

17/eng06/098 Itseoritse Metsaphanin. ENG 382.

ASSIGNMENT II

If the maximum percentage absolute error is desired to be 1%, using the Newton Raphson Iteration method and initial guess value of $x_0 < 0.5$; Find the root of the function in the given equation (1)

1. Manually
2. With the aid of Matlab

Solution

i. for manual solution

$$f(x) = e^{-0.5x} (4-x) - 2$$

$$f'(x)$$

$$\text{Let } u = e^{-0.5x} \quad v = (4-x)$$

$$\frac{du}{dx} = -0.5e^{-0.5x} \quad \frac{dv}{dx} = -1$$

$$f'(x) = u \frac{dv}{dx} + v \frac{du}{dx}$$

$$= -e^{-0.5x} - 0.5x e^{-0.5x} (4-x)$$

$$x_0 = 0.5 \text{ (Initial guess)}$$

General Newton Raphson's formula

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$$

$$f(x_0) = f(0.5) = 0.7258027407$$

$$f'(x_0) = f'(0.5) = -2.141702153$$

$$x_1 = x_0 - \frac{f(x_0)}{f'(x_0)}$$

$$= 0.8388906061 \text{ (Root 1)}$$

$$f(x_1) = 0.07814999779$$

$$f'(x_1) = -1.696486032$$

$$x_2 = x_1 - \frac{f(x_1)}{f'(x_1)} = 0.8849560003 \text{ (Root 2)}$$

$$f(x_2) = 1.236575203 \times 10^{-3}$$

$$f'(x_2) = -1.643060762$$

$$x_3 = x_2 - \frac{f(x_2)}{f'(x_2)} = 0.885705605 \text{ (Root 3)}$$

$$f(x_3) = 3.23583557 \times 10^{-3}$$

$$f'(x_3) = -1.642200927$$

$$x_4 = x_3 - \frac{f(x_3)}{f'(x_3)} = 0.885708802 \text{ (Root 4)}$$

$$f(x_4) = 7.845 \times 10^{-12}$$

$$f'(x_4) = -1.642200704$$

$$x_5 = x_4 - \frac{f(x_4)}{f'(x_4)} = 0.885708802 \text{ (Root 5)}$$

$\therefore 0.885708802$ is the root of equation (1.1)

ii. MATLAB

ET function [x1200, ruler] = assign 2 (x0, max1, tol, iter, f, fprime)

$$x_0 = 0.5;$$

$$\text{max1} = 100$$

$$\text{tol} = 0.000000001$$

$$\text{iter} = 1$$

$$f = (5(x)) (\exp(-0.5 * x)) * (4.00) - 2$$

$$f_{\text{prime}} = (5(x)) (-\exp(-0.5 * x)) + ((-0.5 * \exp(-0.5 * x)) * (4 - x))$$

for $x = 1$ max1

$$x_1 = x_0 - \frac{f(x_0)}{f_{\text{prime}}(x_0)}$$

$$\text{err} = \text{abs}(x_1 - x_0), \text{ ruler}, \text{abs}(x_1 - x_0) / x_0$$

fprint f (% 2 (f % 10.10 f % 10.10 f % 10.10 % / x

err, x0, x1, err, ruler)

$$x_0 = x_1, \text{iter} = 1 + \text{iter}$$

ferr < tol, break, end

end.