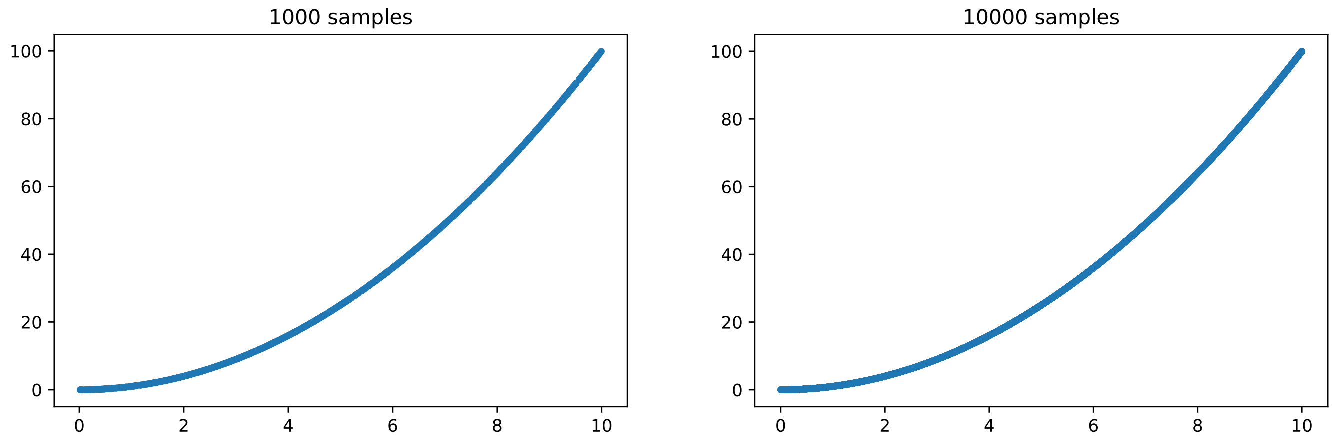
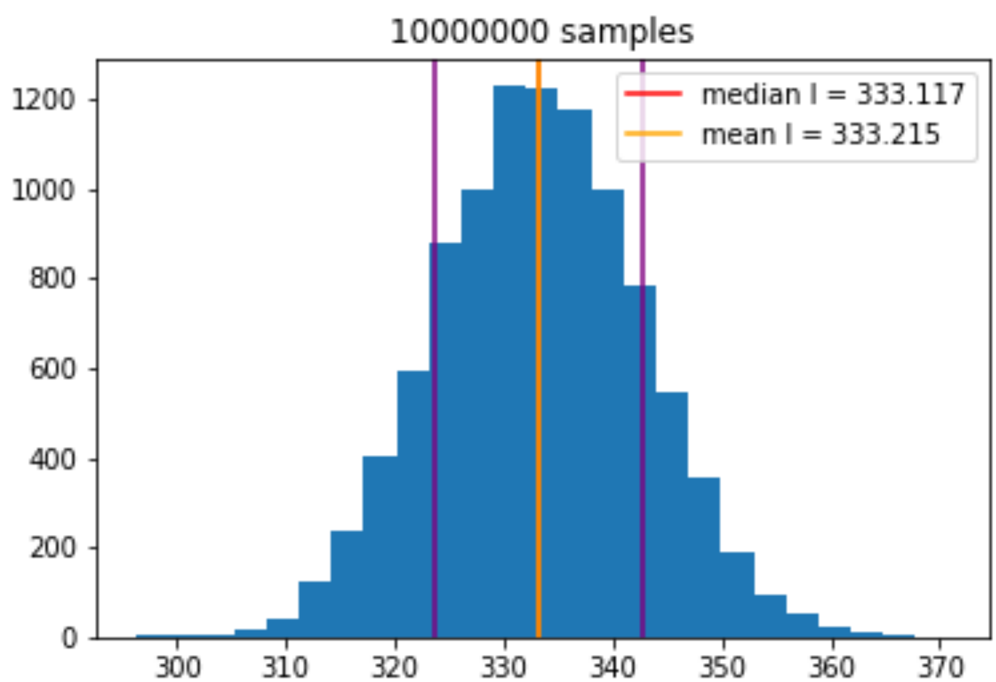
(1) The analytic value of x^2 should be 333.3333…, using 1000 samples the MC method gives a value of ~319.17, and 10000 samples gives a value of ~327.94. This demonstrates that as the number of samples increases, you get a closer approximation to the analytic value, at the expense of computation time.

(2) You do not get the same value for the MC integral every time due to the random element of the simulation. As you increase the samples, the value converges and there is less variability from run to run. Plotting x vs. y for the two sample sizes, we see the simulation creates a parabola, demonstrating that the sampler is literally sampling y values of the. Function over the defined interval.



(3)



Instead of drawing 100 * 1000 samples, I drew 10000 * 1000 samples to get a better distribution and get a better approximation of the integral value. Increasing the sample size gets the numerical value closer to the analytic value, as demonstrated by the median and mean values I got for the numerical values.

(4) From my 10000 trials, I got a standard deviation of 9.467. This gives me a numerical value of I = 333.215 +/- 9.467. Using the equation in the book, I calculated 1/sqrt(N)*std(sampled y) two ways. In the first was, I calculated it as the total number of y points samples divided by the square root of the number of trials multiplied by the number of samples per trial. This gave an approximation to the standard deviation in the numeric integral of: 0.009426965273561324. In the second way I calculated it, I took the standard deviation of the y values from each trial and took the standard deviation of these values. I then divided this number by the square root of the number of trials, giving an approximation of the standard deviation in the numeric integral of: 0.005031250644958026. These are both orders of magnitude different from the standard deviation I calculated :(I don't know why but tbc.

(5) Using this method to calculate the integral of sin(100x) from o to 2 pi, using 10000000 samples I got a value of I ~ 0.0006012902994893473, which is somewhat consistent with the analytical value of 0, and the numeric value from the previous exercise of -6.267021898338499e-08. Albeit, the previous exercises approximation is orders of magnitude closer to the analytic value.