

# Buffon's Needle Simulation

There are many approaches one can take and obtain perfectly acceptable solutions. Here is my version; many of you did something similar, others focused on the perpendicular distance from the midpoint of the stick to the nearest line. I will assume there are 1000 lines on my paper. I will set the distance ( $d$ ) between them to be 1, and will set the value of the stick length,  $L$ , as 0.3. I will get the same set of results as long as  $L < d$ , but this is the value I arbitrarily chose for this simulation.

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In[863]:= Clear[y0, y,  $\theta$ , success, ntrials, L]
success = 0; d = 1; ntrials = 1000000; L = 0.3;

(*Initialize the length of the stick L, the distance between the lines d,
the number of tosses (ntrials). Success measures the number
of times a stick intersects a line; I initialize it to zero. *)

y0[n_] := FractionalPart[RandomReal[{0, 1000}]]

(* y0[n] will measure the y value of one
end of the stick. If the stick is randomly thrown,
it can land anywhere from the bottom of the grid to the 1000th line. All I
really care about is the distance with respect to the two nearest lines,
so I just take the fractional part of the number generated. *)

 $\theta$ [n_] :=  $\theta$ [n] = RandomReal[{0, 2  $\pi$ }]

(* The stick can have any orientation from 0 to 2  $\pi$ . Simple trig shows that if
one of the stick is at y0[n], the other end will be at y0[n] + L Sin[ $\theta$ [n]]. *)

Do[If[y0[n] + L Sin[ $\theta$ [n]]  $\geq$  1  $\vee$  y0[n] + L Sin[ $\theta$ [n]]  $\leq$  0, success = success + 1], {n, ntrials}]

(* The step above determines how many intersections there are in ntrials tosses of the
stick. The stick will intersect a line if its endpoint is either greater than
the value of 1 or less than 0. If either of the conditions for success are met,
the loop increments the value of 'success' by one. This Do loop returns the
final value of success, the total number of intersections in our trial. *)

prob = success / ntrials // N;
pi = 2 (L / d) / prob;

Print["The value of pi determined by this simulation of ",
ntrials, " tosses of a stick is = ", pi]

The value of pi determined by this simulation of 1000000 tosses of a stick is = 3.14449
```