

STAT 549-001: Functional Data Analysis and Wavelets

Wavelets in Statistics and their Applications

Marina Vannucci

Spring 2008

Lecture: Mon and Wed 9:25-10:40am, ???

Instructor: Marina Vannucci, Professor, Department of Statistics, Rice University, Duncan Hall 2083. Phone:(713)348-6132. E-mail:MARINA@RICE.EDU

Course website: [HTTP://WWW.STAT.RICE.EDU/~MARINA/STAT549.HTML](http://www.stat.rice.edu/~marina/stat549.html)

Textbook: *Statistical Modeling by Wavelets*, by Brani Vidakovic, Wiley, 1999.

Course goals and objectives: This 3-credit course focuses on wavelet methods in statistics. The course will start with a brief introduction to the wavelet theory, followed by an overview of wavelet-based statistical methods and applications. Topics will include smoothing of noisy signals, nonparametric estimation of functional data and representation of stochastic processes. Emphasis will be given to Bayesian inferential procedures. The course objective is to illustrate practical applications of the wavelet methods. Complex mathematical details and filtering theory of the wavelets will be only partially covered.

Prerequisites: No knowledge of wavelets is required. Some knowledge in statistics is desirable, particularly in Bayesian inference.

Course topics:

- Mathematical preliminaries and historical overview
- Continuous and discrete wavelet transformations
- Construction and properties of some families of wavelets
- Multiresolution analysis
- Overview of available wavelet software
- Wavelet shrinkage, thresholding policies, traditional and Bayesian approaches
- Wavelet regression, density and function estimation, traditional and Bayesian approaches
- Multiple curves, multivariate curve regression, hierarchical functional data
- Wavelets and time series, scalograms, variance decompositions
- Wavelet transformations of stationary processes, selfsimilarity, change point

Grades: There will be assigned homeworks. The course grade will consist of 40% homeworks and 60% a semester research project. The final project can be either an analysis of new data or a critical review of the literature on aspects not fully covered in class.

Software: MATLAB will be used for classroom demonstrations. Students may use other software with wavelet capabilities for the final projects (MATLAB, Splus, Mathematica, ...).