

Math 201 - Program #2

March 20, 2015

The secant method for approximating a solution of the equation $f(x) = 0$ is much like Newton's method, except that the derivative is approximated by a difference quotient. Given two distinct initial approximations x_0 and x_1 , the secant method generates a sequence of "improved" approximations according to the formula

$$x_{n+1} = x_n - \frac{(x_n - x_{n-1})f(x_n)}{f(x_n) - f(x_{n-1})}, \quad n = 1, 2, 3, \dots$$

When using the secant method, the error in the current approximation, x_{n+1} , is often estimated by $|x_{n+1} - x_n|$.

Write, compile, and test a C++ program that implements the secant method to solve the equation $f(x) = 0$, where f is a continuous function of x . All floating-point numbers and functions should be declared `double`. You must use a main function and one other function to define f , but you may also use other functions if appropriate.

Your program should approximate the error at each iteration. It should continue until your error approximation is less than some prescribed value (set by you) or the maximum number of iterations (set by you) has been exceeded. Also be sure to guard against division by zero.

At each successful step of the secant method, your program should output the iteration count, the current approximation, and the approximate error. You need not output your initial approximations.

1. Test your program by solving $10x^2 + 2x - 3 = 0$ starting with $x_0 = 0.0$ and $x_1 = 1.0$. Then repeat the test using $x_0 = -1.0$ and $x_1 = 0.0$.
2. Test your program by solving $\cos(x) - x = 0$ starting with $x_0 = 0.0$ and $x_1 = 1.0$.

Example: Your output from problem 2 should be somewhat similar to

Starting with 0 and 1...

Iteration #1, Approx = 0.685073, Error = 0.314927

Iteration #2, Approx = 0.736299, Error = 0.0512256

Iteration #3, Approx = 0.739119, Error = 0.00282036

Iteration #4, Approx = 0.739085, Error = 3.42498e-005

Iteration #5, Approx = 0.739085, Error = 2.10875e-008

Iteration #6, Approx = 0.739085, Error = 1.59428e-013

Process exited after 0.2025 seconds with return value 0
Press any key to continue . . .