PHSX815: Computational Methods in Physical Sciences
Project 2
Title: Simulation of Random Walk

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Introduction

In Science, we are often interested in a set of outcomes rather than a single event. Stochastic simulations allow us to generate and examine a series of simulations of a system in which the steps are governed by random choice. A simple algorithm for flipping of coin can be a useful tool to 'choose' if a step in a phenomenon will occur or not. Consider a drunkard trying to walk along the pavement in the middle of the night. In their drunk state of mind, they can only move sideways-either to the left or the right from their current position. Whether they take a step to the left or the right can be dictated by flipping a coin and checking if the outcome is 'Heads' or 'Tails'. The philosophy behind the seemingly simple thought experiment has a wide range of appli- cation in physics, chemistry as well as biology; to describe the diffusion of gas molecules, simulate bacterial motion and learn the pattern of genetic drift.

How the code works

Flipping of coin

The first section consists of importing the necessary modules for computation and plotting. We then begin by flipping the coins and understanding their output. To see why this is relevant in random walk, think of a gas molecule that has equal probabilities of moving either to the left of the right. To dictate whether the molecule moves to the left or the right by flipping a coin. This will obviously change every time that we run the code cell. To convert this to a 'heads' and 'tails' readout, we can assume that this is a totally fair coin. This means that the probability of getting "heads" to get P(H) is the same as flipping a "tails" P(T) such that P(H)+P(T)=1 . This means that for a fair coin, P(H)=P(T)=0.5 . To convert our coin flips above, we simply have to test if the flip is above or below 0.5 . If it is below, we'll say that the coin was flipped "heads", otherwise, it is "tails".

What I would like to learn from peer review

I would like to gain some ideas on how I could add one more level of 'complication' or randomness to the simulation. For example, making the coin-toss a result of another probability distribution of another random experiment. I look forward to reading your suggestions.