STAT8002
Applied Time Series Analysis

Course Description

This course considers statistical techniques to evaluate processes occurring through time. It introduces students to time series methods and the applications of these methods to different types of data in various contexts (such as actuarial studies, climatology, economics, finance, geography, meteorology, political science, risk management, and sociology). Time series modelling techniques will be considered with reference to their use in forecasting where suitable. While linear models will be examined in some detail, extensions to non-linear models will also be considered.

The topics will include: deterministic models; linear time series models, stationary models, homogeneous non-stationary models; the Box-Jenkins approach; intervention models; non-linear models; time-series regression; time-series smoothing; case studies. Statistical software R will be used throughout this course.

Heavy emphasis will be given to fundamental concepts and applied work. Since this is a course on applying time series techniques, different examples will be considered whenever appropriate.

<table>
<thead>
<tr>
<th>Semester and Year</th>
<th>S1 2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course URL</td>
<td><a href="http://programsandcourses.anu.edu.au/course/STAT8002">http://programsandcourses.anu.edu.au/course/STAT8002</a></td>
</tr>
<tr>
<td>Mode of Delivery</td>
<td>On campus</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>STAT2001/STAT6039 and STAT2008/STAT6038 or enrolment in the Master of Applied Statistics</td>
</tr>
<tr>
<td>Incompatible Courses</td>
<td>Dr Hanlin Shang</td>
</tr>
<tr>
<td>Office Location</td>
<td>Room 4.38, Level 4, Building 26C</td>
</tr>
<tr>
<td>Phone</td>
<td>02 6125 0535</td>
</tr>
<tr>
<td>Email</td>
<td><a href="mailto:hanlin.shang@anu.edu.au">hanlin.shang@anu.edu.au</a></td>
</tr>
<tr>
<td>Consultation hours</td>
<td>3-5pm Wednesday</td>
</tr>
<tr>
<td>Bio and research interests</td>
<td>Hanlin joined RSFAS in 2014 after completed his PhD and two postdocs in the research areas of functional data analysis. His Research interests are: Time series forecasting for large high-dimensional (or functional) data</td>
</tr>
<tr>
<td>Tutor(s) (optional)</td>
<td>Anna Pickering 02 6125 9045 <a href="mailto:anna.pickering@anu.edu.au">anna.pickering@anu.edu.au</a></td>
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COURSE OVERVIEW

Course Learning Outcomes
Upon successful completion of the requirements for this course, students will be able to:

LO1: Understand and apply the concept of stationarity to the analysis of time series data in various contexts (such as actuarial studies, climatology, economics, finance, geography, meteorology, political science and sociology)

LO2: Run and interpret time-series models and regression models for time series

LO3: Use the Box-Jenkins approach to model and forecast time-series data empirically and understand the theoretical concepts of the Box-Jenkins approach

LO4: Develop fundamental research skills (such as data collection, data processing, and model estimation and interpretation) in applied time series analysis

LO5: Use existing R functions and packages for analysing time series data, and develop their own R code for problem at the end of each chapter in the textbook as well as additional exercises (useful for completing assignments, but will not be tested in the final exam)

LO6: Use multivariate time-series models such as vector autoregression (VAR) and VARMA to analyse stationary multivariate time series data

Research-Led Teaching
Where possible, topics covered will be related to current research problems and reflect real world situations to emphasize the use of the techniques covered.

Technology, Software, Equipment
All course notes and materials will be provided via Wattle. You will need access to a computer to get the materials necessary for the course. There is a limited use of R in this course. Some in class work will be illustrated using R. Students are encouraged to complete their assignments in R.

Co-teaching
This course will be taught alongside STAT4102. There will be some material in this course, which may not be relevant to STAT4102 but applies only to STAT8002. This will be clearly identified during the lecture and final exam. Students enrolled in STAT8002 will need to demonstrate a deeper understanding of the concepts and material. This will be done and tested through different assessment tasks.

