PHSX815: Computational Methods in Physical Sciences
Report on Project 1 for Peer Review
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 application in physics, chemistry as well as biology; to describe the diffusion of gas molecules, simulate bacterial motion and learn the pattern of genetic drift.

Code in development (in Python)

Flip a coin twice:

$\boxed{flip1 = np.random.rand()}$

$\boxed{flip2 = np.random.rand()}$

$\boxed{flip3 = np.random.rand()}$

$\boxed{flip4 = np.random.rand()}$

$\boxed{print(flip1, flip2, flip3, flip4)}$

This generates two random numbers between 0 and 1. For example, the output can be

$\boxed{0.8707968048396337}$ $\boxed{0.20683664164305005}$ $\boxed{0.1358419906969558}$ $\boxed{0.022864157035517363}$

Of course, the output will change every time the code cell is run. The probability of getting a number below 0.5 is the same as getting one above 0.5. Therefore, it is reasonable to describe coin-toss by choosing that the coin shows ’Heads’ if the output is less than 0.5, and ’Tails’ if the output is greater than 0.5.

In turn, the result of the coin will dictate if the drunkard takes a step to the right or the left.

To test that the algorithm for the coin toss is fair, one can check if the probabilities for obtaining ’Heads’ or ’Tails’ get closer to 0.5 when the number of trials of the coin-toss is increased.

The next step would be translate the results of the coin-toss trials to the random walk experiment.

What I would like learn from peer review

In my current plan of simulating 1D random walk, I am making use of coin-toss for dictating the probabilities of the system taking a step to the ’right’ or ’left’. I am interested in learning about and gaining insights into other ways of simulating random walk by dictating the ’i+1’th step based on a random experiment other than coin-toss, like dice-roll. I would like to try new methods out and implement them in my project as additional approaches.

References

1. https://www.codespeedy.com/random-walk-program-in-python/

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