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16/ENG04/047

ASSIGNMENT 2

1.)

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

Finding the root

$$\text{When } x=0; f(x) = e^{-0.5 \cdot 0}(4-0) - 2 = 2$$

$$\text{When } x=1; f(x) = e^{-0.5 \cdot 1}(4-1) - 2 = -0.180408$$

$\therefore f'(x)$

$$\text{Expand } f(x) = e^{-0.5x}(4-x) - 2 \quad \text{OR } f(x) = e^{-0.5x}(4-x) - 2$$
$$= 4e^{-0.5x} - xe^{-0.5x} - 2$$

Differentiating with Product Rule

$$f'(x) = \frac{d}{dx} \left\{ e^{-0.5x}(4-x) \right\} - \frac{d}{dx} \left\{ 2 \right\}$$

$$= e^{-0.5x} \cdot \frac{d}{dx}(4-x) + (4-x) \cdot \frac{d}{dx}(e^{-0.5x}) - 0$$

$$= e^{-0.5x}(-1) + (4-x)(-0.5e^{-0.5x})$$

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

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

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

$$f'(x) = 0.5xe^{-0.5x} - 3e^{-0.5x}$$

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Using Newton-Raphson Method

$$x_{k+1} = x_k - \frac{f(x_k)}{f'(x_k)}$$

$$\% \text{ Absolute Error} = \left\{ \frac{x_{k+1} - x_k}{x_{k+1}} \right\} \times 100\%$$

For iter 1;

$$\text{Let } x_k = 0.5 = x_0$$

$$f(x_0) = (4 - 0.5)e^{-0.5 \cdot 0.5} - 2$$

$$f(x_0) = 0.7258$$

$$f'(x) = e^{-0.5(0.5)} [(0.5 \times 0.5) - 3]$$

$$= -2.142$$

$$x_{k+1} = 0.5 - \frac{0.7258}{-2.142}$$

$$= 0.8388$$

$$\% \text{error} = \left(\frac{0.8388 - 0.5}{0.8388} \right) \times 100$$

$$\% \text{error} = 40.396$$

For iter 2;

$$\text{Let } x_k = 0.8388 = x_1$$

$$f(x_1) = (4 - 0.8388) e^{-0.5(0.8388)} - 2$$

$$f(x_1) = 0.0783$$

$$f'(x_1) = e^{-0.5 \times 0.8388} [(0.5 \times 0.8388) - 3]$$

$$f'(x_1) = -1.6966$$

$$\therefore x_{k+1} = 0.8388 - \frac{0.0783}{-1.6966}$$

$$x_{k+1} = 0.88496$$

$$\% \text{error} = \left(\frac{0.88496 - 0.8388}{0.88496} \right) \times 100$$

$$= 5.2151$$

For iter 3;

$$\text{Let } x_k = 0.88496 = x_2$$

$$f(x_2) = (4 - 0.88496) e^{-0.5(0.88496)} - 2$$

$$f(x_2) = 0.00123$$

$$f'(x_2) = e^{-0.5 \times 0.88496} [(0.5 \times 0.88496) - 3]$$

$$f'(x_2) = -1.64306$$

$$x_{k+1} = 0.88496 - 0.00123$$

$$-1.64306 = 0.885708605$$

$$\% \text{error} = \left(\frac{0.88571 - \overset{0.88496}{\cancel{0.88496}}}{0.88571} \right) \times 100$$

$$= 0.0846$$

For iter 4;

$$\text{Let } x_k = 0.88571$$

$$f(x_3) = (4 - 0.88571)e^{-0.5(0.88571)^2}$$

$$f(x_3) = -1.9674 \times 10^{-6}$$

$$f'(x_3) = e^{-0.5 \times 0.88571} ((0.5 \times 0.88571) - 3)$$

$$f'(x_3) = -1.64220$$

$$x_{k+1} = 0.8857 - \frac{1.96734 \times 10^{-6}}{-1.64220} = 0.88571$$

$$\% \text{error} = \left(\frac{0.88571 - 0.88571}{0.88571} \right) \times 100$$

$$= 0$$

i	x_k	$f(x_k)$	$f'(x_k)$	x_{k+1}	%obs. error
0	0.5	0.7258	-2.142	0.8388	40.396
1	0.8388	0.0783	-1.6966	0.88496	5.2151
2	0.88496	0.00123	-1.64306	0.88571	0.0846
3	0.88571	-1.9674×10^{-6}	-1.64220	0.88571	0

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Editor - C:\Users\tomisin\Documents\MATLAB\ass2.m
INTERPOLATION.m x linear.m x Untitled.m x Ass1.m x ass3.m x ass2.m x +
1 function [x1, err, relerr] = newraph(x0, max1, tol, iter, f, fprime)
2     x0=0.5;
3     max1=100;
4     tol=0.000000000005;
5     iter=1;
6     f=@(x) exp(-0.5*x)*(4-x)-2;
7     fprime=@(x) exp(-0.5*x)*((-0.5*x)-3);
8     for i=1:max1;
9         x1=x0-feval(f,x0)/feval(fprime,x0)
10        err=abs(x1-x0); relerr=abs(x1-x0)/x1
11        fprintf('%2.0f %10.10f %10.10f %10.10f %10.10f\n', iter, x0, x1, err, relerr)
12        x0=x1, iter=1+iter;
13        if err<=tol, break, end
14    end
15

Command Window
New to MATLAB? See resources for Getting Started.

ans =

    0.88571
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