Continuous Improvement
We use feedback from students, professional bodies and staff to make regular improvements to the course. In response to this feedback, design improvements from the previous version of the course include:

- When time permits, we will also study non-linear time series analysis
Student Feedback
All CBE courses are evaluated using Student Experience of Learning and Teaching (SELT) surveys, administered by Planning and Statistical Services at the ANU. These surveys are offered online, and students will be notified via email to their ANU address when surveys are available in each course. Feedback is used for course development so please take the time to respond thoughtfully. Course feedback is anonymous and provides the Colleges, University Education Committee and Academic Board with opportunities to recognise excellent teaching and to improve courses across the university. For more information on student surveys at ANU and reports on feedback provided on ANU courses, visit http://unistats.anu.edu.au/surveys/self/students/ and http://unistats.anu.edu.au/surveys/self/results/learning/

COURSE SCHEDULE

<table>
<thead>
<tr>
<th>Week</th>
<th>Summary of Activities</th>
<th>Assessment</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Overview of STAT8002/4102 and general information</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Time Series Characteristic and R language</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Time Series Smoothing, Regression and Exploratory Data Analysis</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Time Series Smoothing, Regression and Exploratory Data Analysis</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Box-Jenkin approach and its multivariate variant</td>
<td>Assignment 1 due</td>
</tr>
<tr>
<td>6</td>
<td>Box-Jenkin approach and its multivariate variant</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Difference equations</td>
<td>Teaching break</td>
</tr>
<tr>
<td>8</td>
<td>Teaching break</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Autocorrelation and partial autocorrelation functions</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Time Series Estimation and Forecasting</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Time Series Estimation and Forecasting</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Nonstationary time series</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Multiplicative Seasonal ARIMA models</td>
<td>Assignment 2 due</td>
</tr>
<tr>
<td>14</td>
<td>Revision</td>
<td>Examination period</td>
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COURSE ASSESSMENT

Assessment Summary

<table>
<thead>
<tr>
<th>Item</th>
<th>Title</th>
<th>Value</th>
<th>Due Date</th>
<th>Linked Learning Outcomes (optional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Assignment 1</td>
<td>15%</td>
<td>23rd March 2016</td>
<td>LO1, LO2, LO4, LO5</td>
</tr>
<tr>
<td>2</td>
<td>Assignment 2</td>
<td>25%</td>
<td>25th May 2016</td>
<td>LO3, LO5, LO6</td>
</tr>
<tr>
<td>3</td>
<td>Final exam</td>
<td>60%</td>
<td>TBA</td>
<td></td>
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Assessment Task 1: Assignment 1
Details of task: Cover materials in Week 1 to 5
Value: 15%
Due Date: 3pm, Friday of Week 6 (23rd March 2016)
Further details will be provided in the Assignment Guidelines. Students are expected to complete this assignment *individually*. Students will need to submit their assignments in person at the end of Wednesday class.

Assessment Task 2: Assignment 2
Details of task: Cover materials in Week 1 to 9
Value: 25%
Due date: 3pm, Friday of Week 12 (25th May, 2016)
Further details will be provided in the Assignment Guidelines. Students are expected to complete this assignment *individually*. Students will need to submit their assignments in person at the end of Wednesday class.

Examination
A three-hour examination will be held in the final examination period. It will contribute 60% of your final raw score. The final examination will be based on all the work covered throughout the duration of the semester. The exam will include a mixture of theoretical and numerical questions. Students will be provided with further details regarding the exam as it approaches.

Assignment Submission
Assignments must be submitted to me at the end of Wednesday lecture and include a cover sheet. Email and fax submissions are not acceptable. You must keep a copy of assessment materials submitted for your records. Please put your ID (not name) on the cover sheet.

Extensions and Penalties
Extensions are generally only granted for medical reasons or as a result of other extenuating circumstances, and must be agreed upon with the lecturer before the deadline for assignment submission has passed. In case of medical reason, please present lecturer with your medical certificate at the last lecture before the due date of your assignment.

