Aaron Lo

Ms. Peregrino

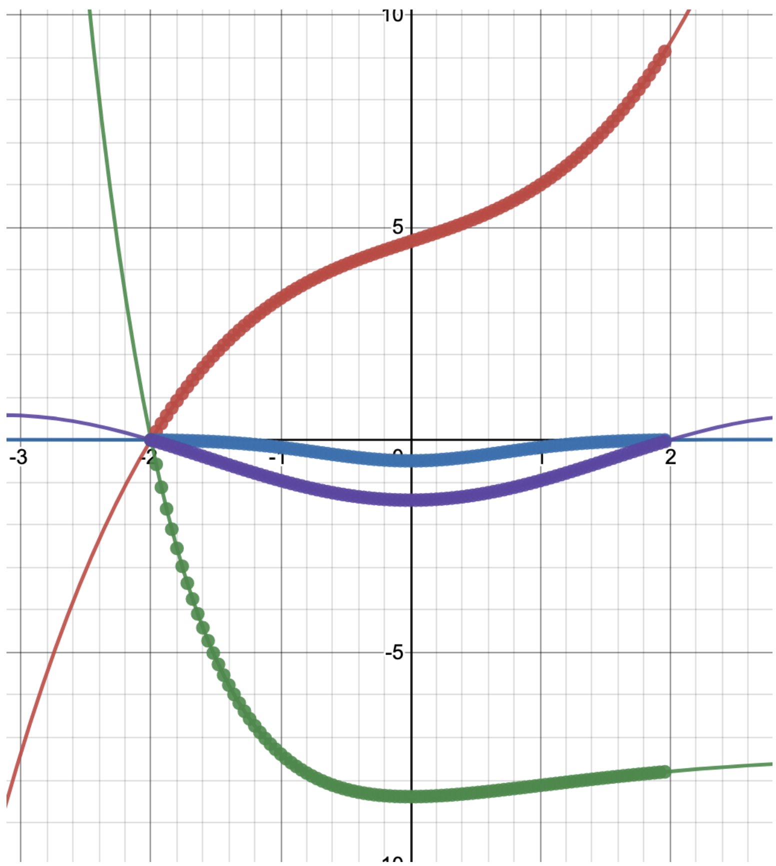
ATCS Numerical Method, p3

8 December 2021

Integration Lab Report

Trapezoidal & Simpson's Rule Write Up:

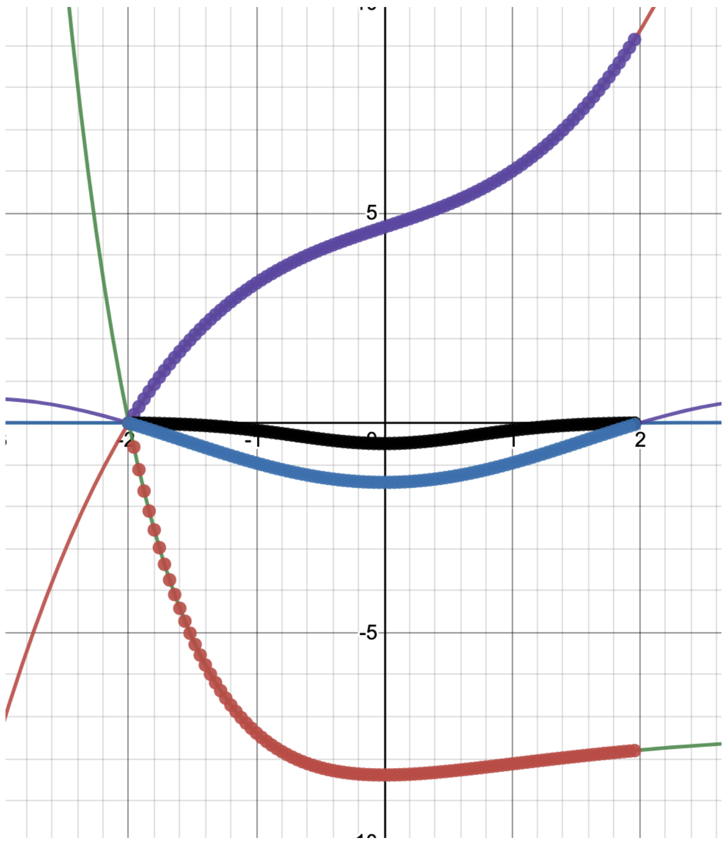
The four functions tested were 1 + x^2, x e^(-x^2), x e^(-x), and sin(x). When run through the trapezoidal rule with 100 iterations, the RMS of each function was 0.000396116, 1.98868e-05, 0.00130329, and 4.33689e-05. The percent error of the functions were 90.67%, NAN (from dividing by zero), 107.795%, and NAN. The generated graph is shown below, compared to the actual.



