[P9] A simple method to calculate first--passage time densities with arbitrary initial conditions

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Numerous applications all the way from biology and physics to economics depend on the density of first crossings over a boundary. Motivated by the lack of general purpose analytical tools for computing first--passage time densities (FPTDs) for complex problems, we propose a new simple method based on the Independent Interval Approximation (IIA). We generalise previous formulations of the IIA to include arbitrary initial conditions as well as to deal with discrete time and non--smooth continuous time processes. We derive a closed form expression for the FPTD in z and Laplace--transform space to a boundary in one dimension. Two classes of problems are analysed in detail: discrete time symmetric random walks (Markovian) and continuous time Gaussian stationary processes (Markovian and non--Markovian). Our results are in good agreement with Langevin dynamics simulations.