LMS Undergraduate Summer School

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Mini-course

Enrico Scalas (Sussex)

Monte Carlo simulations of anomalous random walks

Abstract

The random walk can be seen as a process in which a particle moves randomly in space. We shall consider random walks in a one-dimensional space. So the particle will be able to move just to the left or to the right of its current position on the real line. We shall assume that the particle stays in its current position for a random waiting time and then instantaneously jumps either to the left or to the right with the jump size being a real random variable.

Monte Carlo simulations are computer simulations using pseudo-random number generators. Using a language called R, we shall write a program generating "anomalous" random walks where both the waiting times and the jumps have a distribution with power-law tails making extreme values more likely than with exponential and Gaussian distributions. Using this program, we shall explore some interesting conjectures on the behaviour of the random walk under rescaling of waiting times and jumps. It turns out that these conjectures can be rigorously proven.