Methods of Computational Physics - 2022, Assignment No. 02

(Date: 27 July, 2022; Due Date: August 03, 2022)

Note: Print and file only the program listings and plots. Do not print output files of the programs, unless specifically asked in the question.

Q1 Write a program to an unbiased 1D random walk on a lattice starting at the origin. Generate four different random walks of the length 1000 steps. Plot them on the same set of axes in a plot of position x Vs time t.

Q2 Write a program to generate the data for the probability distribution $\rho(x)$ of position x of a random walker (1D, unbiased, on lattice, starting point is the origin) for a random walk of length $n = 1000$. Use $m = 10^6$ independent random walks. While calculating the distribution $\rho(x)$, think carefully about the choice of bin size Δx. What do you notice if you choose $\Delta x \leq 1.0$? Explain. Calculate the mean and the variance of the position x of after n steps and compare them to the theoretically expected values. Plot both the computationally obtained $\rho(x)$ and the theoretically expected distribution on the same set of axis.

Q3 For the random walk discussed in the previous question obtain a $\sigma(x)$ Vs $\sqrt{n}$ for $n = 1000$, 2000, 4000, 8000, 16000. In each case use $m = 10^6$. Fit a straight line to the data.