With the attachment of medical certificate, the penalty is 5% of the possible marks available for the assessment task per working day or part thereof. Please note that assessment tasks are not to be accepted after the earlier of the following:

a) The tenth working day after the due date; or,

b) The date specified in due course on Wattle for the return of the assessment item.

Returning Assignments
Assignments will be returned approximately one or two weeks after they are submitted. You should retain a copy of your submission for your own records. If you do not collect your assignments, they will be destroyed after the end of the semester. If you cannot collect your assignments in the class, please visit me during my consultation hours.

Resubmission of Assignments
For each of the two assignments, there is no possibility of resubmission.

Examinations
You will need a nonprogrammable scientific calculator. More details will be provided as the exam approaches. Details of the final examination timetable are available on the ANU
Timetabling website (http://timetable.anu.edu.au/). The onus is upon students to acquire their own scheduling details.

**Scaling**

Your final mark for the course will be based on the raw marks allocated for each of your assessment items. However, your final mark may not be the same number as produced by that formula, as marks may be scaled. Any scaling applied will preserve the rank order of raw marks (i.e. if your raw mark exceeds that of another student, then your scaled mark will exceed the scaled mark of that student), and may be either up or down.

**Referencing Requirements**

The University offers a number of support services for students. Information on these is available online from http://students.anu.edu.au/studentlife/

**READING LISTS**


**COMMUNICATION**

Should you have questions, please come at the consultation hours. For very urgent matters, please email me or phone 50535.

**Email**

If necessary, the lecturers for this course will contact students on their official ANU student email address. Information about your enrolment and fees from the Registrar and Student Services’ office will also be sent to this email address.

**Announcements**

Students are expected to check the Wattle site for announcements about this course, e.g. changes to timetables or notifications of cancellations. Notifications of emergency cancellations of lectures or tutorials will be posted on the door of the relevant room.

**Course URLs**

More information about this course may be found on:

- Programs and Courses (http://programsandcourses.anu.edu.au/2015/Catalogue)
- The College of Business and Economics website (http://cbe.anu.edu/courses) and
- Wattle (https://wattle.anu.edu.au), the University's online learning environment. Log on to Wattle using your student number and your ISIS password.

**TUTORIAL AND/OR SEMINAR REGISTRATION**

Enrolment in tutorials will be completed online using the CBE Electronic Teaching Assistant (ETA). To enrol, follow these instructions:
1. Go to http://eta.fec.anu.edu.au
2. You will see the Student Login page. To log into the system, enter your University ID (your student number) and password (your ISIS password) in the appropriate fields and hit the Login button.
3. Read any news items or announcements.
4. Select "Sign Up!" from the left-hand navigation bar.
5. Select your courses from the list. To select multiple courses, hold down the control key. On PCs, this is the Ctrl key; on Macs, it is the ⌘ key. Hold this key down while selecting courses with the mouse. Once courses are selected, hit the SUBMIT button.
6. A confirmation of class enrolments will be displayed. In addition, an email confirmation of class enrolments will be sent to your student account.
7. For security purposes, please ensure that you click the LOGOUT link on the confirmation page, or close the browser window when you have finished your selections.
8. If you experience any difficulties, please contact the School Office (see page 1 for contact details).
9. Students will have until 5pm Wednesday 25 February to finalise their enrolment in tutorials. After this time, students will be unable to change their tutorial enrolment.

POLICIES

The University offers a number of support services for students. Information on these is available online from http://students.anu.edu.au/studentlife/

ANU has educational policies, procedures and guidelines, which are designed to ensure that staff and students are aware of the University’s academic standards, and implement them. You can find the University’s education policies and an explanatory glossary at: http://policies.anu.edu.au/

Students are expected to have read the Student Academic Integrity Policy before the commencement of their course.

Other key policies include:

- Student Assessment (Coursework)
- Student Surveys and Evaluations