Lab Report: Lagrange Interpolation Polynomial

Introduction

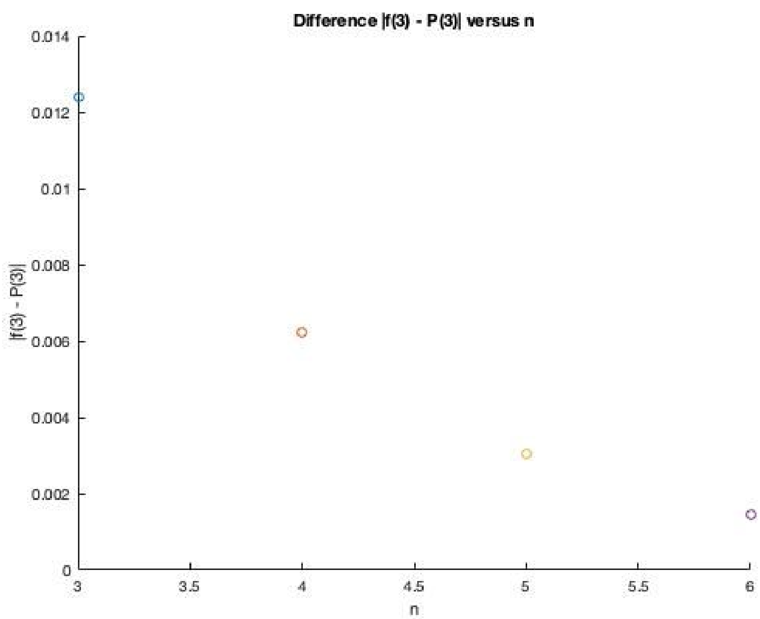
I will first be coding out the Lagrange interpolation polynomial as the function f_lagrange that will take input X, Y and a point x and P(x) as output. Using the function f(x) = 1/x as an example for the model, I will then compute the difference of f(x) and P(x) by evaluating both function at 3 using the degree n = 3 for the convenience of plotting. Furthermore, I will plot my first graph for the absolute differences between f(x) and P(x) versus different Lagrange interpolants i.e. n = 3, 4, 5, and 6. Lastly, I will modify the algorithm method in order to produce my second graph which is a single plot showing the exact function f(x)=1/x and the Lagrange interpolants using n=3, 4, and 6.

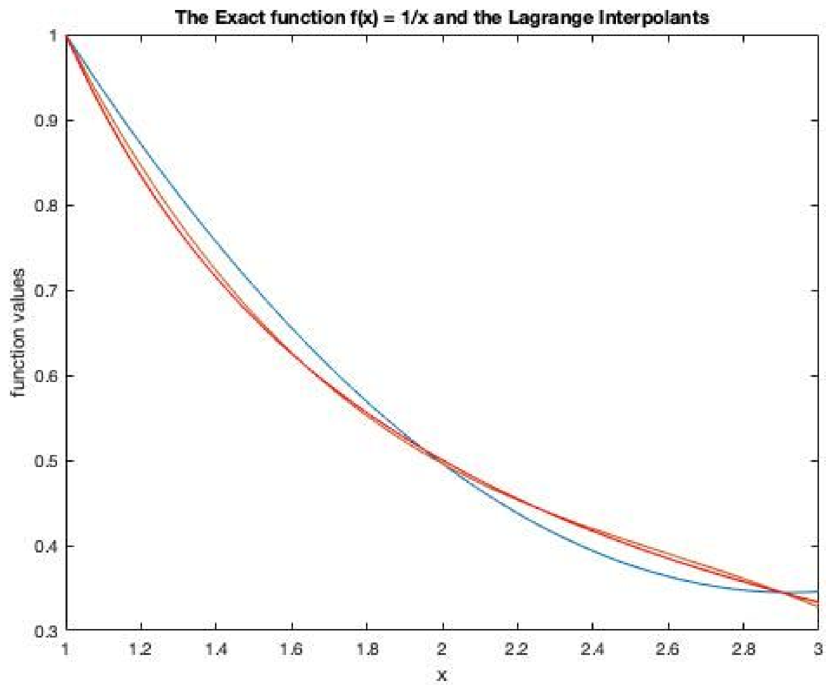
Algorithm Method

Part A: Since the Lagrange interpolation polynomial consist of a summation of f(x) and L(x) from 1 to n, I created a variable named sum and set it to 0 to store the terms that will be added at the end of every loop for j. Using the provided assumption that n = 3, I set a for loop that goes from 1 to 3 for the term j. Since L(x) is a product, I created a variable named product and set it to 1 to store the terms that will be multiplied at the end of every loop for k. Then I set my second and last for loop that goes from 1 to 3 for the term k with an if statement to make sure that the jth term and the kth term is not the same in order to omit getting a zero for the formula. The next few lines consist of ending the if statement and the two for loops and finally storing the product f(x) with its respected L(x). I end the function by getting P(x) as output variable y to the variable sum. Using the code provided from the professor, I run my function f_lagrange in a for loop and proceed to get y(i) for x(i) in the interpolation points set x. To ensure that my function is accurate, I test out my function by inputting x = 1.95 as provided and receive the output of y = 0.5128. In addition, when I plot the interpolated values and the actual function, I received a plot that contains two lines that resemble close to one another. Checking the absolute difference between f(3) - P(3), I got the result of 0.0124 using n = 3.

Part B: In order to plot the absolute difference between f(x) and P(x) versus n, I created a for loop from 3 to 6 and modify my function by adding an extra input n so I can easily change the polynomial in my function to get the difference and solution of P(x) for different n values. For the second graphs, I simply plot the exact function f(x) = 1/x and the Lagrange interpolants with the same modification of my function but this time I created a for loop skipping over 5 for the code to only go through n values 3, 4, and 6. I plot using the code provided by the professor to get the four lines in a single plot.

Graph





Conclusion

As shown above, I obtain the graphs for the difference of f(3) - P(3) versus n and a single plot of the exact function and the three lagrange interpolants by using the function f_lagrange. Taking note that the Lagrange interpolant lines are very identical to the exact function, I can conclude that the estimation using the Lagrange interpolating polynomial provides a very close approximation to the function f(x) using different lagrange interpolants.