Part A Simulation and Statistical Programming HT14

The workload of this course is equivalent to an 16-lecture course. There are 14 lectures and 6 practicals.

Lectures 4-5pm Mondays in the Lecture Theater, Statistics Department, 1 South Parks Road will focus on Simulation.

Lectures 2-3pm Fridays in weeks 2-6 and 8 will take place in the Evenlode Room of the OUCS building 13 Banbury road. These lectures focus on Statistical Programminig. See

$$http://www.oucs.ox.ac.uk/about/$$

if you need help finding this. The OUCS lectures are followed by practical teaching sessions 3-4pm Fridays in weeks 2-6 and 8 in the same room.

There are classes 4-5pm on Tuesdays in weeks 3 and 7 and 10-11am on Fridays in week 5 and 8.

Aims and Objectives. Building on Part A probability and Mods statistics, this course introduces Monte Carlo methods, collectively one of the most important toolkits for modern statistical inference. In parallel, students are taught programming in R, a programming language widely used in statistics. Lectures alternate between Monte Carlo methods and Statistical Programming so that students learn to programme by writing simulation algorithms.

Synopsis.

Simulation. : Transformation methods. Rejection sampling including proof for a scalar random variable, Importance Sampling. Unbiased and consistent IS estimators. MCMC including the Metropolis-Hastings algorithm.

Statistical Programming. : Numbers, strings, vectors, matrices, data frames and lists, and Boolean variables in R. Calling functions. Input and Output. Writing functions and flow control. Scope. Recursion. Runtime as a function of input size. Solving systems of linear equations. Numerical stability. Regression. Monte Carlo and optimisation examples for elementary Bayesian inference.

Course Structure. The course will consist of fourteen lectures. Six of these will be held in a computer laboratory and are followed by an associated practical session. There will be four classes on problem sheets.

Texts.

Reading. The following texts have a large overlap with the course.

W.J. Braun and D.J. Murdoch, "A First Course in Statistical Programming with R". CUP 2007
C.P. Robert and G Casella, "Introducing Monte Carlo Methods with R"

Reference. The last two listed are rather advanced.

J.R Norris, "Markov Chains", CUP, 1997
S.M Ross, "Simulation", Elsevier, 4th edition, 2006
C.P. Robert and G Casella, "Monte Carlo Statistical Methods", Springer, 2004
B.D Ripley, "Stochastic Simulation", Wiley, 1987

Geoff Nicholls
nicholls@stats.ox.ac.uk