

Statistical Mechanics Assignment 8

Due: April 17, 11:00 a.m.

Marks: 15

In this assignment, you will simulate a random walk in a potential energy well in one dimension, i.e. a random walk with an applied force directed toward the origin. Define p as the probability of taking a step away from the origin (i.e. to the left if x is negative, or to the right if x is positive). In this model, p depends on x as follows:

$$p(x) = \frac{1}{2}e^{-x^2/a^2}$$

with $a = 10$. The probability of taking a step toward the origin is $q = 1 - p$. Using a simulation, determine the mean recurrence time of the origin during this random walk, i.e. how often (in simulation steps) on average a random walker comes back to $x = 0$. Report both the mean recurrence time and the standard error of your estimate. Make sure that you provide some comments with your simulation code that explain how it works.

Notes: This is not (quite) the same thing as the mean first-passage time. The following Maple function *may* be useful (depending on how you implement the random step): `sign()` returns 1 if its argument is greater than or equal to zero, and -1 if its argument is negative.