

Iterasi satu titik + Newton-Raphson + Secant

Bilqis

Perbedaan Akolade dan Terbuka

M. Akolade

1. Konvergen (Jawaban ditemukan) → Karena penerapan metoda berulang kali akan mendekati akar sebenarnya
2. Diketahui 2 titik X_L dan X_U dan jawaban (X_r) berada diantara 2 titik ini

M. Terbuka

1. Kadang divergen (Jawaban tidak ditemukan) → Bergerak menjauhi akar sebenarnya, karena hanya dibutuhkan sebuah harga tunggal dari X
2. Kadang konvergen → Kadang lebih cepat dari metoda akolade

Metoda Terbuka

- Iterasi Satu Titik Sederhana
- M. Newton – Raphson
- M. Secant
- M. Newton - Raphson yang dimodifikasi
- M. Faktorisasi

1. Iterasi Satu Titik Sederhana

- Variabel X , dibawa ke kiri
- Rubah Var X dikiri $\rightarrow X_{i+1}$
- Rubah Var X di kanan $\rightarrow X_i$

Contoh Soal 1

Carilah **akar x** dengan menggunakan **metode iterasi**, jika diketahui

$$f(x) = x^2 + 5x + 6$$

- Mulai dari $x_0 = -1$
- x sebenarnya adalah -2

$$f(x) = x^2 + 5x + 6$$

$$x^2 + 5x + 6 = 0$$

$$-5x = x^2 + 6$$

$$5x = -x^2 - 6$$

$$x = \frac{-x^2 - 6}{5}$$

$$x_{i+1} = \frac{-(x_i)^2 - 6}{5}$$

Iterasi 0: $x_0 = -1$

$$\begin{aligned}\textbf{Iterasi 1: } x_1 &= \frac{-(x_0)^2 - 6}{5} \\ &= \frac{-(-1)^2 - 6}{5} \\ &= -1.4\end{aligned}$$

$$\begin{aligned}E_t &= \left| \frac{-2 - (-1.4)}{-2} \right| \times 100\% \\ &= 30\%\end{aligned}$$

$$\begin{aligned}E_a &= \left| \frac{-1.4 - (-1)}{-1.4} \right| \times 100\% \\ &= 28.57\%\end{aligned}$$

Iterasi 2:

$$\begin{aligned}x_2 &= \frac{-(x_1)^2 - 6}{5} \\&= \frac{-(-1.4)^2 - 6}{5} \\&= \boxed{-1.59}\end{aligned}$$

$$E_t = \left| \frac{-2 - (-1.59)}{-2} \right| \times 100\%$$

$$= \boxed{20.4\%}$$

$$\begin{aligned}E_a &= \left| \frac{-1.59 - (-1.4)}{-1.59} \right| \times 100\% \\&= \boxed{12.06\%}\end{aligned}$$

Iterasi 3:

$$\begin{aligned}x_3 &= \frac{-(x_2)^2 - 6}{5} \\&= \frac{-(-1.59)^2 - 6}{5} \\&= \boxed{-1.71}\end{aligned}$$

$$E_t = \left| \frac{-2 - (-1.71)}{-2} \right| \times 100\%$$

$$= \boxed{14.66\%}$$

$$\begin{aligned}E_a &= \left| \frac{-1.71 - (-1.59)}{-1.71} \right| \times 100\% \\&= \boxed{6.73\%}\end{aligned}$$

Dengan Persamaan yang sama,
kita coba dengan $x_0 = -4$

Iterasi 0: $x_0 = -4$

$$\begin{aligned}\text{Iterasi 1: } x_1 &= \frac{-(x_0)^2 - 6}{5} \\&= \frac{-(-4)^2 - 6}{5} \\&= -4.4\end{aligned}$$

$$\begin{aligned}E_t &= \left| \frac{-2 - (-4.4)}{-2} \right| \times 100\% \\&= 120\%\end{aligned}$$

$$\begin{aligned}E_a &= \left| \frac{-4.4 - (-4)}{-4.4} \right| \times 100\% \\&= 9.09\%\end{aligned}$$

Iterasi 2:

$$\begin{aligned}x_2 &= \frac{-(x_1)^2 - 6}{5} \\&= \frac{-(-4.4)^2 - 6}{5} \\&= \frac{-5.07}{5}\end{aligned}$$

