

5634 - Stochastic Methods

Michaelmas Term - 2014-2015

John Bulava
office: 2.44, Lloyd Building
phone: +353 (1) 896 4598
email: jbulava@maths.tcd.ie

Topics

- Probability and Statistics (2 weeks)
 - Random Variables
 - Central Limit Theorem, Confidence Intervals
 - Error estimation, non-parametric methods (bootstrap, jackknife)
- Generating Random Numbers (1 week)
 - Linear Congruential
 - ‘Die-hard’ tests
 - Advanced generators: ran-lux and the Mersenne twister
 - Generating random variables
- Monte Carlo Integration (2 weeks)
 - Importance Sampling
 - Other variance reduction techniques
- Markov chain Monte Carlo (2 weeks)
 - equilibrium properties
 - error analysis and autocorrelations
 - Metropolis and the Gibbs Sampler
- Example 1: The Ising Model (2 weeks)
- Example 2: Discrete Event Simulation (2 weeks)

Grading

- Homework: 40%
 - written
 - Computer programs: C or C++
- Exam: 60%

References

- Stochastic Methods:
 - Sheldon M. Ross, *Simulation*, 3rd edition, Academic Press 2002
 - Pierre Bremaud, *Markov Chains, Gibbs Fields, Monte Carlo Simulation and Queues*, Springer (1999)

- I. Sachs, S. Sen and J. Sexton, *Elements of Statistical Mechanics*, Cambridge University Press (2006)
- Colin Morningstar, *The Monte Carlo Method in Quantum Field Theory*, [arXiv:hep-lat/0702020v1](#)
- Alan Sokal, *Monte Carlo methods in statistical mechanics: Foundations and New Algorithms*, Cours de Troisième Cycle en Suisse Romande, Lausanne, Switzerland, Jun 15-29, 1989
- U. Wolff, *Monte Carlo errors with less errors*, Comput. Phys. Commun. 156 (2004) 143 [Erratum-ibid. 176 (2007) 383], [arXiv:hep-lat/0306017](#)
- Bernd Berg, *Markov Chain Monte Carlo simulations and their statistical analysis*, World Scientific (2004)
- Computer Programming
 - Brian W. Kernighan and Dennis M. Ritchie, *The C Programming Language*, 2nd Edition, Prentice Hall (1988)
 - Bruce Eckel, *Thinking in C++*, Vols. 1 and 2, <http://mindview.net/Books/TICPP/ThinkingInCPP2e.html>