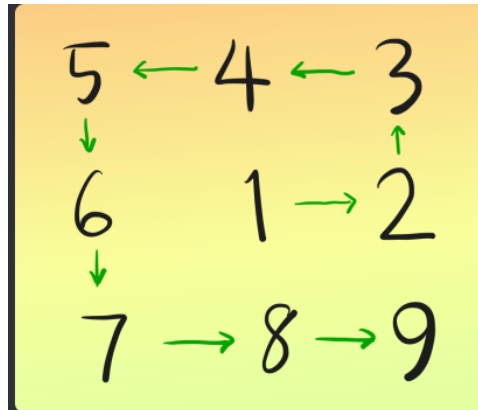# MA3K7 Week 10 Rubric
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The Questionable walk

One day, A lad at the pub had a few too many pints to drink and he lived quite far from his house and he was alone. His path home from the pub can be mapped using the figure below.

The number one starts is the starting point of the pub and the arrows directions represent the path he normally takes home with a weight of 1 mile. But due to his drunken nature he stumbles around and suddenly finds himself getting lost.

The Question: Investigate his divergence from his original path

1   Entry

KNOW

To the summarise the above question, we are dealing with a path based problem where we are seeing a high probability of a divergent path from the individual compared to the above figure. So we need to investigate this and see what we can find and see if any trends exist etc.

INTRODUCE

This question seemed quite straight forward when I thought of it initially however I re modified it to make it a more interesting investigation. A couple of questions come to my mind when I think of this problem:

- What mathematical model can we use to represent this problem?

- Is there multiples ways we can map this problem?

- What would the probability be that his drunken nature actually takes him home the correct way?

WANT

My plan is to maybe use Python to graph some potential paths to see if I can visualise the problem more and have a better idea of the situation I'm dealing with. There may be some potential to use some graph theory to try and represent this problem a bit different which seems quite exciting. With this maybe I can do some combinatorial type operations to see if I can represent the drunken path of the individual.
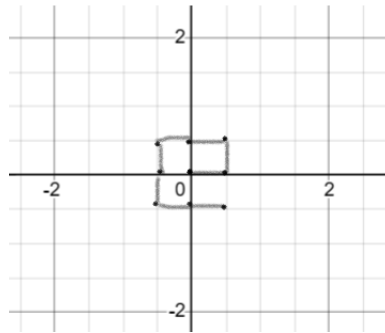
2   Attack

Initially, I was unsure on how to model this problem from the start so I then came up with some thought and I decided thatto simplify this problem we are gonna assume that the path of divergence is completely random. So we can use the random nature of this problem to start investigation. Lets initially use a grid.

Grid

This can represent the desired path that needs to be taken. Without loss of generality, we can take 1 to be (0,0) and then each small square will be 1 mile in the desired direction. Lets experiment with this. With my python code I will create some random paths with 9 iteration.

[(0, 0), (0, 1), (1, 1), (1, 0), (1, -1), (0, -1), (0, 0), (1, 0), (1, -1)]
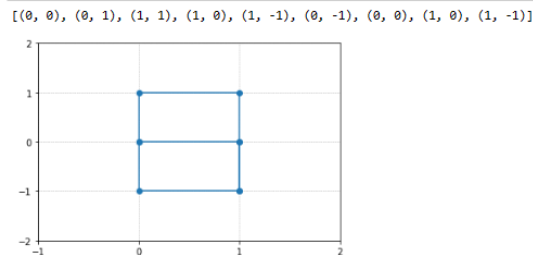
Above a path that was done in Python, the graph shows the coordinates plotted and connected and the coordinates symbolise the actual path that was taken. We can now compare the 2 paths below:
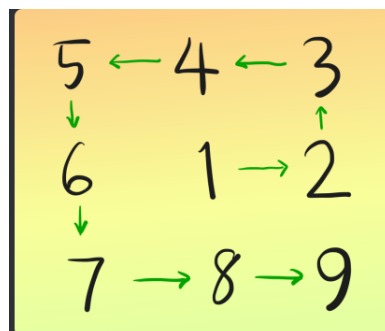
Normal Path
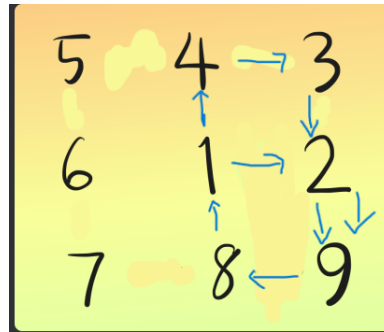
New path

As we can see, there is quite a difference and it can be told that drunk people can sometimes get their directions mixed up and even repeat or loop around a lace multiple times. This shows the reliability of the random model I used for this investigation. However, during my **Entry** phase I enquired about probability so lets start working on the probability of the drunken path matching the original path. I'm going to use python to do multiple iterations to see if I can get a numerical estimate for the answer.

Aha!

I'm going to use 10000 iterations and create 10000 possible paths and see how many of these paths match with the original path. And do this 5 times to gain an average value. I can imagine this to be quite a small number as the number of path possibilities are quite a lot but to get an estimation would be very nice for this investigation. The answer that we got using Python was a probability of:

0.00038

Aha!

And as expected, it is a very small number so lets compare it to the analytical answer.

Analytical

Justifying

IF we start at 1, we have 4 possible directions that we can take(diaginals do not count as directions) so 1/4 to get to 2 then from 2 we have 3 possible directions so 1/3 to get to 3 then from 3 we have 2 possible directions and etc. To summarise:

- 4,6,8 : 1/3
- 5,7: 1/2

so the product of all of these would give around **0.00039 to 3 d.p**. Which is actually quite similar to our original numerical estimation which is a plus!

3 Review

Extend

With this question posed by myself, I had quite a hard time thinking of a good way to investigate this question due to me thinking that this problem lacked depth. However, I was able to find a nice way of investigating this question using similar techniques from previous assignments.

The use of Python was similar to how I used python with the previous problems I tackled in previous assignments. I tried to simulates path of a drunken man waling by using the concept of randomness to create a random path. I then used these paths to make a comparison to the original path which then led me to find probabilities.

I used a numerical approach initially to get an estimation using numerical methods and then used an analytical approach to compare the answers and saw them to be very similar. In my **Entry** phase, said I would try to use graph theory but I couldn't find an avenue to use it that wouldn't be waste of time in my opinion.

Overall, I felt that my approach was fine and that I tackled the problem accordingly. However, the problem may have been a little too similar to others that I've done in terms of approach wise but I don't feel like that is much of an issue. With Python, I learned that you can model so much more than you can think.

Overall, I really enjoyed this rubric!!!

Supplementary material

Below is attached my GitHub repository where my code resides:
`https://github.com/rizwan3254/PS-with-yth`