IE 598AC Syllabus

Statistical Inference for Stochastic Systems with Long Memory

Instructor: Alexandra Chronopoulou
Office: 216D Transportation Building
Email: achronop@illinois.edu
Phone: (217) 300–0851

Class Time: T/Th 9:00AM – 10:20AM
Office Hours: T/Th 2:00PM – 3:00PM (or by appointment)

Course Objective
The focus of this course is on the probabilistic and statistical properties of stochastic processes that exhibit long memory (or long-range dependence). Specifically, we will study limit theorems for processes with long-memory and consider the problems of parameter estimation and filtering in fully and partially observed stochastic systems with long-memory. Applications of these models will also be discussed, with a particular focus on Mathematical Finance.

By the end of this course, students will be able to:
  – identify the presence of long-range dependence in time-series data
  – use processes with long-memory as models in different applications.
  – estimate parameters in such models.

Prerequisites
Master level course on Stochastic Processes, and ideally on Probability Theory.

References


Grading
50% Homework: There will be 2-3 homework assignments throughout the semester.
50% Paper Presentation: The students will be responsible for an in-class presentation of research paper(s) related to the topics discussed in class.
IE 598AC Topics

Main Topics:

1. *Introduction to Long-Range Dependence (LRD):* Origins, definition and applications.

2. *Limit Theorems for Long-Memory Processes:* Limit theorems for sums with finite moments (ARCH(∞), LARCH models); sample covariances; quadratic forms.


4. *Non-linear Models with LRD:* Inference for partially observed models, LARCH and ARCH(∞) processes.

5. *Forecasting for Linear Processes:* Forecasting for fractional ARIMA and FEXP processes.


Additional Topics (depending on students’ interest):

- *Continuous-time LRD processes:* Fractional Brownian motion (definition/properties), Fractional Ornstein-Uhlenbeck process.

- Drift estimation for linear fractional SDEs.

- Filtering for continuous-time LRD models.

- Applications to queuing theory with heavy-tailed input.