

LTCC Advanced Course

Title: Advanced Computational Methods in Statistics

Basic Details:

- Core Audience: Statistics, Machine Learning, Applied Probability and Numerical Analysis
- Course Format: (10h) 5x2hr lectures.

Course Description:

Overview: This course will provide an overview of Monte Carlo methods when used for problems in Statistics. After an introduction to simulation, its purpose, and challenges, we will cover in more detail Monte Carlo methods for sampling and recent generative modelling techniques from a statistical perspective. Whilst the focus will be on the methodology and its relevance to applications, we will often mention relevant theoretical results and their importance for problems in practice.

- Keywords: Simulation, Variance reduction, Monte Carlo methods, Importance Sampling, Markov Chain Monte Carlo, Sequential Monte Carlo
- Syllabus:
 1. Introduction to simulation
 - basics of Monte Carlo
 - variance reduction
 2. Importance Sampling
 - some basics, theoretical results
 - sequential importance sampling
 3. Markov Chain Monte Carlo (MCMC)
 - Metropolis-Hastings, Gibbs sampling
 - some basics on theory and practice
 4. Sequential Monte Carlo (SMC)
 - particle filtering for state space models
 - sampling for fixed dimensional state spaces
 - particle MCMC
 5. Applications (time permitting)
- Relevant introductory textbooks:
 1. Robert and Casella (1999) Monte Carlo Statistical Methods, Springer
 2. Liu (2001) Monte Carlo strategies in scientific computing, Springer.
- Prerequisites:
 1. Basic knowledge of Statistics and Probability.
 2. Basic knowledge of programming in any language appropriate for scientific computing.
 3. Familiarity and exposure to Markov Chains or stochastic processes will be useful.

Format:

- There will be exercises/mini-courseworks posed as homeworks. There will be no separate problem sheets. The problems will require the use of some programming.
- Lecture/computer session/tutorial/discussion split: 10/0 /0 /0 /0

Lecturer details:

- Deniz Akyildiz, Imperial College London
- Email: deniz.akyildiz@imperial.ac.uk
- Website: <http://akyildiz.me>