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16/ENG01/008
chemical engineering
Assignment 2.

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

finding the root

when $x = 0$, $f(x) = e^{-0.50}(4-0) - 2 = 2$,,

when $x = 1$, $f(x) = e^{-0.51}(4-1) - 2 = 0.1804084$

$\therefore f'(x)$

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

$= 4e^{-0.5x} - xe^{-0.5x} - 2$

differentiating with product rule.

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

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

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

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

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

$= x0.5e^{-0.5x} - 2e^{-0.5x} - e^{-0.5x}$

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

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

using Newton Raphson method

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

% absolute Error $\left(\frac{x_{k+1} - x_k}{x_{k+1}}\right) \times 100\%$.

for iter 1

Let $x_k = 0.5 = x_0$

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

$f(x_0) = 0.7258$

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

$= -2.142$

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

$= 0.8388$,,

$\%$ error $= \left[\frac{0.8388 - 0.5}{0.8388}\right] \times 100$

$\%$ error $= 40.396$

for iter 2

let $x_k = 0.8388 = x_1$

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

$f(x_1) = 0.0783$

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

$f'(x_1) = -1.6986$

$\therefore x_{k+1} = 0.8388 - \frac{0.0783}{-1.6986}$

$x_{k+1} = 0.88496$

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

$= 5.2151$

for iter 3,

let $x_k = 0.88496 = x_2$

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

$f(x_2) = 0.00123$

$f'(x_1) = e^{-0.5 \times 0.88496}((0.5 \times 0.88496) - 3)$

$f'(x_1) = -1.64306$

$x_{(k+1)} = 0.88496 - \frac{0.00123}{-1.64306} = 0.885708605$

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

$= 0.0846$,,

for iter 4

Let $x_k = 0.88571$

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

$f(x_3) = -1.96734 \times 10^{-6}$

$f'(x_1) = e^{-0.5 \times 0.88671}((0.5 \times 0.88571) - 3)$

$f'(x_1) = -1.64220$

$x(x+1) = 0.8857 - \dfrac{1.96734 \times 10^{-6}}{-1.64220} = 0.88571$

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

i	x_k	$f x_k$	$f' x_k$	x_{k+1}	% abs. error
0	0.5	0.7258	-7.142	0.8388	40.396
1	0.8388	0.0783	-1.6466	0.88496	5.2151
2	0.88496	0.00123	-1.64306	0.88571	0.0826
3	0.88571	-1.9624×10^{-6}	-1.64220	0.88571	0.