DATA 609 - Homework 4

Joshua Sturm

October 3, 2018

Chapter 5 problems

1 (Page 191, exercise #3)

Using Monte Carlo simulation, write an algorithm to calculate an approximation to π by considering the number of random points selected inside the quarter circle

$$Q : x^2 + y^2 = 1, \quad x \geq 0, \ y \geq 0$$

where the quarter circle is taken to be inside the square

$$S : 0 \leq x \leq 1 \text{ and } 0 \leq y \leq 1$$

Use the equation $\frac{\pi}{4} = \frac{\text{area}Q}{\text{area}S}$

1 Solution

Sample Size	Actual π	Estimated π	Absolute difference
10	3.141593	2.80000	0.3415927
50	3.141593	3.12000	0.0215927
100	3.141593	3.20000	0.0584073
500	3.141593	3.19200	0.0504073
1000	3.141593	3.12800	0.0135927
5000	3.141593	3.11040	0.0311927
10000	3.141593	3.13280	0.0087927
50000	3.141593	3.13520	0.0063927
100000	3.141593	3.14772	0.0061273

As the sample size increases, the simulation's accuracy improves.

2 (Page 194, exercise #1)

Use the middle-square method to generate

a. 10 random numbers using $x_0 = 1009$.

b. 20 random numbers using $x_0 = 653217$.

c. 15 random numbers using $x_0 = 3043$.

d. Comment about the results of each sequence. Was there cycling? Did each sequence degenerate rapidly?

2 Solution