Hasil menjauhi -2, sehingga
kita simpulkan **Difergen**

$$E_t = \left| \frac{-2 - (-5.07)}{-2} \right| \times 100\%$$

$$= 153.6\%$$

$$\begin{aligned}E_a &= \left| \frac{-5.07 - (-4.4)}{-5.07} \right| \times 100\% \\&= 13.25\%\end{aligned}$$

Iterasi 3:

$$\begin{aligned}x_3 &= \frac{-(x_2)^2 - 6}{5} \\&= \frac{-(-5.07)^2 - 6}{5} \\&= \frac{-6.35}{5}\end{aligned}$$

$$E_t = \left| \frac{-2 - (-6.35)}{-2} \right| \times 100\%$$

$$= 217.25\%$$

$$\begin{aligned}E_a &= \left| \frac{-6.35 - (-5.07)}{-6.35} \right| \times 100\% \\&= 20.06\%\end{aligned}$$

Contoh 1.1

$$x^2 + 5x + 6 = 0$$

$$-5x = x^2 + 6$$

$$5x = -x^2 - 6$$

$$x = \frac{-x^2 - 6}{5}$$

$$x_{i+1} = \frac{-(x_i)^2 - 6}{5}$$

$x_0 = -1$:

Iterasi	x_i	$x_{(i+1)}$	E_t (%)	E_a (%)
1	-1.00	-1.40	30.00	28.57
2	-1.40	-1.59	20.40	12.06
3	-1.59	-1.71	14.66	6.73
4	-1.71	-1.78	10.87	4.25
5	-1.78	-1.84	8.22	2.88
6	-1.84	-1.87	6.31	2.04
7	-1.87	-1.90	4.89	1.49
8	-1.90	-1.92	3.81	1.12

$x_0 = -4$:

Iterasi	x_i	$x_{(i+1)}$	E_t (%)	E_a (%)
1	-4.00	-4.40	120.00	9.09
2	-4.40	-5.07	153.60	13.25
3	-5.07	-6.35	217.25	20.06
4	-6.35	-9.25	362.59	31.42
5	-9.25	-18.32	815.98	49.50
6	-18.32	-68.32	3316.05	73.19
7	-68.32	-934.75	46637.59	92.69
8	-934.75	-174753.37	8737568.28	99.47

