Practice exam 2 2020

Stochastic Simulation (Universiteit van Amsterdam)

Sample questions for Exam - Part II

Note on math: Wherever the inclusion of formal mathematical explanation is expected, there will be a reminder about "ASCII math". But it is possible (and welcome) to use mathematical explanation elsewhere too! Both ASCIImath and equations with the built-in editor are acceptable.

Some info on the syntax of ASCIIMath here: http://asciimath.org in case it is needed.

Sample questions - Aim to solve these within 40 mins.

1. Assume that we have a Poisson process (e.g. arrivals) with an event (arrival) once every 4 minutes on average. If we had no events during the first 10 minutes, what is the probability that we will get 3 events in the subsequent 10 minutes? Explain the steps! (Write down the calculations briefly - ASCII math).

2. We are observing a small powder particle in water at two temperatures (e.g. 20 and 50 degrees). We want to run two random walker simulations to compute the particle movement in both cases. Will the step size l be the same for both simulations? Explain your answer!

3. Consider a Markov chain with three states $X_i = \{A, B, C\}$, and transition matrix $P_{\mathrm{ij}} = \begin{pmatrix} \frac{1}{2} & \frac{1}{6} & \frac{2}{6} \\ \frac{1}{3} & 0 & \frac{2}{3} \\ \frac{1}{4} & \frac{3}{4} & 0 \end{pmatrix}$

Draw the directed graph for this chain (e.g. Lecture08/slide5)! Is this chain: a.) Irreducible b.) aperiodic c.) time-reversible? For each one explain why!

4. Explain what is the "burn-in" length of a Hastings-Metropolis simulation! How do we typically handle it?

5. We want to sample from a multivariate normal distribution. Which of the discussed sampling methods would you choose and why?