Numerical Methods

By

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False Position Method (Regula Falsi Method) Steps

Step-1:	Find points x_0 and x_1 such that $x_0 < x_1$ and $f(x_0) \cdot f(x_1) < 0$.
Step-2:	Take the interval $[x_0, x_1]$ and find next value $x_2 = x_0 - f(x_0) \cdot \frac{x_1 - x_0}{f(x_1) - f(x_0)}$ Or $x_2 = \frac{x_0 f(x_1) - x_1 f(x_0)}{f(x_1) - f(x_0)}$
Step-3:	If $f(x_2) = 0$ then x_2 is an exact root, else if $f(x_0) \cdot f(x_2) < 0$ then $x_1 = x_2$, else if $f(x_2) \cdot f(x_1) < 0$ then $x_0 = x_2$.
Step-4:	Repeat steps 2 & 3 until $f(x_i) = 0$ or $\lvert f(x_i) \rvert \leq \text{Accuracy}$

Example

Find a root of an equation $f(x)=x^3-x-1$ using False Position method.

Here $x^3-x-1=0$

Let $f(x)= x^3-x-1$

Here

x	0	1	2
$f(x)=$	-1	-1	5

Example

n	x_0	$f(x_0)$	x_1	$f(x_1)$	x_2	$f(x_2)$	Update
1	1	-1	2	5	1.16667	-0.5787	$x_0 = x_2$
2	1.16667	-0.5787	2	5	1.25311	-0.28536	$x_0 = x_2$
3	1.25311	-0.28536	2	5	1.29344	-0.12954	$x_0 = x_2$
4	1.29344	-0.12954	2	5	1.31128	-0.05659	$x_0 = x_2$
5	1.31128	-0.05659	2	5	1.31899	-0.0243	$x_0 = x_2$
6	1.31899	-0.0243	2	5	1.32228	-0.01036	$x_0 = x_2$
7	1.32228	-0.01036	2	5	1.32368	-0.0044	$x_0 = x_2$
8	1.32368	-0.0044	2	5	1.32428	-0.00187	$x_0 = x_2$
9	1.32428	-0.00187	2	5	1.32453	-0.00079	$x_0 = x_2$
10	1.32453	-0.00079	2	5	1.32464	-0.00034	$x_0 = x_2$

Example

1*st* iteration :

Here $f(1)=-1<0$ and $f(2)=5>0$

∴ Now, Root lies between $x_0=1$ and $x_1=2$

$x2=\{ 1\cdot(5)- \ 2 \cdot (-1) \}/ \{5 - (-1)\}$

$=7/6$

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

$x2=1.16667$

$f(x2)=f(1.16667)=-0.5787<0$

Example

2*nd* iteration :

Here $f(x_2) = f(1.16667) = -0.5787 < 0$
and $f(x_1) = f(2) = 5 > 0$

∴ Now, Root lies between $x_0 = 1.16667$ and $x_1 = 2$

If $f(x_2) = 0$ then x_2 is an exact root,
else if $f(x_0) \cdot f(x_2) < 0$ then $x_1 = x_2$,
else if $f(x_2) \cdot f(x_1) < 0$ then $x_0 = x_2$.

$x3 = \{1.16667 \cdot (5) - 2 \cdot (-0.5787)\} / \{5 - (-0.5787)\}$

$x3 = 1.25311$

$f(x3) = f(1.25311) = -0.28536 < 0$

Example

3*rd* iteration :

Here $f(1.25311)=-0.28536<0$

and $f(2)=5>0$

$\therefore$ Now, Root lies between $x_0=1.25311$ and $x_1=2$

$x4=?$

$x4=$ 1.29344

Assignment

Fixed Point Iteration Method Algorithm or Iteration Method