- Mulai dari $x_0 = -1$ dan $x_0 = -4$
- x sebenarnya adalah -2

Contoh 1.2

$$x^2 + 5x + 6 = 0$$

$$x(x + 5) + 6 = 0$$

$$x(x + 5) = -6$$

$$x = \frac{-6}{(x + 5)}$$

$$x_{i+1} = \frac{-6}{(x_i + 5)}$$

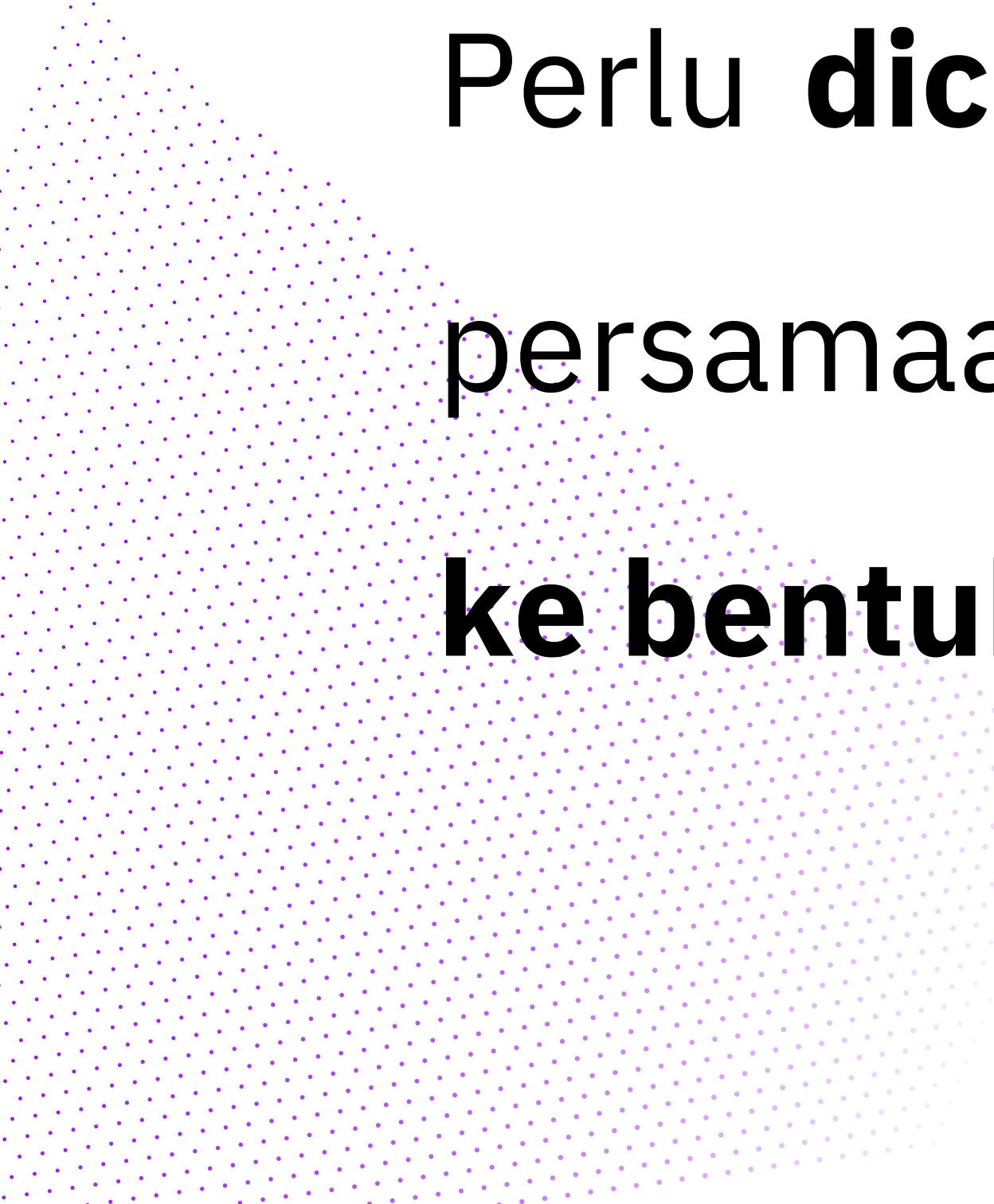
$x_0 = -1$:

$x_0 = -4$:

Iterasi	x_i	$x_{(i+1)}$	E_t (%)	E_a (%)
1	-1.00	-1.50	25.00	33.33
2	-1.50	-1.71	14.29	12.50
3	-1.71	-1.83	8.70	6.12
4	-1.83	-1.89	5.48	3.40
5	-1.89	-1.93	3.52	2.03
6	-1.93	-1.95	2.30	1.26
7	-1.95	-1.97	1.51	0.80
8	-1.97	-1.98	0.99	0.52

Iterasi	x_i	$x_{(i+1)}$	E_t (%)	E_a (%)
1	-4.00	-6.00	200.00	33.33
2	-6.00	6.00	400.00	200.00
3	6.00	-0.55	72.73	1200.00
4	-0.55	-1.35	32.65	59.50
5	-1.35	-1.64	17.88	17.99
6	-1.64	-1.79	10.65	8.09
7	-1.79	-1.87	6.63	4.31
8	-1.87	-1.92	4.23	2.50

- Mulai dari $x_0 = -1$ dan $x_0 = -4$
- x sebenarnya adalah -2



**Perlu dicoba-coba saat merubah
persamaan jika salah, coba rubah
ke bentuk yang lain**

Contoh Soal 2

Carilah akar x , dengan menggunakan **Metoda Iterasi 1 Titik** dengan memindah dan mengurai variabel x^3 menjadi $x(10x^2\dots)$

$$f(x) = 10x^3 - 220x^2 - 630x - 3600$$

- Mulai dari $x_0 = -4$
- x sebenarnya adalah 3

$$f(x) = 10x^3 - 220x^2 - 630x - 3600$$

$$10x^3 - 220x^2 - 630x - 3600 = 0$$

$$x(10x^2 - 220x - 630) - 3600 = 0$$

$$x = \frac{3600}{(10x^2 - 220x - 630)}$$

$$x_{i+1} = \frac{3600}{(10(x_i)^2 - 220x_i - 630)}$$

Iterasi 0: $x_0 = -4$

Iterasi 1:

