STAT722

Time Series

S2 Day 2018

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 625, 12WW (E7A)
12pm - 2pm Tuesdays

Credit points
4

Prerequisites
Admission to MRes

Corequisites
STAT710

Co-badged status
STAT822 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

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.

Assessment Tasks

Name	Weighting	Hurdle	Due
Assignment 1	8%	No	21st August
Assignment 2	12%	No	2nd October
Assignment 3	12%	No	30th October
Practical Assignment	18%	No	6th November
Final Examination	50%	No	10th November

Assignment 1

Due: **21st 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 7th August. Submit to the lecturer by 5pm on the due date. There is no “group work” assessment in this unit. All work is to be the student’s own. In the case of the late submission of an assignment, if no special consideration has been granted, 10% of the earned mark will be deducted for each day that the assignment is late, up to a maximum of 50%. After 5 days, including weekends and public holidays, a mark of 0% will be awarded for the assignment.

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: **2nd 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 4th September. Submit to the lecturer by 5pm on the due date. There is no “group work” assessment in this unit. All work is to be the student’s own. In the case of the late submission of an assignment, if no special consideration has been granted, 10% of the earned mark will be deducted for each day that the assignment is late, up to a maximum of 50%. After 5 days, including weekends and public holidays, a mark of 0% will be awarded for the assignment.

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: **30th October**
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 9th October. Submit to the lecturer by 5pm on the due date. There is no “group work” assessment in this unit. All work is to be the student’s own. In the case of the late submission of an assignment, if no special consideration has been granted, 10% of the earned mark will be deducted for each day that the assignment is late, up to a maximum of 50%. After 5 days, including weekends and public holidays, a mark of 0% will be awarded for the assignment.

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: **6th 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 9th October. Submit to the lecturer by 5pm on the due date. There is no “group work” assessment in this unit. All work is to be the student’s own. In the case of the late submission of an assignment, if no special consideration has been granted, 10% of the earned mark will be deducted for each day that the assignment is late, up to a maximum of 50%. After 5 days, including weekends and public holidays, a mark of 0% will be awarded for the assignment.

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: **10th 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. There is no “group work” assessment in this unit. All work is to be the student's own. The University's special consideration policy will apply in case you are unable to complete the exam on the day.

https://students.mq.edu.au/study/my-study-program/special-consideration

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. If the lecture room is equipped with Echo facilities, they will be used, i.e. audio and/or video recordings will be available soon after the lecture.

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. Please email me if you have difficulty, as the download is rather large.

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 (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 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

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: This may be downloaded by Macquarie University staff and students. Type "Springerlink" in the MultiSearch window at https://www.mq.edu.au/about/campus-services-and-facilities/library and type "Brockwell Davis" in the main window at the SpringerLink site. Then click on "Book" under Content Type and uncheck "Include Preview-Only content". There is only one book, which is the one you should download.
- 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
- Robert Shumway and David Stoffer, Time Series Analysis and Its Applications With R Examples, (2017), also available on SpringerLink.

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.