Plotting the integration of the four stated functions overlaid with the calculations from the trapezoidal rule.

Purple is the sin function, Red is the 1+x^2, Blue is xe^(-x), Purple is xe^(-x^2)

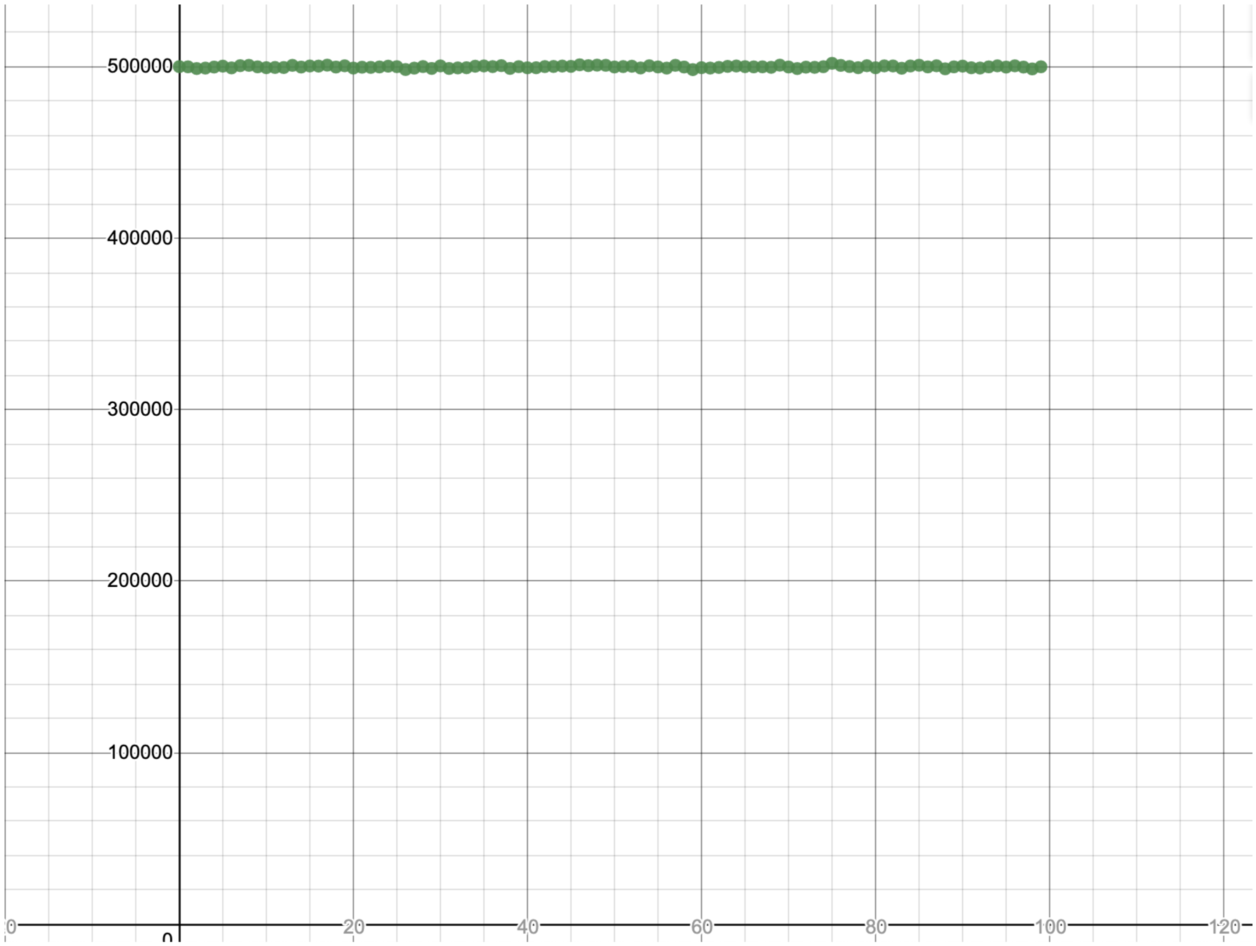
The simpsons rule on the other hand had an RMS of 1.78311e-15, 5.24779e-10, 1.05985e-08, and 1.48036e-10, a much better RMS compared to the trapezoidal rule. The percent errors were 90.6667%, NAN, 107.795%, and NAN. The graph of the points is shown below.