$$x_2 = \frac{3600}{(10(x_1)^2 - 220x_1 - 630)}$$

$$x_2 = \frac{3600}{(10(-4)^2 - 220(-4) - 630)}$$

$$= 8.78$$

$$E_t = \left| \frac{3 - 8.78}{3} \right| \times 100\% \\ = 192.68\%$$

$$E_a = \left| \frac{8.78 - (-4)}{8.78} \right| \times 100\% \\ = 145.56\%$$

Iterasi 2:

$$x_3 = \frac{3600}{(10(x_2)^2 - 220x_2 - 630)}$$

$$\begin{aligned}x_3 &= \frac{3600}{(10(8.78)^2 - 220(8.78) - 630)} \\&= -2.01\end{aligned}$$

$$\begin{aligned}E_t &= \left| \frac{3 - (-2.01)}{3} \right| \times 100\% \\&= 167.01\%\end{aligned}$$

$$\begin{aligned}E_a &= \left| \frac{-2.01 - 8.78}{-2.01} \right| \times 100\% \\&= 536.77\%\end{aligned}$$

Iterasi 3:

$$x_4 = \frac{3600}{(10(x_3)^2 - 220x_3 - 630)}$$

$$\begin{aligned}x_4 &= \frac{3600}{(10(-2.01)^2 - 220(-2.01) - 630)} \\&= -24.44\end{aligned}$$

$$\begin{aligned}E_t &= \left| \frac{3 - (-24.44)}{3} \right| \times 100\% \\&= 914.61\%\end{aligned}$$

$$\begin{aligned}E_a &= \left| \frac{-24.44 - (-2.01)}{-24.44} \right| \times 100\% \\&= 91.77\%\end{aligned}$$

2. Metoda Newton - Raphson

- Metode ini adalah metode yang **paling sering digunakan**
- **Formula:**

$$x_{i+1} = x_i - \frac{f(x)}{f'(x)}$$

Contoh Soal 1A

Diketahui :

$$f(x) = x^3 + 10x^2 - 7x + 196$$

Nilai x sebenarnya = 4

Cari akar x dengan menggunakan metoda **Newton-Raphson**,

- Nilai $x_0 = -5$

Note:

- Tiap iterasi cari E_t dan E_a
- Ketelitian 2 angka dibelakang koma
- Cari dari iterasi 1 sampai iterasi 3
- Tuliskan rumusnya terlebih dahulu

$$f(x) = x^3 + 10x^2 - 7x + 196$$

$$f'(x) = 3x^2 + 20x - 7$$

$$x_{i+1} = x_i - \frac{f(x)}{f'(x)}$$

Iterasi 1:

$$x_0 = -5$$

$$f(x_0) = -36$$

$$f'(x_0) = -32$$

$$x_1 = x_0 - \frac{f(x_0)}{f'(x_0)} = -5 - \frac{-36}{-32}$$

$$= \textcircled{-6.13}$$

$$E_t = \left| \frac{5 - (-6.13)}{5} \right| \times 100\%$$

$$= \textcircled{253.25\%}$$

$$E_a = \left| \frac{-6.13 - (-5)}{-6.13} \right| \times 100\%$$

$$= \textcircled{18.43\%}$$

Iterasi 2:

$$x_1 = -6.13$$

$$f(x_1) = -7.67$$

$$f'(x_1) = -16.87$$

$$x_2 = x_1 - \frac{f(x_1)}{f'(x_1)} = -6.13 - \frac{-7.67}{-16.87}$$

$$= \textcircled{-6.58}$$

$$E_t = \left| \frac{5 - (-6.58)}{5} \right| \times 100\%$$

$$= \textcircled{264.5\%}$$

$$E_a = \left| \frac{-6.58 - (-6.13)}{-6.58} \right| \times 100\%$$

$$= \textcircled{6.84\%}$$

Iterasi 3:

$$x_2 = -6.58$$

$$f(x_2) = -1.87$$

$$f'(x_2) = -8.71$$

$$x_3 = x_2 - \frac{f(x_2)}{f'(x_2)} = -6.58 - \frac{-1.87}{-8.71}$$

$$= -6.79$$

Walaupun **Divergen** (karena menuju $x = -7$), namun sebenarnya

-7 juga merupakan akar-akar dari persamaan pada soal

$$E_t = \left| \frac{5 - (-6.79)}{5} \right| \times 100\%$$

$$= 269.75\%$$

$$E_a = \left| \frac{-6.79 - (-6.58)}{-6.79} \right| \times 100\%$$

$$= 3.09\%$$

Contoh Soal 1B

Diketahui:

$$f(x) = 15x^2 + 15x - 90$$

Nilai x sebenarnya = -3

Cari **akar** x dengan menggunakan metoda **Newton-Raphson**,

- Nilai $x_0 = -5$

Note:

