

## Multiple Roots

\* The user needs to make sure that the function  $f(X)$  is continuous.

- 1) Prompt the user for the function  $f(X)$ , the first derivative  $f'(X)$ , and the second derivative  $f''(X)$ , the tolerance and the maximum number of iterations
- 2) Ask the user for an initial value we will call  $X_0$
- 3) Evaluate  $X_0$  in the function to obtain  $f(X_0)$ . If  $f(X_0) = 0$ , tell the user that this is the root.
- 4) Evaluate  $X_0$  in the first and second derivate to obtain  $f'(X_0)$  and  $f''(X_0)$
- 5) Now we find the following value of  $X$ , we will store it in the variable of  $X_n \dots$  we will find it using the following formula :  $X_n = X_0 - [f(X_0) * f'(X_0) / f'(X_1)^2 - f(X_0) * f''(X_0)]$ . Now we evaluate this in the function  $f(X)$  and if  $f(X_n)$  is equal to zero then we tell the user this is the root.
- 6) We make an iterations counter and will call it  $n$  and start it at 1
- 7) We find the error,  $\text{Error} = |X_0 - X_1|$
- 8) Now me make a cycle... while the error  $>$  tolerance,  $f(X_n) \neq 0$ ,  $n <$  the max number of iterations, do :
  - a)  $X_0 = X_n$
  - b)  $f(X_0)$  = the new value of  $X_0$  evaluated in the function
  - c)  $f'(X_0)$  = the new value of  $X_0$  evaluated in the first derivative
  - d)  $f''(X_0)$  = the new value of  $X_0$  evaluated in the second derivative
  - e)  $X_n = X_0 - [f(X_0) * f'(X_0) / f'(X_1)^2 - f(X_0) * f''(X_0)]$ .(with the new values)
  - f)  $\text{Error} = |X_1 - X_n|$
  - g)  $f(X_n)$  = the new value of  $X_n$  evaluated in the function
  - h)  $n = n+1$
- 9) If the error  $\leq$  tolerance, tell the user that the root is approximately  $X_n$  (final value) with an error of: \_\_\_\_ (with the final value of the error)
- 10) If  $X_n = 0$  then tell the user that  $X_n$  is the root .
- 11) If  $n$  is equal to the number of iterations then tell the user that he has reached the maximum number of iterations and that the root will be approximately  $X_n$  (final value) with an error of: \_\_\_\_ (with the final value of the error)