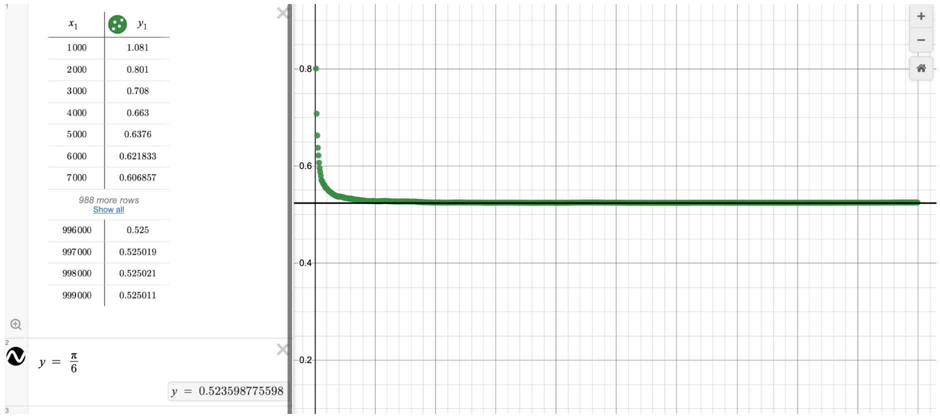
Plotting the Simpsons integration of the four stated functions overlaid with the calculations. The lines are the functions: Purple is the sin, Red is the 1+x^2, Blue is xe^(-x), Purple is xe^(-x^2)

Monte Carlo Write Up:

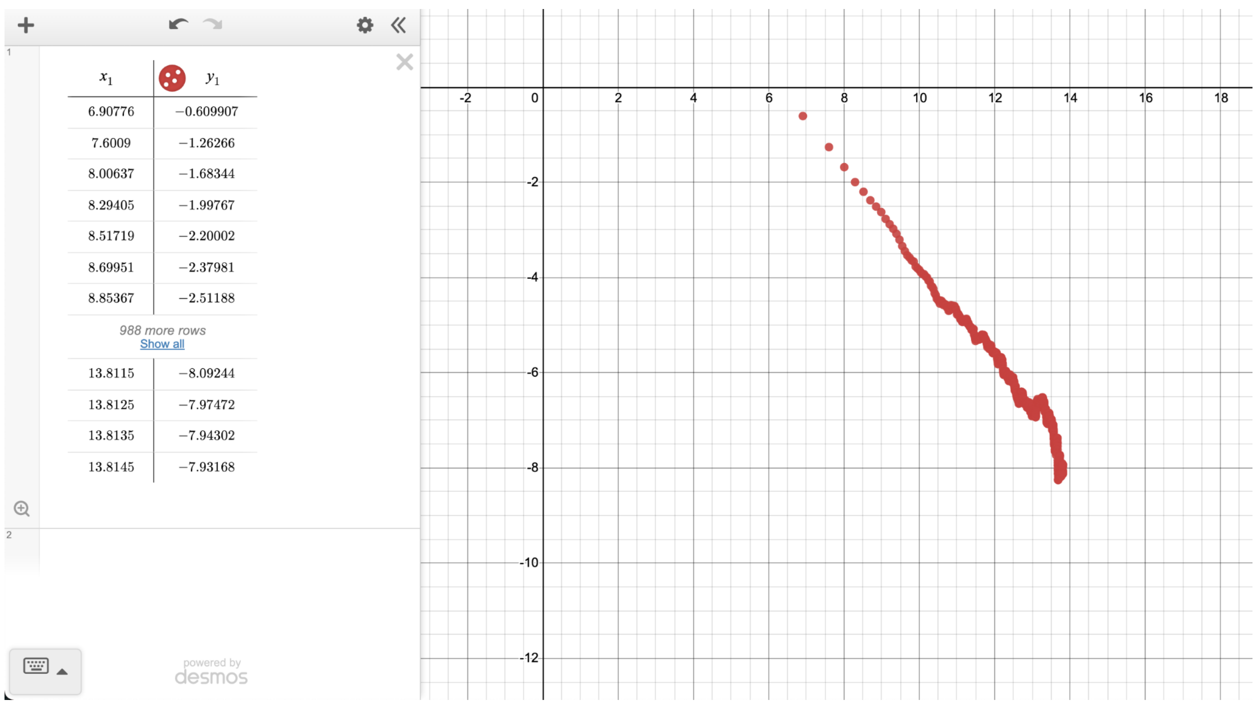
The Monte Carlo code works like a charm, calculating the areas very well. To ensure it works, a histogram of the points generated by the random number generator is produced. Because of its flat distribution, we know it works very well. The histogram is shown below.



The histogram of the random number generator with 100 buckets



This graph is the iterations in Monte Carlo as it gets nearer to the real value.



This graph plots the log of abs (y - f) to log(number of iterations) where f is the calculated area and y is the actual value.

This shows that as the iterations increase, the error decreases by a drastic amount. In this case, there is a nearly 10^-8 difference between the real value and the calculated value.