- Tiap iterasi cari E_t dan E_a
- Ketelitian 2 angka dibelakang koma
- Cari dari iterasi 1 sampai iterasi 3
- Tuliskan rumusnya terlebih dahulu

$$f(x) = 15x^2 + 15x - 90$$

$$f'(x) = 30x + 15$$

Iterasi 1:

$$x_0 = -5$$

$$f(x_0) = 210$$

$$f'(x_0) = -135$$

$$x_1 = x_0 - \frac{f(x_0)}{f'(x_0)} = -5 - \frac{210}{-135}$$

$$= -3.44$$

$$E_t = \left| \frac{-3 - (-3.44)}{-3} \right| \times 100\%$$

$$= 14.67\%$$

$$E_a = \left| \frac{-3.44 - (-3)}{-3.44} \right| \times 100\%$$

$$= 45.35\%$$

$$x_{i+1} = x_i - \frac{f(x)}{f'(x)}$$

Iterasi 2:

$$x_1 = -3.44$$

$$f(x_1) = 35.9$$

$$f'(x_1) = -88.2$$

$$x_2 = x_1 - \frac{f(x_1)}{f'(x_1)} = -3.44 - \frac{35.9}{-88.2}$$

$$= -3.03$$

$$E_t = \left| \frac{-3 - (-3.03)}{-3} \right| \times 100\%$$

$$= 1\%$$

$$E_a = \left| \frac{-3.03 - (-3.44)}{-3.03} \right| \times 100\%$$

$$= 13.53\%$$

Iterasi 3:

$$x_2 = -3.03$$

$$f(x_2) = 2.26$$

$$f'(x_2) = -75.9$$

$$x_3 = x_2 - \frac{f(x_2)}{f'(x_2)} = -3.03 - \frac{2.26}{-75.9}$$

$$= -3$$



Konvergen menuju nilai x sebenarnya

$$E_t = \left| \frac{-3 - (-3)}{-3} \right| \times 100\%$$

$$= 0\%$$

$$E_a = \left| \frac{-3 - (-3.03)}{-3} \right| \times 100\%$$

$$= 1\%$$

3. Metoda Secant

- Metode ini mirip dengan **metode Posisi Salah**, karena kita harus mengetahui 2 titik
- Metode ini adalah modifikasi dari metode **Newton-Raphson**, jika suli untuk mencari turunan maka gunakan pendekatan

$$f'(x) \approx \frac{f(x_{i-1}) - f(x_i)}{x_{i-1} - x_i}$$

- **Formula:**

$$x_{i+1} = x_i - \frac{f(x_i)(x_{i-1} - x_i)}{f(x_{i-1}) - f(x_i)}$$

3. Metoda Secant

Metode Secant perlu 2 nilai awal x . Tetapi karena $f(x)$ tidak membutuhkan perubahan tanda di antara batas-batas intervalnya, maka metode ini tidak digolongkan ke dalam kelompok metode Akolade.

Contoh Soal 1

Diketahui :

$$f(x) = x^3 + 10x^2 - 7x + 196$$

Nilai x sebenarnya = 4

Cari akar x dengan menggunakan metoda **Newton-Raphson**,

- Nilai $x_0 = -5$ dan $x_1 = 8$

Note:

- Tiap iterasi cari E_t dan E_a
- Ketelitian 2 angka dibelakang koma
- Cari dari iterasi 1 sampai iterasi 3
- Tuliskan rumusnya terlebih dahulu

$$f(x) = x^3 + 10x^2 - 7x + 196$$

Iterasi 1:

$$x_0 = -5, \quad f(x_0) = -36$$

$$x_1 = 8, \quad f(x_1) = 900$$

$$\begin{aligned} x_2 &= x_1 - \frac{f(x_1)(x_0 - x_1)}{f(x_0) - f(x_1)} \\ &= -8 - \frac{(900)(-5 - 8)}{-36 - 900} = \textcircled{-4.5} \end{aligned}$$

$$\begin{aligned} E_t &= \left| \frac{4 - (-4.5)}{4} \right| \times 100\% \\ &= \textcircled{212.5\%} \end{aligned}$$

