STAT6087

Time Series Analysis

Danny Pfeffermann &
Angela Luna-Hernandez
University of Southampton

Duncan Elliott
Office for National Statistics (ONS)

23 -27 February 2015

Certificate/Diploma/MSc in Official Statistics

Professional Development Programme

STAT6087 – TIME SERIES ANALYSIS

Location: University of Southampton
Building 39 (S3RI), Seminar Room

Lecturers: Prof. Danny Pfeffermann
Southampton Statistical Sciences Research Institute
msdanny@soton.ac.uk

Duncan Elliott
Office for National Statistics
duncan.elliott@ons.gsi.gov.uk

Aim: Introduce the students to the basic ideas and theory underlying time series analysis. Teach and practice time series models in common use for the prediction of future observations and/or estimation of unobservable components like trend and seasonal effects.

Learning Outcomes:

By the end of this unit, students should be able to understand and apply the concepts and methods used for univariate time series modelling. In addition, students should be able to decompose a time series into a trend component, seasonal effects and irregular terms.

Computing: The course includes several computing lab sessions, in which the students will apply a variety of programs of time series analysis.

Contents: Basic concepts and assumptions: calendar effects, outliers, stationarity; ARIMA and SARIMA models for forecasting; exponential smoothing; periodogram and spectral analysis; local models and moving average methods; X13ARIMA-SEATS package for decomposition of times series into trend, seasonal effects, calendar effects and irregulars.

Assessment: For those wishing to gain a university credit, the assessment of this module will be divided into two parts, as follows:

Part I: consists of problem solving;

Part II: contains an analysis of a time series. You will be required to write a report on your findings from this analysis.

The deadline for handing in both assignments is **31 March 2015** with a post mark of the preceding Monday at latest. Students who fail to meet the deadline will receive a 5% reduction in their mark for every working day up to 5 working days. After 6 working days, the standard policy is to award zero for the coursework assignment.

Deadlines are made to be met. If students want to request an extension, they must have medical or personal circumstances to justify the late submission of assessed coursework (medical evidence must be substantiated by a doctor's note). They should initially fill out a coursework extension request form available at: http://www.southampton.ac.uk/demography/postgraduate/taught_courses/msc_official_statistics.page and send it to their personal tutor, Dr Solange Correa-Onel, who will, where appropriate, agree to the extension of the deadline after discussion with the module coordinator and examination officer. Under no circumstances will extensions be granted beyond a period of two weeks.

No mark below 35% is allowed for any module in the programme. Students attaining marks below the minimum mark will have to re-sit the module according to the school policy.

Blackboard: Computing lab material will be placed in the blackboard www.blackboard.soton.ac.uk under 'STAT6087-28294-14-15: 14-15-Time Series Analysis-28294'. You must submit an electronic version of the coursework assignment for the Turn-it-in plagiarism software. You must access the specific module on Blackboard: "STAT6087-28294-14-15: 14-15-Time Series Analysis-28294" and upload the assignment through the 'Assignments' folder according to the instructions. All students enrolled in the module will gain access to this site.

NOTE: the uploading of an electronic version of the coursework assignment does NOT replace the two hard-copies of the assignment that are to be sent to the MOffStat Administrator using the coursework hand-in form available at:
http://www.southampton.ac.uk/demography/postgraduate/taught_courses/msc_official_statistics.page

References:

1. Models

Abraham, B. and Ledolter, J. (1983). Statistical Methods for Forecasting.

Box, G.E.P., Jenkins, E.M. and Reinsel, G.C. (1994). Time Series Analysis, Forecasting and Control, 3rd edition.

Chatfield, C. (1996). The Analysis of Time Series, 5th edition.

Hamilton, James D. (1994). Time Series Analysis.

Harvey, A.C. (1989) Forecasting, Structural Time Series Models and the Kalman Filter. (Especially Chapters 1 and 2.)

Janacek, G. (2001). Practical Time Series.

Newbold, P. and Bos, T. (1994). Introductory Business & Economic Forecasting, 2nd edition.

Montgomery, D.C., Johnson, L.A. and Gardiner, J.S. (1990). Forecasting and Time Series Analysis, 2nd edition.

Wei, W. S. (1994) Time Series Analysis: Univariate and Multivariate Methods.

2. Seasonal adjustment

Den Butter, F.A.G and Fase, M.M.G. (1991).Seasonal adjustment as a practical problem. North Holland.

Ladiray, D. and B. Quenneville (2001). Lecture Notes in Statistics: Seasonal Adjustment with the X-11 Method, Springer: New York.

X-13ARIMA-SEATS Reference Manual, Version 1.0., Time Series Research Staff, Statistical Research Division, U.S. Census Bureau (free on-line at http://www.census.gov/ts/x13as/docX13ASHTML.pdf).

Recommended preliminary reading:

Chapters 1 and 2 of Chatfield book.

US Census Bureau website on X-13ARIMA-SEATS:

http://www.census.gov/srd/www/x13as/papers4newusers.html

In particular, read:

- First few pages of paper 5 "Seasonality: Causation, Interpretation, and Implications", Granger, C. W. J.

- Paper 2 "X-12-ARIMA and Its Application to Some Italian Indicator Series", Findley, D.F. and Hood, C.C.

http://www.census.gov/srd/www/x13as/glossary.html

Timetable

Monday, 23 February 2015

09:30 – 10:00 Registration
10:00 – 10:15 Welcome and opening remarks
10:15 – 11:00 Introduction to time series analysis
11:00 – 11:30 Coffee break
11:30 – 13:00 Moving average & autoregressive models
13:00 – 14:00 Lunch
14:00 – 15:30 Self practice, exercise solution
15:30 – 16:00 Coffee break
16:00 – 17:30 Moving average & autoregressive models (cont.)

Tuesday, 24 February 2015

09:30 – 11:00 ARIMA and SARIMA models
11:00 – 11:30 Coffee break
11:30 – 13:00 Model selection and verification
13:00 – 14:00 Lunch
14:00 – 15:30 Self practice, exercise solution
15:30 – 16:00 Coffee break
16:00 – 17:30 Lab session 1: Fitting ARIMA models to real data

Wednesday, 25 February 2015

09:30 – 11:00 ARIMA model estimation and forecasting
11:00 – 11:30 Coffee break
11:30 – 13:00 Exponential smoothing
13:00 – 14:00 Lunch
14:00 – 15:30 Self practice, exercise solution
15:30 – 16:00 Coffee break
16:00 – 17:30 Models in the Frequency Domain

Thursday, 26 February 2015

09:30 – 11:00 Periodogram and spectral analysis

11:00 – 11:30 Coffee break

11:30 – 13:00 Self practice, exercise solution

13:00 – 14:00 Lunch

14:00 – 15:30 Lab session 2: periodogram and spectral analysis of real data

15:30 – 16:00 Coffee break

16:00 – 17:30 Moving averages

Friday, 27 February 2015

09:00 – 10:30 Seasonal adjustment using X13 ARIMA –SEATS I

10:30 – 11:00 Coffee break

11:00 – 12:30 Seasonal adjustment using X13 ARIMA –SEATS II

12:30 – 13:15 Lunch

13:15 – 15:00 Lab Session 3: X13 ARIMA –SEATS in practice

15:00 – 15:30 Course review, hand-out of coursework assignment

15:30 – 17:00 Open (optional) session on X13 ARIMA –SEATS