STAT722

Time Series

S2 Evening 2014

Statistics

Contents

General Information

Unit convenor and teaching staff
Lecturer
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Credit points
4

Prerequisites
Admission to MRes

Corequisites

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

Have seen many of the theoretical issues, including asymptotic behaviour of parameter

estimators

Know the limitations of such modelling

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

General Assessment Information

Students MUST perform satisfactorily in the final examination in order to pass the unit regardless of their performance throughout the semester. Students should note that, if they fail the final examination, their coursework will not count and the SNG allocated will be based on their final examination mark only.

The only exception to not sitting an examination on the designated date is because of documented illness or unavoidable disruption. In these circumstances you may wish to consider applying for special consideration.

Assessment Tasks

Name	Weighting	Due
Assignment 1	10%	26 August
Assignment 2	10%	7 October
Assignment 3	10%	4 Novermber
Modelling Assignment	10%	11 November
Final Examination	60%	15 November

Assignment 1

Due: **26 August**
Weighting: **10%**

Assignments may be submitted electronically, via email to Prof Quinn, but NOT via iLearn. There is no requirement that assignments be word-processed, since the mathematical typesetting capabilities of Microsoft word are inadequate (The lecture notes have been prepared using LaTeX). 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 special consideration is made and approved.

On successful completion you will be able to:

- Have seen many 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: **7 October**
Weighting: **10%**

Assignments may be submitted electronically, via email to Prof Quinn, but NOT via iLearn. There is no requirement that assignments be word-processed, since the mathematical typesetting capabilities of Microsoft word are inadequate (The lecture notes have been prepared using LaTeX). 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 special consideration is made and approved.

On successful completion you will be able to:

- Be able to model real time series using a variety of techniques
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- Be able to write Matlab code to implement the algorithms developed in the course

Assignment 3

Due: **4 Novermber**
Weighting: **10%**

Assignments may be submitted electronically, via email to Prof Quinn, but NOT via iLearn. There is no requirement that assignments be word-processed, since the mathematical typesetting capabilities of Microsoft word are inadequate (The lecture notes have been prepared using LaTeX). 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 special consideration is made and approved.

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
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- Know the limitations of such modelling
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Modelling Assignment

Due: **11 November**
Weighting: **10%**

Assignments may be submitted electronically, via email to Prof Quinn, but NOT via iLearn. There is no requirement that assignments be word-processed, since the mathematical typesetting capabilities of Microsoft word are inadequate (The lecture notes have been prepared using LaTeX). Each student will be given a unique time series to model, and will be awarded marks based on the description of the methods used to determine the time series model. 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 special consideration is made and approved.

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
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Final Examination

Due: **15 November**
Weighting: **60%**

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:

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- Be able to use these models to forecast future values
- Have seen many of the theoretical issues, including asymptotic behaviour of parameter estimators

- Know the limitations of such modelling
- 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 Unit 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 the final examination and most of the assessments. There will be extensive use of Matlab during practical classes. Students may use an old (provided) version of Matlab or the iLab version, on their own computers.

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

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/help/.

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 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
- Have seen many of the theoretical issues, including asymptotic behaviour of parameter estimators
- Know the limitations of such modelling
- Be able to write Matlab code to implement the algorithms developed in the course

Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
- Modelling 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
- Have seen many of the theoretical issues, including asymptotic behaviour of parameter estimators
- Be able to write Matlab code to implement the algorithms developed in the course

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- 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
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- Assignment 3
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- 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
- Know the limitations of such modelling

Assessment tasks

- Assignment 2
- Assignment 3

- Modelling 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

- Know the limitations of such modelling

Assessment tasks

- Assignment 3
- Modelling Assignment
- Final Examination

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
- Modelling Assignment
- Final Examination

Changes from Previous Offering

Only the detail in the lecture notes will have changed.

Grading in this unit

Your final SNG and grade in STAT722 will be based on your work during semester and in the final examination as specified in the 'Assessment' section. The determination of your final SNG and Grade will be based on an assessment of your performance on individual assessment tasks against identified criteria and standards as set out in the section titled 'Assessment Criteria', and an assessment of overall performance in the unit. Final grades will be awarded on the basis of your overall performance and the extent to which you demonstrate fulfilment of the learning outcomes listed for this unit.

The relationship between SNGs and Final Grades is shown in the table below:

SNG.Range	Grade	Standard
85 - 100	High Distinction (HD)	Provides consistent evidence of deep and critical understanding in relation to the learning outcomes. There is substantial originality and insight in identifying,generating and communicating competing arguments, perspectives or problem solving approaches; critical evaluation of problems, their solutions and their implications; creativity in application as appropriate to the discipline.
75 - 84	Distinction (D)	Provides evidence of integration and evaluation of critical ideas, principles and theories, distinctive insight and ability in applying relevant skills and concepts in relation to learning outcomes. There is demonstration of frequent originality in defining and analysing issues or problems and providing solutions; and the use of means of communication appropriate to the discipline and the audience.
65 - 74	Credit (Cr)	Provides evidence of learning that goes beyond replication of content knowledge or skills relevant to the learning outcomes. There is demonstration of substantial understanding of fundamental concepts in the field of study and the ability to apply these concepts in a variety of contexts; convincing argumentation with appropriate coherent justification; communication of ideas fluently and clearly in terms of the conventions of the discipline.
50 - 64	Pass (P)	Provides sufficient evidence of the achievement of learning outcomes. There is demonstration of understanding and application of fundamental concepts of the field of study; routine argumentation with acceptable justification;communication of information and ideas adequately in terms of the conventions of the discipline. The learning attainment is considered satisfactory or adequate or competent or capable in relation to the specified outcomes.
0 - 49	Fail (F)	Does not provide evidence of attainment of learning outcomes. There is missing or partial or superficial or faulty understanding and application of the fundamental concepts in the field of study; missing, undeveloped, inappropriate or confusing argumentation; incomplete, confusing or lacking communication of ideas in ways that give little attention to the conventions of the discipline.

Please note that a student must meet the performance standard outlined above in **both** the coursework **and** the examination sections of this unit in order to be awarded a particular grade.

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 version 2013b or 2014a will be used in the practical classes. It is not possible to give students copies of this version, but an older version is available free from the lecturer. Although this version is old, it is the last version which students are freely permitted to install on their own computers. Students may also use iLab, which requires internet access. Students using Windows 8 will need to use a special vmware edition of the old Matlab version.