will be on practice.

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:

Be able to model real time series using a variety of techniques

Be able to judge the adequacy of these models

Be able to use these models to forecast future values

Demonstrate knowledge of the limitations of such modelling

Demonstrate knowledge of the theoretical issues, including asymptotic behaviour of parameter estimators

Be able to write Matlab code to implement the algorithms developed in the course

General Assessment Information

See http://www.mq.edu.au/policy/docs/assessment/schedule_1.html

Assignments may be handwritten, and submitted in person, or electronically via email to Prof Quinn. There is no requirement that assignments be word-processed, since the mathematical typesetting capabilities of Microsoft word are inadequate. Submit to Prof Barry Quinn by the end of the lecture on the due date. There is no "group work" assessment in this unit. All work is to be the student's own. No extensions will be granted. Students who have not submitted the assignment prior to the deadline will be awarded a mark of 0 for the assignment, except for cases in which an application for disruption to studies is made and approved.

Assessment Tasks

Name	Weighting	Due
Assignment 1	8%	23rd August
Assignment 2	12%	4th October
Assignment 3	12%	1st November
Practical Assignment	18%	8th November
Final Examination	50%	12th November

Assignment 1

Due: **23rd August**
Weighting: **8%**

Assignment 1 will be mainly theoretical, but may involve simulation and the writing of Matlab code. It will be available on the iLearn page by 9th August.

On successful completion you will be able to:
- Demonstrate knowledge of the theoretical issues, including asymptotic behaviour of parameter estimators
- Be able to write Matlab code to implement the algorithms developed in the course

Assignment 2

Due: **4th October**

Weighting: **12%**

Assignment 2 will be mainly theoretical, but may involve simulation and the writing of Matlab code. It will be available on the iLearn page by 30th August.

On successful completion you will be able to:

- Be able to model real time series using a variety of techniques
- Demonstrate knowledge of the theoretical issues, including asymptotic behaviour of parameter estimators
- Be able to write Matlab code to implement the algorithms developed in the course

Assignment 3

Due: **1st November**

Weighting: **12%**

Assignment 3 will be mainly theoretical, but may involve simulation and the writing of Matlab code. It will be available on the iLearn page by 11th October.

On successful completion you will be able to:

- Be able to model real time series using a variety of techniques
- Be able to judge the adequacy of these models
- Be able to use these models to forecast future values
- Demonstrate knowledge of the limitations of such modelling
- Demonstrate knowledge of the theoretical issues, including asymptotic behaviour of parameter estimators
- Be able to write Matlab code to implement the algorithms developed in the course

Practical Assignment

Due: **8th November**

Weighting: **18%**

This will be a practical assignment, with emphasis on time series model fitting, Matlab coding and simulation. It will be posted on iLearn on 11th October.

On successful completion you will be able to:

- Be able to model real time series using a variety of techniques
- Be able to judge the adequacy of these models
- Be able to use these models to forecast future values

- Demonstrate knowledge of the limitations of such modelling
- Be able to write Matlab code to implement the algorithms developed in the course

Final Examination

Due: **12th November**

Weighting: **50%**

The final examination will be a take-home exam, available at 9am local time and finishing at 5pm.

Evidence should be given that the examination finished at 5pm. Details will be given closer to the date.

On successful completion you will be able to:

- Be able to model real time series using a variety of techniques
- Be able to judge the adequacy of these models
- Be able to use these models to forecast future values
- Demonstrate knowledge of the limitations of such modelling
- Demonstrate knowledge of the theoretical issues, including asymptotic behaviour of parameter estimators
- Be able to write Matlab code to implement the algorithms developed in the course

Delivery and Resources

There are three contact hours per week, usually comprised of two hours of lectures and one hour of practical work. Check the timetable for classes.

Please consult iLearn or the Statistics Department webpage for details of consultation hours.

Technologies used and required

Lecture material will be placed on iLearn.

Students will need to use a computer for most of the assessments. There will be extensive use of Matlab during practical classes. Students are entitled to download the full version of Matlab, and use it for the duration of their studies. Details are at

https://web.science.mq.edu.au/it/matlab/

I urge you to install it on your laptop, or home desktop. I shall bring a usb stick with Windows and OSX versions to classes.

