Monte_Carlo

Gabriel Rączkowski

Estimating the value of pi Using the Monte Carlo Method

This project aims to use the Monte Carlo method to estimate the value of pi.

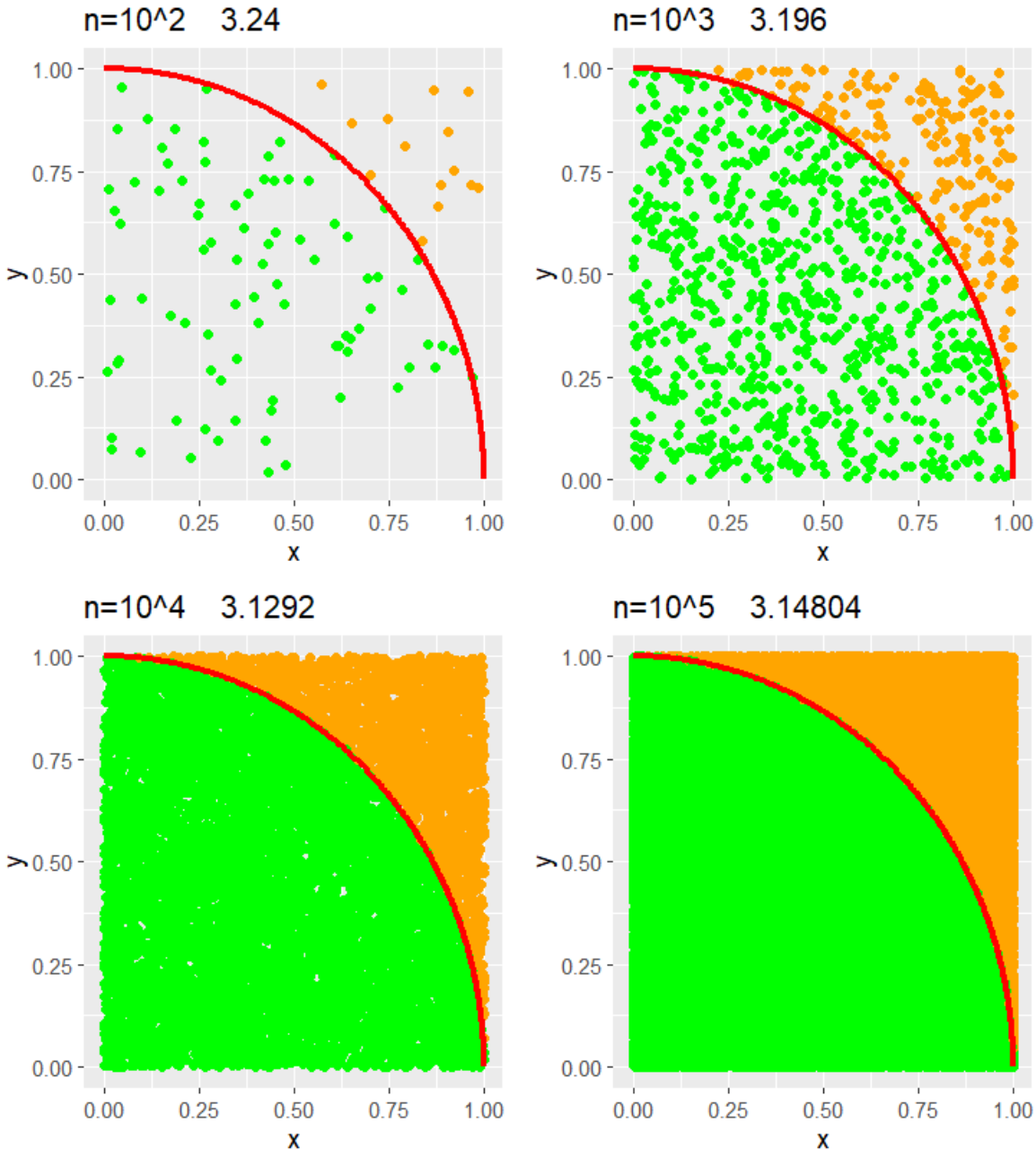
The method involves randomly generating points within a square and then classifying them as either inside a quarter circle or outside it, based on the equation of a circle. As the number of points increases, the ratio of points inside the circle to the total number of points approaches the ratio of the areas of the two shapes (that is, pi $\times$ r^2 / 4). After rearranging, we obtain the formula:

