DEPARTMENT OF STATISTICS

Stat 443: Time Series and Forecasting (Term 1, 2011/2012)

Lecturer: Dr. Natalia Nolde (room: LSK 323, email: `natalia@stat.ubc.ca`)
Lecture times: Tuesdays and Thursdays, 9:30 a.m. – 11:00 a.m. (in MATH 105).
Office hours: TBA

Assessment: one-hour midterm test (20%), $2\frac{1}{2}$-hour unseen examination (50%), assignments (30%). The usual university rules for extenuating circumstances and plagiarism apply.

Aims: The course aims to provide learners with a toolkit for the understanding and application of a range of key methods in the field of time series. Fundamental ideas in both the time and frequency domain analysis of time series will be described.

Objectives: On completing the course, students should be able to demonstrate an understanding of the techniques and applications of well–known ideas in time series, including autocorrelation, stochastic models (including the ARIMA family), spectral analysis and popular forecasting methods for univariate time series, as well as basic ideas for bivariate series; familiarity with the statistical software R for a time series analysis.

Teaching methods: Lectures of approximately eighty minutes duration will occur twice a week, with sets of notes being available from the course web page. In most sessions an in–class activity will replace at least part of the lecture component. Sometimes guided reading or other activities may be set at the end of one lecture to be completed prior to the next. The web page includes some detailed notes covering much of the course content, and other sundry resources like solutions to exercises when appropriate.

Recommended texts: There are a variety of books which cover at least some of the material in this course, and it is suggested you try the UBC library stock to find those that suit you. The latest version of the classic "first" textbook is
Chatfield, C. (2004): *The Analysis of Time Series: An Introduction (sixth edit.).* Chapman & Hall/CRC.
Earlier editions are acceptable too; however, this will be considered the course text. Amongst other useful texts are
Diggle, P.J. (1990): *Time Series: A Biostatistical Introduction.* Clarendon Press, Oxford.
Janacek, G.S. and Swift, L. (1993): *Time Series Forecasting: Simulation and Applications.* Ellis Horwood.

Further information will appear on the course web page, accessible via `www.slate.stat.ubc.ca`. Access is restricted to the students registered in the course. To *view* the link to the course web page, LOGON using the following username and password: *username* is the first eight characters of your name (including middle name if applicable, and not case sensitive); *password* is S followed by the first seven digits of your student number.

There follows a provisional guide to the lecture slots available. It is possible that the material covered in the classes will differ slightly from the description below.

1. Introduction, motivation, notation and plotting. Properties of time series: trend and seasonal variation.
2. Operators on time series: filtering and differencing.
3. The sample autocorrelation and the correlogram. The R language.
4. Stochastic models for time series, the autocorrelation function.
5. White noise, random walk and moving average processes.
6. More on MA processes, including MA(1). Autoregressive processes.
7. Stationary conditions for AR processes, the Yule–Walker equations. ARMA models.
8. ARIMA and SARIMA models.
9. Estimation in the time domain. AR model fitting. ARIMA model fitting and estimation.
10. Model diagnostics.
11. Forecasting: introduction, exponential smoothing.
12. Mid–term test.
13. Holt and Holt–Winters smoothing/forecasting.
14. Box–Jenkins method. Prediction intervals.
15. Examples and application in R.
16. Introduction to the frequency domain.
17. Fourier transforms. Spectral distributions.
18. Examples of spectral densities. Fourier series.
19. A simple sinusoidal model. The periodogram.
20. Properties of the periodogram. Modifying the periodogram.
21. Test for white noise. Comparisons of methods.
22. Discussion and examples using R. Bivariate series: cross–correlation.
23. Bivariate series in R.