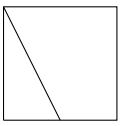
Homework 4 - Math 381 A - Autumn 2016 - Dr. Matthew Conroy

Consider a variation of Buffon's needle experiment.

For this version, suppose the plane is ruled with two sets of parallel lines, $\{x = a : a \in \mathbb{Z}\}$ and $\{y = a : a \in \mathbb{Z}\}$. In addition, the plane is also ruled with the set of parallel lines $\{y = 2a - 2x : a \in \mathbb{Z}\}$.

As a result, the plane is cut into identical unit squares that look like this (possibly after rotation):



The diagonal-ish line segment runs from the upper left corner to the midpoint of the bottom side.

(a) Write a simulation to experimentally estimate the probability that a randomly thrown needle of one-half unit length (i.e., half the same length as a side of the square in the figure) will cross a line (either one of the -2-sloped lines, or one from one of the sets of parallel lines). Describe your process in developing your code (separately from code comments, and in complete sentences).

Include your code, code output and plot the estimate of the probability versus the number of iterations for several (at least 10) runs of the simulation (run it long enough that you can see some asymptotic behavior).

The more runs you do, and the longer the runs are, the better.

Make a statement about the value of this experimentally estimated probability. From the values output by your simulation, give an interval that you feel confident contains the actual probability. Describe why you feel this confidence.

(b) Now, using the same code as you used for part (a) (with perhaps a very small modification), run simulations to estimate the length of the needle which would have a probability of 0.5 of hitting one of the lines when thrown. Give plenty of supporting simulation results, and give an interval you feel confident contains this length. Describe why you feel this confidence.

(You don't have to include any code, or figures for this part.)