

# Math 305 Homework 5

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## Problem 1

```
11 % Initialize the game board
12 board = [0 0 0 0 0 9 0 9 0 -6 0 0 0 0 0 0 -6 0 0];
13
14 num_simulations = 500;
15 total = 0;
16
17 for i=1:num_simulations
18 % Initialize the player's position and turn counter
19 pos = 1;
20 num_turns = 0;
21
22 % Play the game until the player reaches square 20 (EXACTLY)
23 while pos < 20
24 % Roll the die
25 roll = randi(6);
26
27 % Update the player's position based on the roll
28 if roll == 1 || roll == 2
29 % Do not move
30 elseif roll == 3 || roll == 4
31 pos = pos + 1;
32 else
33 pos = pos + 2;
34 end
35
36 % Reset player to square 19 if they roll a 2.
37 if pos == 21
38 pos = 19;
39 end
40
41 % Check for chutes and ladders
42 if board(pos) ~= 0
43 pos = pos + board(pos);
44 end
45
46 % Increment the turn counter
47 num_turns = num_turns + 1;
48 end
49 game_lengths(i) = num_turns;
50 total = total + num_turns;
51 end
```

```
42 average = total / num_simulations;
```

2. Average of 500 games: 23.4260 turns.

3. Transition matrix:

```
1 P = zeros(20, 20);
2
3 % Roll a 1 or 2
4 P(1:20+1:end) = 1/3;
5
6 % Roll a 3 or 4
7 P(1:19, 2:20) = 1/3;
8 P(20, 20) = 1/3;
9
10 % Roll a 5 or 6
11 P(1:18, 3:20) = 1/3;
12 P(19, 20) = 1/6;
13 P(20, 20) = 1/3;
14
15 % Chutes and ladders
16 P(6, 15) = 1;
17 P(8, 17) = 1;
18 P(9, 3) = 1;
19 P(18, 12) = 1;
20 P(19, 20) = 1/3;
```

4.
  - As  $n$  increases, the probability of being on square 20 increases, and the probability of being on square 1 decreases.
  - The absorbing state is square 20 (but idk if that counts because the game instantly ends)
  - Minimum length is 6 turns, rolling 2,2,2,1,2,1.
  - The number of turns at which you'd be done 50% of the time is 9 turns.

```
1 p50 = prctile(game_lengths, 50)
2
```

I got around 9 on average.

- The number of turns at which you'd be done 90% of the time is 24 turns.

```
1 p90 = prctile(game_lengths, 90)
2
```