Bios 259, Fall 2000

Applied Time Series Analysis

Young Truong
School of Public Health
Department of Biostatistics
Rm 3105A McGavran-Greenberg Hall
truong@bios.unc.edu
(919) 966-7270

This is an introductory course in time series analysis and it is designed for applications in life sciences. Real data will be used throughout the course to motivate the methodological development. As an integral part of the course, we will develop a practical guide for time series analysis by melting the theory and applications together. The usage of this guide will be illustrated using computer software such as SPLUS and SAS.

Topics:

- Univariate models: AR, MA, ARMA, harmonic processes, mean function–trend, correlogram, partial autocorrelation, power spectrum, linear filtering, relationship between spectra and autocovariance function, spectral interpretation of stationary processes—spectral ANOVA.
- Bivariate models: transfer function models, regression, cross covariance function, cross spectra, multiple and partial coherency, spectral interpretation.
- Practical guide to time series analysis: seasonal adjustment, trend removal, model identification and estimation, Fast Fourier Transformation, smoothed periodogram, spectral windows, complex demodulation, SPLUS and SAS.
- Special topics: non-stationarity, smoothing, forecasting, state space modelling, repeated measures models and regression with AR errors.

Prerequisites: Basic statistical inferences, linear regression and maximum likelihood estimation.

Grades: Weekly homeworks (30%), midterm project (30%) and a final project involving a bivariate time series (40%).

Recommended texts/references:

- Diggle, P. J. (1990). *Time Series: A Biostatistical Introduction.* Oxford University Press, NY.
- Brockwell, P. J. and Davis, R. A. (1991). *Time Series: Theory and Methods.* (2nd ed.) Springer, NY.
- Venables, W. N. and Ripley, B. D. (1999). *Modern Applied Statistics with S-Plus.* (3rd ed.) Springer, NY.
- Shumway, R. H. (1988). *Applied Statistical Time Series Analysis.* Prentice-Hall, NJ.
- Shumway, R.H. & Stoffer, D. S. (2000). *Time Series Analysis and Its Applications.* Springer, NY.
- Bowerman, B. L. and O'Connell, R. T. (1993). *Forecasting and Time Series.* Duxbury, CA.

- Newton, H. J. (1988). *TIMESLAB: A Time Series Analysis Laboratory.* Wadsworth, CA.
- My lecture notes will be available at: `http://www.bios.unc.edu/~truong/`

Time table:

Date	Topics	Book/Sections
08/22/2000	Introduction	1.1–1.4
08/24/2000	Random Variates, software	1.5–1.7
08/29/2000	Types of time series	2.1–2.2
08/31/2000	Examples of time series	2.3–2.4
09/05/2000	Harmonic processes	2.5–2.7
09/07/2000	Partial correlations, S+	2.8–2.10
09/12/2000	On leave for conference	
09/14/2000	On leave for conference	
09/19/2000	On leave for conference	
09/21/2000	On leave for conference	
09/26/2000	Spectral Analysis	3.1–3.2
09/28/2000	Power Spectrum:	
	Definition and Examples	3.3–3.4
10/03/2000	Linear Filters, AR models	3.5–3.6
	Handout Project 1	
10/05/2000	Fall Break	
10/05/2000	Spectral representation	3.7–3.8
10/10/2000	Descriptive Statistics	4.1–4.3
10/12/2000	Examples of harmonic analysis	4.4
	Project 1 due	
10/17/2000	Smoothed periodogram analysis	4.5–4.9
10/19/2000	Testing for periodogram ordinates	4.10–4.11
10/24/2000	Misc topics	4.12–4.15
10/26/2000	ARMA Processes: Preliminary	5.1–5.2
10/31/2000	ARMA Processes: Estimation	5.3–5.4
11/02/2000	ARMA Processes: Examples	5.5–5.8
11/07/2000	ARMA Processes: Examples (cont'd)	5.9–5.13
11/09/2000	Bivariate Time Series	6.1–6.2
11/14/2000	Cross-spectra	6.3–6.5
11/16/2000	Linear relationships: Examples	6.6–6.7
11/21/2000	Testing for zero coherence	6.9–6.10
	Handout Project 2	
11/23/2000	Thanksgiving Day	
11/28/2000	Examples: SPLUS, SAS	6.11–6.14
11/30/2000	Examples: cont'd	6.13–6.14