EEC161, Applied Probability for Electrical & Computer Engineers

Project 1

In this project, we will simulate the plinko game of the "Price is Right" played on the plinko board shown. To learn about the plinko game, go to

`https://priceisright.fandom.com/wiki/Plinko`

You can watch some plinko games in the Price of Right such as

`https://www.youtube.com/watch?v=ZisUkbR8ZkU`
`https://www.youtube.com/watch?v=TOzeAT8gsHU`

Write a MATLAB program to estimate the probability $p_{i,j}$ that a chip dropped in slot i at level $t = 1$ ends in slot j at level $t = 7$ for each i and each j. Summarize the results in a 9×9 table with rows indexed by the slots in which chips are dropped at level $t = 1$ at the top of the board and the columns indexed by the slots in which the chips land at level $t = 7$ at the bottom of the board. This is done by simulating the game a large number of times. Then, $p_{i,j}$ is the number of times a chip dropped in slot i ends up in slot j divided by the number of times the chip is dropped in slot i. For accuracy, you have to drop a chip at least 100,000 times in each slot. Assume the following: When a chip hits a peg, it is equally probable to go to the left or to the right and in either case it falls in the first available space. If a chip hits a wall, it has only one direction to go to and it falls in the first available space. In particular, this means that the chip does not move horizontally.

Hint: A chip dropped in a slot at level $t = 1$ encounters at most 12 pegs until it reaches level $t = 7$. It may encounter less if it hits a wall. In simulations, when a chip hits a peg, it may go to the right or left with equal probability. We can use binornd(1,0.5) to randomly generate the numbers 0 and 1 with equal probability or binornd(1,0.5,1,12) to generate a sequence of 12 such numbers. These 12 numbers (or less if the chip hits a wall) characterize

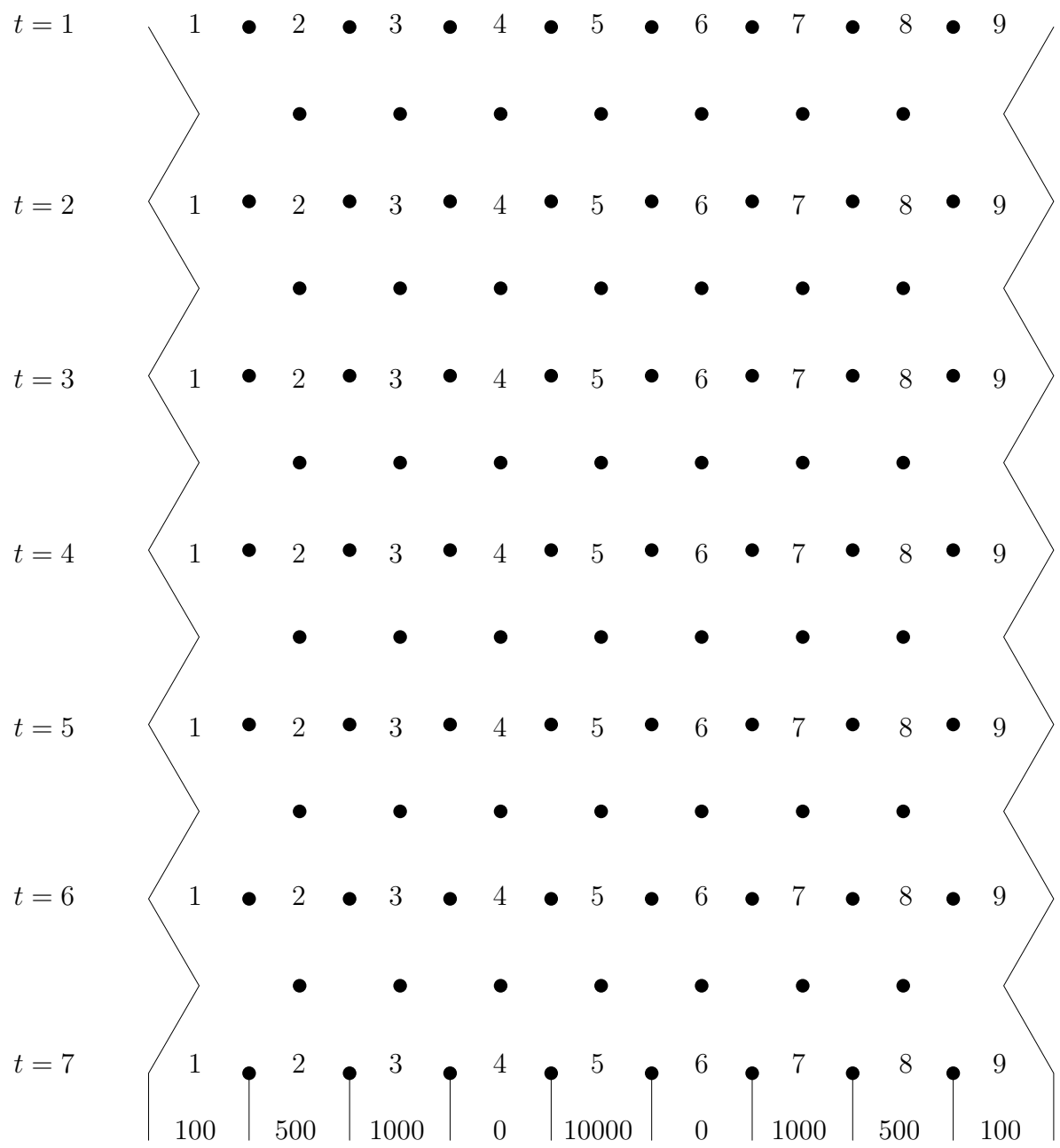
the random movement of the chip from level $t = 1$ at which it is dropped in a particular slot until it reaches the final slot. See https://www.mathworks.com/help/stats/binornd.html

Compute the expected win in \$ of each slot at level $t = 1$ based on the table you generated using MATLAB. In particular, the expected win of slot i at level $t = 1$ is

$$100p_{i,1} + 500p_{i,2} + 1000p_{i,3} + 0p_{i,4} + 10000p_{i,5} + 0p_{i,6} + 1000p_{i,7} + 500p_{i,8} + 100p_{i,9}.$$

Which slot at the top of the board results in the maximum expected win?

Submit the matlab program and the table, the expected win of each of the 9 slots, and the slot resulting in the maximum expected win. (Had the contestants taken EEC161, they should have dropped all their chips in the slot resulting in the maximum expected win.)


$t = 1$
$t = 2$
$t = 3$
$t = 4$
$t = 5$
$t = 6$
$t = 7$
1 2 3 4 5 6 7 8 9
100 500 1000 0 10000 0 1000 500 100