$$\pi = 4 * r^2 * P/N$$

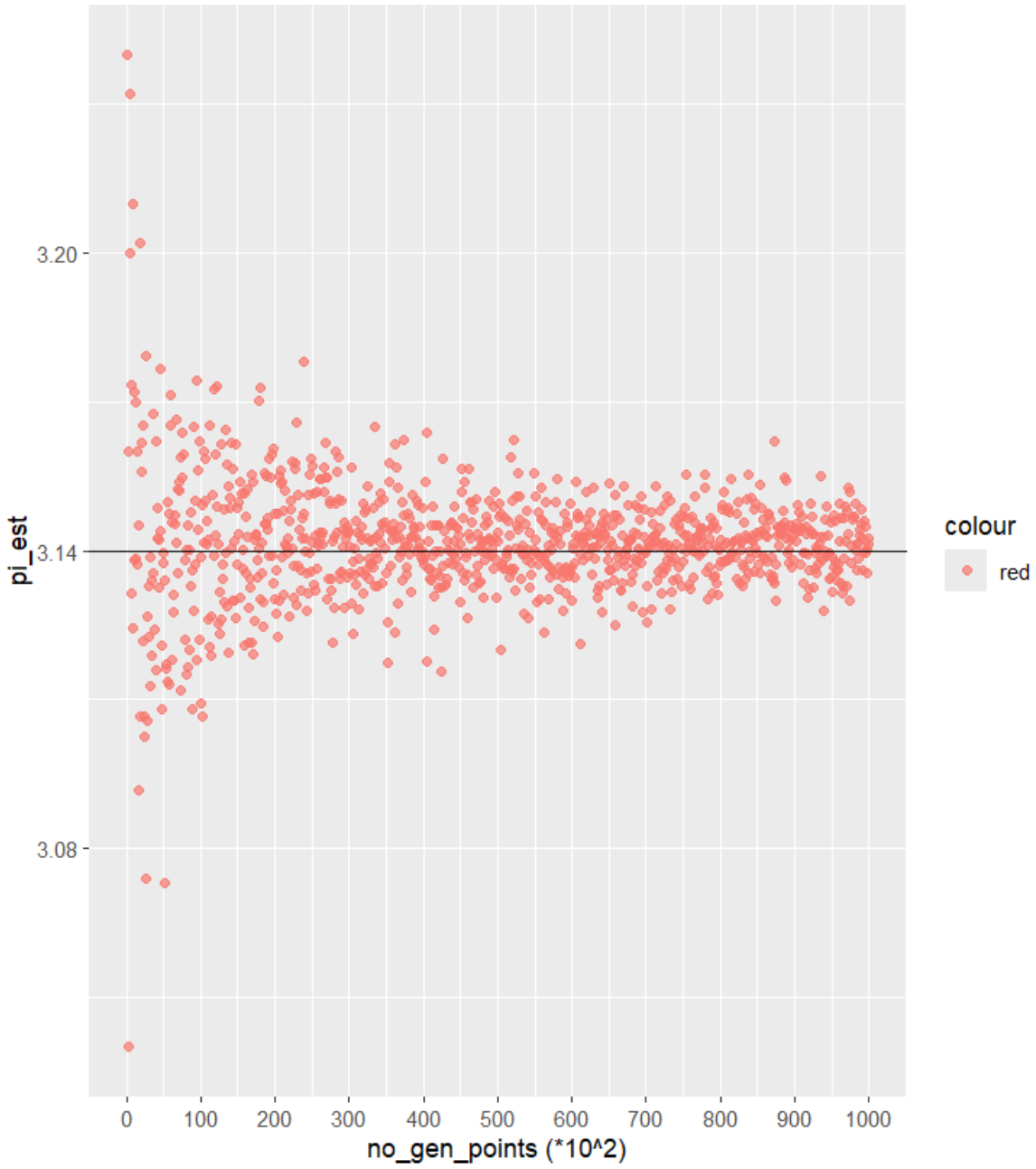
Where:
P - number of points inside the quarter circle
N - total number of points

We sample points from a square with side length a = 1, and our circle has radius r = 1.

A grid visual showing how the points are distributed as more are generated. We can clearly observe how the quarter circle gradually fills in as n increases.



This plot illustrates how the estimated values converge toward pi. We also see that the estimates oscillate around pi — the result lacks precision. In theory, with a much larger n, the curve would align closely with pi, but this was the computational limit of my machine.



As in the previous case, we observe convergence toward the true value as n increases.