Time series : change-point detection and regime switching models

MadalinaOlteanu, Université Paris 1
12 hrs : 9hrs + 3hrsPractical Class with R, in english

The lecture is thought as an introduction to time series analysis and more particularly to the specific topic of change-point detection. The first part is devoted to an overview of time-series analysis, with a focus on the concepts of stationarity/non-stationarity and some basic examples : ARMA, ARIMA and ARCH/GARCH models. The second part contains an introduction to the topic of change-point detection and its various frameworks : online/off-line, single/multiple change points, ...
The concepts are illustrated on a basic example with the CUSUM and GLR algorithms. In the third part, the case of multiple change-points detection in offline framework is considered and detailed. Several optimization algorithms are introduced and theoretical results of consistency for the estimate of the number and locations of the change-points are given in the case of dependent data. Finally, the last part is devoted to another class of models for change-point detection, autoregressive-hidden Markov models. The detailed EM algorithm is presented. Throughout the lecture, examples with real and simulated data are provided with the R software.

Out and About with Brownian Motion:
a mini-course on extreme-value statistics and applications

Julien Randon-Furling, Université Paris 1
8hrs (4 two-hour sessions), in english

The ubiquity of Brownian motion in both “natural” and “man-made” contexts (from particle diffusion to financial markets), together with its mathematicalstatus as a fundamental stochastic process has made it of particular interestfor mathematical scientists over the last hundred years (at the very least!).
With a view to introducing some recent exact results on the order statistics of the maxima ofindependent Brownian motions, we will try to offer in this mini-course an overview of the many and diverse applications of extreme-value statistics.
The mathematical tools and techniquesused to this end shall either belong to the mainstream of mathematical sciences'undergraduate material, or be readily explained during the lectures, so as tomake the course as self-contained as possible.

Outline:
1. Introduction - Definition(s) & construction(s) of linear Brownian motion
2. First-passage times, Brownian meander & Brownian excursion
3. Extremum & time of extremum for linear Brownian motion
4. Order statistics of the maxima of two Brownian motions

Sample introductory reading:
_ Chung, K.L., Excursions in Brownian motion, Arkivf orMatematik, 14,1-2, pp 155-177 (1976).
_ Majumdar S. N., Comtet A., Randon-Furling J., Random Convex Hullsand Extreme Value Statistics, Journal of Statistical Physics 138, 6 (2010).
_ Ben-Naim, E. Krapivsky, P.L., Slow Kinetics of Brownian Maxima,Phys. Rev. Lett. 113, 030604 (2014)
_ Randon-Furling J., Fro, Markovian to non-Markovian persistence exponents, EPL 109, 40015 (2015)