$$\begin{aligned} E_a &= \left| \frac{-4.5 - 8}{-4.5} \right| \times 100\% \\ &= \textcircled{277.78\%} \end{aligned}$$

$$x_{i+1} = x_i - \frac{f(x_i)(x_{i-1} - x_i)}{f(x_{i-1}) - f(x_i)}$$

Iterasi 2:

$$x_1 = 8, \quad f(x_1) = 900$$

$$x_2 = -4.5, \quad f(x_2) = -53.13$$

$$\begin{aligned} x_3 &= x_2 - \frac{f(x_2)(x_1 - x_2)}{f(x_1) - f(x_2)} \\ &= -4.5 - \frac{(-53.13)(8 - (-4.5))}{900 - (-53.13)} = \textcircled{-3.8} \end{aligned}$$

$$\begin{aligned} E_t &= \left| \frac{4 - (-3.8)}{4} \right| \times 100\% \\ &= \textcircled{195\%} \end{aligned}$$

$$\begin{aligned} E_a &= \left| \frac{-3.8 - (-4.5)}{-3.8} \right| \times 100\% \\ &= \textcircled{18.42\%} \end{aligned}$$

Iterasi 3:

$$x_2 = -4.5, \quad f(x_2) = -53.13$$

$$x_3 = -3.8, \quad f(x_3) = -79.87$$

$$\begin{aligned}x_4 &= x_3 - \frac{f(x_3)(x_2 - x_3)}{f(x_2) - f(x_3)} \\&= -3.8 - \frac{(-79.87)(-4.5 - (-3.8))}{-53.13 - (-79.87)} = -5.89\end{aligned}$$

$$\begin{aligned}E_t &= \left| \frac{4 - (-5.89)}{4} \right| \times 100\% \\&= 247.25\%\end{aligned}$$

$$\begin{aligned}E_a &= \left| \frac{-5.89 - (-3.8)}{-5.89} \right| \times 100\% \\&= 35.48\%\end{aligned}$$

Contoh Soal 2

Diketahui:

$$f(x) = 15x^2 + 15x - 90$$

Nilai x sebenarnya = -3

Cari **akar** x dengan menggunakan metoda **Secant**,

- Nilai $x_0 = -5$ dan $x_1 = 1$

Note:

- Tiap iterasi cari E_t dan E_a
- Ketelitian 2 angka dibelakang koma
- Cari dari iterasi 1 sampai iterasi 3
- Tuliskan rumusnya terlebih dahulu

$$f(x) = 15x^2 + 15x - 90$$

$$x_{i+1} = x_i - \frac{f(x_i)(x_{i-1} - x_i)}{f(x_{i-1}) - f(x_i)}$$

Iterasi 1: $x_0 = -5, f(x_0) = 210$

$$x_1 = 1, f(x_1) = -60$$

$$\begin{aligned}x_2 &= x_1 - \frac{f(x_1)(x_0 - x_1)}{f(x_0) - f(x_1)} \\&= 1 - \frac{(-60)(-5 - 1)}{210 - (-60)} = \textcolor{red}{-0.33}\end{aligned}$$

$$\begin{aligned}E_t &= \left| \frac{-3 - (-0.33)}{-3} \right| \times 100\% \\&= \textcolor{red}{89\%}\end{aligned}$$

$$\begin{aligned}E_a &= \left| \frac{-0.33 - 1}{-0.33} \right| \times 100\% \\&= \textcolor{red}{403.03\%}\end{aligned}$$

Iterasi 2:

$$x_1 = 1, \quad f(x_1) = -60$$

$$x_2 = -0.33, \quad f(x_2) = -93.32$$

$$\begin{aligned} x_3 &= x_2 - \frac{f(x_2)(x_1 - x_2)}{f(x_1) - f(x_2)} \\ &= -0.33 - \frac{(-93.32)(1 - (-0.33))}{-60 - (-93.32)} = 3.39 \end{aligned}$$

$$\begin{aligned} E_t &= \left| \frac{-3 - (3.39)}{-3} \right| \times 100\% \\ &= 213\% \end{aligned}$$

$$\begin{aligned} E_a &= \left| \frac{3.39 - (-0.33)}{3.39} \right| \times 100\% \\ &= 109.73\% \end{aligned}$$

