Universidad Industrial de Santander, Colombia
Numerical Analysis, 2020-2
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Lab 4. Secant Method

1 Instructions

- Make a **pdf** report including the solution to each point of the practice with name *Lab4_name_lastname.pdf.*
- Send the report and all created files in a rar or zip file with name *Lab4_name_lastname.rar* in the Moodle.
- You are allowed to use internet, notes, and .m files that you have created before.

2 Purposes

- To implement the secant method in Matlab.
- To interpret problems which can be solved by the secant method.

3 Practice

3.1 Implementing

- (1.5 points) Create a Matlab function called *my_secant_function_name_lastname()* to find the root of a function using the secant method. The arguments of the function must be: the function to be evaluated $f(x)$ (as an inline function), the initial points $[p_0, p_1]$, and the stopping criteria (the number of iterations or the error). Make a script called *run_2a_name_lastname.m* in which you use the created function to solve any exercise. For instance,

  fun = @ $XXXXXX$;
  $p_0 = XX$;
  $p_1 = XX$;
  Iter=X;
  root=my_secant_function_name_lastname(fun,p_0,p_1,Iter);

- (1.5 points) Create a Matlab function called *my_visual_secant_function_name_lastname()* to visualize the behaviour of the secant method. The arguments of the function must be: the function to be evaluated $f(x)$ (as an inline function), the initial points $[p_0, p_1]$, and the number of iterations. Make a script called *run_2b_name_lastname.m* in which you use the created function to visualize the behavior of the secant method when solving the exercise in previous item and conclude about the convergence of the method. For instance,

  fun = @ $XXXXXX$;
  $p_0 = XX$;
  $p_1 = XX$;
  Iter= XX
  P=my_visual_secant_function_name_lastname(fun,p_0,p_1,Iter);

3.2 Interpreting

Suppose that a projectile is launched from the point $(0,0)$ with an elevation angle b_0 and an initial speed v_0. Assuming that the air resistance is proportional to the speed, the projectile motion equations are given by,

$$y(t) = (Cv_y + 32C^2)\left(1 - e^{-\dfrac{t}{C}}\right) - 32Ct, \tag{1}$$

and,

$$x(t) = Cv_x\left(1 - e^{-\dfrac{t}{C}}\right). \tag{2}$$

where $y(t)$ is the height of the projectile at time t, C is a constant, $C = \dfrac{m}{k}$ with m being the mass of the projectile, and k is the air resistance coefficient, $v_y = v_0 \sin(b_0)$, $x(t)$ is the horizontal distance traveled at time t, and $v_x = v_0 \cos(b_0)$.

Consider a projectile with mass equal to 20 and an air resistance coefficient of 2, which is launched with an initial speed of 160 at an angle of 50 degrees.

- (1.2 points) Determine a nonlinear equation $f(t) = 0$ to calculate the time t in which the projectil will be in the ground again.
  $f(t) =$____
- (0.8 points) Make a script called *run_2c_name_lastname.m* to find the root of the nonlinear equation $f(t) = 0$ by using the created function in 3.1.