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C++ Project 2 Report
AMS 595

Question 1

This program defines a function and uses two for loops to approximate the value of pi using the two given equations for the numerical evaluation of the integral using the trapezoidal rule. The program first defines the function “calc_f”, which will be used to calculate $f(x_k)$ and $f(x_{k-1})$ within the summation of equation (2), the trapezoidal rule. This function calculates f(x) for any given x from the integral displayed in equation (1). The main part of the program asks the user to input an integer “N”, which will be the number of subintervals that the interval [0,1] is partitioned into. The program then initializes the bounds of the interval [0,1] as well as the array that will store the N subinterval values. It then iterates from 0 to N using a for loop to calculate and store the subintervals within the array previously defined. Next, the program initializes the value of “calculated_pi” to be 0 and using the function “calc_f” as well as the array of subinterval values, it iterates from 1 to N using a for loop to evaluate the summation from equation (2), the trapezoidal rule. For each iteration, the value obtained from evaluating the equation within the summation from equation (2) is added to “calculated_pi”. It can be observed from equation (1) that the given integral equals (pi/4). Therefore, once the for loop is done iterating, the current value of “calculated_pi” is multiplied by 4 to yield the approximate value of pi from the program. The program then takes the absolute value of “calculated_pi” minus the true value of pi and divides this number by the true value of pi. This value is then multiplied by 100 to yield the error percentage between the computed value of pi and the true value of pi. Finally, the program outputs the computed value of pi, “calculated_pi”, as well as the corresponding error percentage.