Iterasi 3:

$$x_2 = -0.33, \quad f(x_2) = -93.32$$

$$x_3 = 3.39, \quad f(x_3) = 133.23$$

$$\begin{aligned} x_4 &= x_3 - \frac{f(x_3)(x_2 - x_3)}{f(x_2) - f(x_3)} \\ &= 3.39 - \frac{(133.23)(-0.33 - 3.39)}{-93.32 - (133.23)} = 1.2 \end{aligned}$$

$$\begin{aligned} E_t &= \left| \frac{-3 - 1.2}{-3} \right| \times 100\% \\ &= 140\% \end{aligned}$$

$$\begin{aligned} E_a &= \left| \frac{1.2 - 3.39}{1.2} \right| \times 100\% \\ &= 182.5\% \end{aligned}$$

Contoh Soal 3

**Carilah akar X, dengan menggunakan
Metoda Secant.**

Diketahui:

- $f(x) = x^3 + 6x^2 - 19x - 84$
- $x_0 = -4$
- $x_1 = 3$
- Nilai x sebenarnya = -3

$$f(x) = x^3 + 6x^2 - 19x - 84$$

$$x_{i+1} = x_i - \frac{f(x_i)(x_{i-1} - x_i)}{f(x_{i-1}) - f(x_i)}$$

Iterasi 1: $x_0 = -4, f(x_0) = 24$

$$x_1 = 3, f(x_1) = -60$$

$$\begin{aligned} x_2 &= x_1 - \frac{f(x_1)(x_0 - x_1)}{f(x_0) - f(x_1)} \\ &= 3 - \frac{(-60)(-4 - 3)}{24 - (-60)} = \textcircled{-2} \end{aligned}$$

$$\begin{aligned} E_t &= \left| \frac{-3 - (-2)}{-3} \right| \times 100\% \\ &= \textcircled{33.33\%} \end{aligned}$$

$$\begin{aligned} E_a &= \left| \frac{-2 - 3}{-2} \right| \times 100\% \\ &= \textcircled{250\%} \end{aligned}$$

Iterasi 2: $x_1 = 3, f(x_1) = -60$

$$x_2 = -2, f(x_2) = -30$$

$$\begin{aligned} x_3 &= x_2 - \frac{f(x_2)(x_1 - x_2)}{f(x_1) - f(x_2)} \\ &= -2 - \frac{(-30)(3 - (-2))}{-60 - (-30)} = \textcircled{-7} \end{aligned}$$

$$\begin{aligned} E_t &= \left| \frac{-3 - (-7)}{-3} \right| \times 100\% \\ &= \textcircled{133.33\%} \end{aligned}$$

$$\begin{aligned} E_a &= \left| \frac{-7 - (-2)}{-7} \right| \times 100\% \\ &= \textcircled{71.43\%} \end{aligned}$$

Iterasi 3:

$$x_2 = -2, \quad f(x_2) = -30$$

$$x_3 = -7, \quad f(x_3) = 0$$

$$\begin{aligned} x_4 &= x_3 - \frac{f(x_3)(x_2 - x_3)}{f(x_2) - f(x_3)} \\ &= -7 - \frac{(0)(-2 - (-7))}{-30 - (0)} = -7 \end{aligned}$$

$$\begin{aligned} E_t &= \left| \frac{-3 - (-7)}{-3} \right| \times 100\% \\ &= 133.33\% \end{aligned}$$

$$\begin{aligned} E_a &= \left| \frac{-7 - (-7)}{-7} \right| \times 100\% \\ &= 0\% \end{aligned}$$

Walaupun **Divergen**, namun sebenarnya -7 juga merupakan akar-akar dari persamaan pada soal karena ketika $x_3 = -7$ menghasilkan $f(x_3) = 0$

**Carilah akar X, dengan menggunakan
Metoda Secant.**

Diketahui:

- $f(x) = x^3 + 6x^2 - 19x - 84$
- $x_0 = -1$
- $x_1 = 8$
- Nilai x sebenarnya = 4

Soal 1

$$f(x) = x^3 + 6x^2 - 19x - 84 \quad x_{i+1} = x_i - \frac{f(x_i)(x_{i-1} - x_i)}{f(x_{i-1}) - f(x_i)}$$

