Regular false position Method

Working Rule

⟹ step-I given eq^n $f(x)=0$ —— ①

find x_0 and x_1 such that

$f(x_0)<0$ and $f(x_1)>0$

i.e $f(x_0)f(x_1)<0$

⟹ Root of eq^n ① lies bet^n x_0 and x_1

step-II find 1^{st} approximate Root by Regular false method.

$$x_2 = \frac{x_0 f(x_1) - x_1 f(x_1)}{f(x_1) - f(x_0)}$$

find $f(x_2)$ and examine is sing

step-2.1 $f(x_2)<0$ then Replace

$x_0 = x_2$

else

If $f(x_2)>0$ then Replace.

$x_1 = x_2$

step-III find 2nd approximate Root by

$$x_2 = \frac{x_0 f(x_0) + x_1 f(x_2)}{f(x_1) - f(x_2)}$$

find $f(x_2)$ and Repeat step - 2.1 and 2.2 until the Required accurate root.

Q. Solve the eq^n $x^3-4x-9=0$ ~~$xe^x - \cos x$~~ by false position method correct upto 4 decimal places

Sol given

$$f(x) = x^3 - 4x - 9 = 0 \quad \text{--- (1)}$$

To find x_0 and x_1

$f(1) = (1)^3 - 4(1) - 9 = -12 < 0$

$f(2) = (2)^3 - 4(2) - 9 = 8 - 8 - 9 = -9 < 0$

$f(3) = (3)^3 - 3(3) - 9 = 6 > 0$

$f(2.6) = \qquad = -1.824 < 0$

$f(2.7) = \qquad = -0.117 < 0$

$f(2.8) = \qquad = 1.752 >$

Choosing $x_0 = 2.7$ and $x_1 = 2.8$

$f(x_0) = -0.117 \qquad f(x_1) = 1.752$

first appoximate Root by Regular falsi

$$x_2 = \frac{x_0 f(x_1) - x_1 f(x_0)}{f(x_1) - f(x_0)}$$

$$= \frac{(2.7)(1.752) - 2.8(-0.117)}{1.752 - (-0.117)}$$

$$= 2.706260$$

$f(x_2) = (2.706260)^3 - 4(2.706260) - 9 = -0.004816 < 0$

$\therefore x_0 = x_2$

Choosing $x_0 = 2.706260$ and $x_1 = 2.8$

$f(x_0) = -0.004816 \qquad f(x_1) = 1.752$

2nd approximate Root

$$x_2 = \frac{x_0 f(x_1) - x_1 f(x_0)}{f(x_1) - f(x_0)} = \qquad = 2.70651$$

$f(x_2) = (2.706516)^3 - 4(2.706516) - 9 = -0.000214 < 0$

$x_0 = x_2$

choosing $x_0 = 2.706516 \qquad x_1 = 2.8$

$f(x_0) = -0.000214, \qquad f(x_1) = 1.752$

3rd appoximate Root.

$$x_2 = \frac{x_0 f(x_1) - f(x_0) x_1}{f(x_1) - f(x_0)} =$$

$x_2 = 2.706527$

hence the approximate Root correct to four decimal places is $x = 2.7065$

n	x_0	x_1	x_2	$f(x_2)$
1	2.7	2.8	2.706260	−0.004816
2	2.706260	2.8	2.706516	−0.000214
3	2.706516	2.8	2.706527	

$$\boxed{x = 1.7962}$$

Q:- $xe^x = \cos x$ by false position method correct upto 4 decimal places.

Sol^n given:

$xe^x = \cos x$

$f(x) = xe^x - \cos x = 0$ —— (1)

To find x_0 and x_1

$f(0) = 0(e)^0 - \cos 0 = -1 < 0$

$f(1) = 1(e)^1 - \cos(1) = 2.177979 > 0$

∴ Roots lies bet^n $x_0 = 0$ and $x_1 = 1$

$f(x_0) = -1$ $f(x_1) = 2.177979$

Now set

$f(0.5) = (0.5)e^{0.5} - \cos(0.5) = -0.053221$

$f(0.6) = (0.6)e^{0.6} - \cos(0.6) = +0.267935 > 0$

crossing ∴ Root lies bet^n $x_0 = 0.5$ and $x_1 = 0.6$

$f(x_0) = -0.053221$ and $f(x_1) = 0.267935$

1st approximate root

$$x_2 = \frac{x_0 f(x_1) - x_1 f(x_0)}{f(x_1) - f(x_0)} = \frac{(0.5)(0.267935) - (0.6)(-0.053221)}{0.267935 - (-0.053221)}$$

$x_2 = 0.516571$

$f(x_2) = (0.516571)e^{0.516571} - \cos(0.516571)$

$= -0.003605 < 0$

∴ $x_0 = x_2$

choosing $x_0 = 0.516571$ and $x_1 = 0.6$

$f(x_0) = -0.003605 < 0$ $f(x_1) = 0.267935$

2nd approximate root

$$x_2 = \frac{x_0 f(x_1) - x_1 f(x_0)}{f(x_1) - f(x_0)} = \frac{(0.516571)(0.267935) - (0.6)(-0.003605)}{0.267935 - (-0.003605)}$$

$= 0.517678$

$f(x_2) = -0.000241 < 0$

Choosing $x_0 = x_2 = 0.517678$ $x_1 = 0.6$
$f(x_0) = -0.000241$ $f(x_1) = 0.267935$

3rd approximate Root

$$x_2 = \frac{x_0 f(x_1) - x_1 f(x_0)}{f(x_1) - f(x_0)} = \frac{(0.517678)(0.267935) - (0.6)(-0.00024}{0.267935 - (-0.000241)}$$

$$= 0.517751$$

$f(x_2) = -0.000019 < 0$

Choosing $x_0 = x_2 = 0.517751$ $x_1 = 0.6$
$f(x_0) = -0.000019$ $f(x_1) = 0.267935$

4th approximate root

$$x_2 = \frac{x_0 f(x_1) - x_1 f(x_0)}{f(x_1) - f(x_1)}$$

$$= 0.\underline{5177}56$$

hence the approximate root of eq^n $xe^x = \cos x$ correct upto 4-decimal places is:

$\boxed{x = 0.5177}$ Ans

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n	x_0	x_1	x_2	$f(x_2)$
1	0.5	0.6	0.516571	-0.003605
2	0.516571	0.6	0.517678	-0.000241
3	0.517678	0.6	0.517751	-0.000019
4	0.517751	0.6	$\underline{0.51775}6$	