Unit Schedule

TOPIC	MATERIAL COVERED

1	Stationary processes, autocovariances, autocorrelations, the Wold decomposition theorem.
2	Autoregressive moving average (ARMA) processes, the Yule-Walker relations
3	Estimation of ARMA parameters. Goodness of fit. Model building. Estimating the order of ARMA models.
4	Prediction for ARMA processes.
5	Multivariate time series. The Whittle recursion.
6	Stochastic volatility models.
7	Models for periodic phenomena. The estimation of periodicity and applications
8	State space models and the Kalman filter.

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

New Assessment Policy in effect from Session 2 2016 http://mq.edu.au/policy/docs/assessment/policy_2016.html. For more information visit http://students.mq.edu.au/events/2016/07/19/new_assessment_policy_in_place_from_session_2/

Assessment Policy prior to Session 2 2016 http://mq.edu.au/policy/docs/assessment/policy.html

Grading Policy prior to Session 2 2016 http://mq.edu.au/policy/docs/grading/policy.html

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

Complaint Management Procedure for Students and Members of the Public http://www.mq.edu.au/policy/docs/complaint_management/procedure.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/

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. For more information visit ask.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

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 - Capable of Professional and Personal Judgment and Initiative

Our postgraduates will demonstrate a high standard of discernment and common sense in their professional and personal judgment. They will have the ability to make informed choices and decisions that reflect both the nature of their professional work and their personal perspectives.

This graduate capability is supported by:

Learning outcome

- Be able to write Matlab code to implement the algorithms developed in the course

Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
- Practical Assignment
- Final Examination

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

- Be able to model real time series using a variety of techniques
- Be able to judge the adequacy of these models
- Be able to use these models to forecast future values
- Demonstrate knowledge of the limitations of such modelling
- Demonstrate knowledge of the theoretical issues, including asymptotic behaviour of parameter estimators
- Be able to write Matlab code to implement the algorithms developed in the course

Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
- Practical Assignment
- Final Examination

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

- Be able to model real time series using a variety of techniques
- Demonstrate knowledge of the theoretical issues, including asymptotic behaviour of parameter estimators
- Be able to write Matlab code to implement the algorithms developed in the course

Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
- Practical Assignment
- Final Examination

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

- Be able to model real time series using a variety of techniques
- Be able to judge the adequacy of these models
- Be able to use these models to forecast future values
- Demonstrate knowledge of the limitations of such modelling
- Demonstrate knowledge of the theoretical issues, including asymptotic behaviour of parameter estimators
- Be able to write Matlab code to implement the algorithms developed in the course

Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
- Practical Assignment
- Final Examination

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:

Learning outcomes

- Be able to model real time series using a variety of techniques
- Demonstrate knowledge of the limitations of such modelling

Assessment tasks

- Assignment 2
- Assignment 3
- Practical Assignment
- Final Examination

PG - Engaged and Responsible, Active and Ethical Citizens

Our postgraduates will be ethically aware and capable of confident transformative action in relation to their professional responsibilities and the wider community. They will have a sense of connectedness with others and country and have a sense of mutual obligation. They will be able to appreciate the impact of their professional roles for social justice and inclusion related to national and global issues

This graduate capability is supported by:

Learning outcome

- Demonstrate knowledge of the limitations of such modelling

Assessment tasks

- Practical Assignment
- Final Examination

Changes from Previous Offering

The final examination is now a take-home exam.

Textbooks and other reference material

There is no prescribed textbook. Some reference books, not in order of relevance, are

- W.A. Fuller, Introduction to statistical time series.
- C. Chatfield, The analysis of time series: an introduction.
- C. Chatfield, The analysis of time series: theory and practice.
- C. Chatfield, Time-series forecasting.

- P.J. Brockwell and R.A. Davis, Introduction to Time Series and Forecasting.

- S. Makridakis, S.C. Wheelwright and R.J. Hyndman, Forecasting, Methods and Applications.

- W.W. Wei, Time Series Analysis.

- F.X. Diebold, Elements of Forecasting.

- J.D. Cryer, Time Series Analysis.

- B.L. Bowerman and R.T. O'Connell, Forecasting and Time Series.

- H. Joseph Newton, TIMESLAB: A Time Series Analysis Laboratory.

- R.S. Tsay, Analysis of Financial Time Series.

- B.G. Quinn and E.J. Hannan, The estimation and Tracking of Frequency

The lecture notes are extensive.

Matlab will be used in the practical classes. The full version of Matlab may be installed on students' computers for the duration of their studies. Details are given earlier in this guide. iLab may also be used, as it has a full version of Matlab.