Method of False Position (Regula Falsi)

Nonlinear equation $f(x) = 0$

1. Choose two real numbers a and b such that $f(a)f(b) < 0$
2. Set $x_r = \dfrac{af(b) - bf(a)}{f(b) - f(a)}$.
3. - If $f(a)f(x_r) < 0$, the root lies in the interval (a, x_r). Then, set $b = x_r$ and go to step 2.
   - If $f(a)f(x_r) > 0$, the root lies in the interval (x_r, b). Then, set $a = x_r$ and go to step 2.
   - If $f(a)f(x_r) = 0$, then x_r is a root of the equation $f(x) = 0$ and the computation may be terminated.

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Find a real root of the equation $f(x) = x^3 - 2x - 5 = 0$.

1. Take $a = 2,\ b = 3$. Then $f(a) = f(2) = -1$ and $f(b) = f(3) = 16$. Hence

$$x_1 = \frac{2 \times 16 - 3 \times -1}{16 \times -(-1)} = \frac{35}{17} = 2.058823529$$

Now, $f(x_1) = -0.390799917$.

2. Root is in between 2.058823529 and 3. Then

$$x_2 = \frac{2.058823529 \times 16 - 3 \times -0.390799917}{16 - (-0.390799917)} = 2.08126366$$

and $f(x_2) = -0.147204057$.

3. Root is in between 2.08126366 and 3. Then

$$x_3 = \frac{2.08126366 \times 16 - 3 \times - - 0.147204057}{16 - (-0.147204057)} = 2.089639211$$

and $f(x_3) = -0.05476$

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4. $x_4 = 2.092739575$
5. $x_5 = 2.09388371$
6. $x_6 = 2.094305452$
7. $x_7 = 2.094460846$

Root is 2.0945

The equation $x^{2.2} = 69$ has a root between 5 and 8. Use the method of regula falsi to determine it.

Let $f(x) = x^{2.2} - 69$. a=5 and b=8. Then, $f(a) = f(5) = -34.50675846$ and $f(b) = f(8) = 28.00586026$.

1. $$x_1 = \frac{5 \times 28.00586026 - 8 \times -34.50675846}{28.00586026 - (-34.50675846)} = 6.655990062$$

   $f(x_1) = -4.275625415$.

2. Root lies between 6.655990062 and 8. $x_2 = 6.83400179$
3. $x_3 = 6.850669653$

Root is 6.85

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Problems

Use the method of regula falsi to obtain a root, correct to three decimal places, of each of the following equations

- $x^3 + x^2 + x + 7 = 0$
- $x^3 - x - 4 = 0$
- $x^3 + x - 1 = 0.$