

# Homework 1-24-23

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## Exercise Analysis of (a).

It seems that each Monte Carlo simulation is quite different. Roughly half of the time, it is bimodal, i.e. two main spikes, and the other half of the time it is uniform or unimodal. In all cases, they do not follow any particular distribution, for example the bimodal runs, some seem symmetric, and some seem to have a long tail end. Similarly the unimodal. Also for the uniform, it generally is more "spikey" with a common max amount of runs ending with a position.

All cases are also not centered around 0. Most are below 0 with a lower bound of near  $-1500$  to  $-1600$ , which implies the symmetry that occurs that I described before mostly happens around  $-800$  (if it does happen). This is due to the middle agent which in general keeps the lower agent from walking past 5. Also if the middle one goes up, it may not go up as much since it is in the middle and has an upper walker which keeps it from increasing the range of the bottom walker (in the positive/up direction). So there is "more incentive" for the bottom walker to keep decreasing. Also if the middle walker goes down/negative, then the bottom walker must decrease as well.

Also quick note, since the middle walker affects the lower walker, some times the range can be  $-100$  to  $400$ . Which in this case, implies that the middle walker stayed in the middle (and didn't, on average, choose to increase/decrease too much).

Code source: `temple_abm_random_walk_2d_mod`  
from class.

## Exercise Analysis of (b).

I do not know if this is meant to happen, but when looking at a single walk (sample), since the middle walker starts at the midpoint between the top and bottom walker, then the next step has a 50% chance to go up or down. But it always goes the same direction and stays in the middle. I don't know if this is because its basing off of the initial condition or...

As for the histogram, I don't know what I did wrong, but I get a uniform distribution. This is because of my poor code from the previous block. Every walk ends in a specific final position, and the number is usually 100 for each. But the final position generally ranges from  $0 \rightarrow 2$ ,  $-2 \rightarrow 0$ , or  $0 \rightarrow 16$ .

**Exercise Analysis of (c).**

I am stuck on update rule and why it isn't working.