Math 105B Lab Report 7

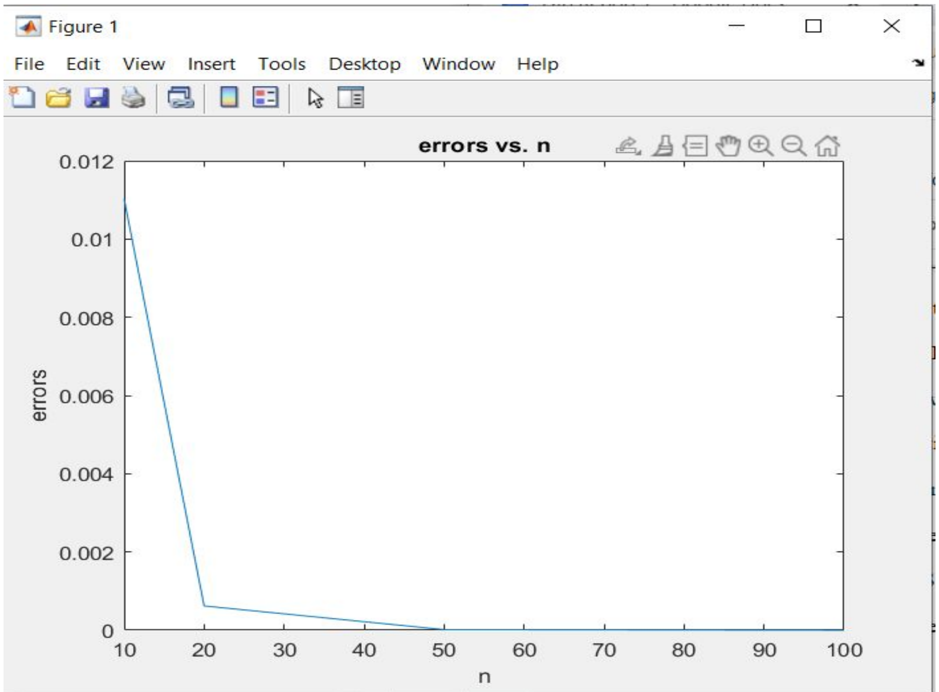
Jingyang Qiu ID:47674821

Purpose/Objective: In this lab, we will test the accuracy of the adaptive Simpson's rule for computing definite integrals numerically. We will first explore the relationship between the number of subintervals n and the error Composite Simpson's rule produces. We will then perform the adaptive Simpson's rule to the given integral and figure out whether 20 levels is sufficient for the desire accuracy of 0.5*10^-4.

Introduction: The given integral is cos(2x)*e^(-x) over the interval [0,2*pi]. Like the last lab assignment, we are asked to produce one plot showing the composite simpson errors versus the n values. Next, we are asked to follow the pseudo code given to write the adaptive numerical quadrature into a function. Lastly, besides determining whether 20 levels is possible to yield a result within the accuracy, we are also asked to compute the number of points we would need if we were to use a non-adaptive method.

Algorithm: The same technique is used as the previous assignments: make empty lists for actual error and error estimate, then loop through the n list and append computations to the lists. When I was coding the adaptive Simpson's rule, I made sure to put the original function inside and initialize lists of N+1 elements. Then it was straightforward to follow the algorithm given and I fixed some typos given.

Result:




```
Exact_value =

    0.1996


simpson_error =

    0.0110    0.0006    0.0000    0.0000


simpson_error_estimate =

    0.0806    0.0050    0.0001    0.0000


S =

    0.1996


n =

   63.3636

We need at least 64 quadrature points for the non-adaptive method
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Conclusion: As expected, the errors approach 0 as n increases, or the composite Simpson's rule becomes more accurate. We can also see that we need 64 points for the non-adaptive method, whereas we only need less than 20 levels of adaptive method to achieve the same accuracy.