STOR 890: High-Dimensional Time Series Spring, 2019

Course description: The course is about a collection of tools and perspectives for analyzing larger systems evolving in time. It should probably be called "Modeling large complex time dependent systems" but this sounds a bit too long (and too ambitious). Though not most revealing, the current title is at least short. Most topics will concern vector but not necessarily high-dimensional time series.

Several applications will be kept in mind in the course. In the first part of the course on continuous-valued (non-)linear models, these are fMRI series modeling brain activity, and financial or economic time series. In the second part of the course on discrete-valued models, these concern link dynamics for temporally evolving networks, or event occurrences in social network activity.

The focus of the course will be on methodology rather than data analysis, though time and preparation permitting, illustrations will be provided. This is also a topics course which I consider as a means to catch up, learn and report on the more recent work in related areas. Lastly, to be better focused, I will consciously stay away from spatial-temporal systems which could make a special topics course on their own.

Place, Time and Instructor: Hanes 125, Monday & Wednesday, 10:10-11:25AM. Prof. Vladas Pipiras; office: Hanes 305; e-mail: pipiras@email.unc.edu; phone: 843-2430. Office hours will be held by appointment: If you need to meet with me, feel free to email me and we will set up a time.

Prerequisites: I will not assume that you are familiar with any of the topics, apart from having background in graduate-level probability and statistics. In particular, though helpful, no prior knowledge of time series analysis is required. If you are not sure of the course level, the first few classes should provide a good idea of what to expect.

Course website: Though I will keep the course website "published" on http://sakai.unc.edu, most of the material will be posted on Dropbox, which is more convenient for me to use. You do not need to have a Dropbox account. In particular, the lecture slides will be posted on Dropbox at least one hour before they are given in class, in case you want to make notes on your tablet, print them, etc.

Textbook: There are no required textbooks for the course. The lectures will be based on a number of sources, whose references will be provided and some of which will be posted on Dropbox.

Course requirements and grades: Regular attendance will guarantee you a P. For an H, a "project" will be required. The format of the "project" will depend on the class size. For a small class size, I may ask you to look into a particular related topic or paper, per my or your suggestion, and to report on it in a written form and, if circumstances allow, to speak about it in class.

Topics: Below is a list of topics that I would like ideally to cover, separated into two major themes.

Part I: continuous-valued, (non-)linear models

* Sparse vector autoregressions (VARs): lasso and variants
* Dynamic factor models: principle components, Kalman filtering, various special forms
* Estimation and testing questions, e.g., for mean, correlation and precision matrices
* Change point detection, e.g., for mean and correlations
* Models for common trends such as cointegration and stationary subspaces
* Heteroscedastic models: large ARCH models
* Network methods and perspectives

As noted above, fMRI and financial/economic time series are seen as motivating applications for these topics.

Part II: discrete-valued, non-linear models

The goal here is to discuss a number of the above topics (sparse modeling, factor modeling) but for discrete data, understanding the latter in a broad sense as something that is not continuous-valued. The focus will be on:

* Hierarchical models such as GLM-like models
* Copula models such as Gaussian and other copula models
* Other HMM constructions
* Estimation of these models through EM, particle filtering, Gaussian-based methods
* Incorporating and estimating community structures
* Hawkes processes

As noted above, dynamic networks and social network activity are seen as motivating applications for these topics.

Other topics might be included as I start preparing for the course, and while we progress through the semester.

Syllabus changes: I reserve the right to make changes to the syllabus, when circumstances demand. These changes will be announced as early as possible. (See also the “last modified” date at the bottom of the syllabus.)

Syllabus last modified: December 12, 2018