Hong Kong WSC 2013 - Short Course programme

COURSE TITLE

Wavelet Methods for Environmental Time Series

DURATION

1 day

INSTRUCTOR 1

Debashis Mondal, Assistant Professor, Department of Statistics, University of Chicago, Chicago, USA

BIOGRAPHICAL SKETCH

Debashis Mondal received both the Bachelor's and the Master's degrees in Statistics from the Indian Statistical Institute, Calcutta, India in 2000 and 2002, and the Ph.D. degree in Statistics from the University of Washington, Seattle, USA in 2007. He is an assistant professor with the Department of Statistics, University of Chicago. His research interests include time series analysis, wavelets, spectral analysis, Markov random fields and geostatistics.

COURSE DESCRIPTION

This short course gives an introduction to a range of wavelet methods that arise in the analysis of environmental time series and space-time data. Specifically, it addresses statistical concepts and methods in wavelet domain that are useful for exploratory data analysis, estimation and modelling. It covers wavelet analysis of variance that provides an understanding of quasi-periodic oscillations, small-scale noises, characteristic scales, long-range dependencies, time inhomogeneity and local stationarity that are often found in environmental time series data. It addresses issues such as how to handle missing observations and contaminated data. There will also be an additional focus on wavelet generalized least squares and wavelet Whittle likelihood methods for estimation of parameters. Finally, the course will probe statistical modelling of environmental space-time data in wavelet domain. Computing sessions will introduce R-software `waveslim', wavelet domain estimation with applications to environmental data and codes for spatio-temporal modelling, including applications to Swedish temperature data.

SYLLABUS

Lecture 1: Introduction of wavelets, wavelet transforms, and scale-based analysis
    Computing session 1: Using waveslim
Lecture 2: Wavelet analysis of variance
Lecture 3: Parameter estimation using wavelet methods
Lunch
    Computing session 2: Statistical calculations of various wavelet variance methodologies using R-software waveslim, and other R-programing codes
Lecture 4: Frameworks for wavelet domain space-time models
Lecture 5: A space-time Swedish temperature data case study
    Computing session 3: R codes for fitting of a space-time model
Summary session.

Recommended texts: NONE, but the following may be useful as secondary reading materials.

Chapter 22: A wavelet variance primer. By Don Percival and Debashis Mondal. *Handbook of statistics Vol 30*: edited by Tata Subba Rao and C.R.Rao, Sc.D., FRS. Elsevier, Chennai.

Chapters 1, 4, 5, 8 and 9: *Wavelet Methods for Time Series Analysis.* By Don Percival and Andrew Walden. Cambridge, England: Cambridge University Press.

Presentation slides will be made available online. Photo copies of reading materials will be provided.

TARGET AUDIENCE

Young statisticians—especially students and young professionals from Asia and other regions of the world, and r*esearchers*

interested in *environmetrics* and time series modelling.

Students should have basic knowledge of statistics and inference and be familiar with linear regression. A basic knowledge of applied probability and dependent data, especially stochastic processes will be useful, but it is not a prerequisite.

To ably complete the computer sessions, some experience with R is needed. Students need to bring a laptop with the latest version of R from http://cran.r-project.org/ installed. People unfamiliar with R are strongly advised to go through the R tutorial http://cran.r-project.org/doc/manuals/R-intro.pdf prior to attending the course.