Iterasi 1: $x_0 = -1, \quad f(x_0) = -60$

$$x_1 = 8, \quad f(x_1) = 660$$

$$\begin{aligned} x_2 &= x_1 - \frac{f(x_1)(x_0 - x_1)}{f(x_0) - f(x_1)} \\ &= 8 - \frac{(660)(-1 - 8)}{-60 - 660} = -0.25 \end{aligned}$$

$$\begin{aligned} E_t &= \left| \frac{4 - (-0.25)}{4} \right| \times 100\% \\ &= 106.25\% \end{aligned}$$

$$\begin{aligned} E_a &= \left| \frac{-0.25 - 8}{-0.25} \right| \times 100\% \\ &= 3300\% \end{aligned}$$

Pertemuan 3
Komputasi Numerik

Iterasi 2:

$$x_1 = 8, \quad f(x_1) = 660$$

$$x_2 = -0.25, \quad f(x_2) = -78.89$$

$$\begin{aligned} x_3 &= x_2 - \frac{f(x_2)(x_1 - x_2)}{f(x_1) - f(x_2)} \\ &= -0.25 - \frac{(-78.89)(8 - (-0.25))}{660 - (-78.89)} = 0.63 \end{aligned}$$

$$\begin{aligned} E_t &= \left| \frac{4 - 0.63}{4} \right| \times 100\% \\ &= 84.25\% \end{aligned}$$

$$\begin{aligned} E_a &= \left| \frac{0.63 - (-0.25)}{0.63} \right| \times 100\% \\ &= 139.68\% \end{aligned}$$

Iterasi 2:

$$x_2 = -0.25, \quad f(x_2) = -78.89$$

$$x_3 = 0.63, \quad f(x_3) = -93.34$$

$$\begin{aligned} x_4 &= x_3 - \frac{f(x_3)(x_2 - x_3)}{f(x_2) - f(x_3)} \\ &= 0.63 - \frac{(-93.34)(-0.25 - 0.63)}{-78.89 - (-93.34)} = -5.05 \end{aligned}$$

$$\begin{aligned} E_t &= \left| \frac{4 - (-5.05)}{4} \right| \times 100\% \\ &= 226.25\% \end{aligned}$$

$$\begin{aligned} E_a &= \left| \frac{-5.05 - 0.63}{-5.05} \right| \times 100\% \\ &= 112.48\% \end{aligned}$$

Perbedaan antara metoda secant dan posisi salah

- Metode **Secant**, dapat bernilai **Konvergen** atau **Divergen**
- Metode **Posisi Salah**, bernilai **Konvergen**
- Metode **Posisi Salah**

Iterasi	x_l	x_u	x_r
1	0.5	5	1.85
2	0.5	1.85	1.21
3	0.5	1.21	1.06

Semakin banyak iterasi, semakin mendekati $x = 1$ (**Konvergen**)

Perbedaan antara metoda secant dan posisi salah

- Metode **Secant**

Iterasi	x_{i-1}	x_i	x_{i+1}
1	0.5	5	1.85
2	5	1.85	-0.12

Pendekatan dengan metode Secant menghasilkan nilai yang **Divergen**, $\ln(-0.12) \rightarrow \text{Error}$

Metode Secant

$$x_{i+1} = x_i - \frac{f(x_i)(x_{i-1} - x_i)}{f(x_{i-1}) - f(x_i)}$$

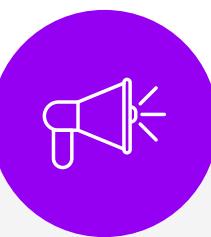
Metode Iterasi

- Variabel X, dibawa ke kiri
- Rubah Var X dikiri $\rightarrow x_{i+1}$
- Rubah Var X di kanan $\rightarrow x_i$

Metode Newton-Raphson

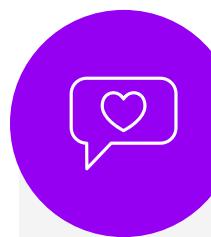
$$x_{i+1} = x_i - \frac{f(x)}{f'(x)}$$

Tugas Kelompok



- **Buatlah Contoh Soal Sendiri, boleh mengarang atau mengambil dari internet:**

1. Iterasi satu titik
2. Newton-Raphson
3. Secant



- **Bentuk file --> PPT + nama kelompok dan anggota**
- **Kumpulkan pada link yang disediakan asisten**
- **Presentasi di depan kelas secara random (3 kelompok)**



Ditanya :

- **Tiap iterasi cari E_t dan E_a**
- **Ketelitian 2 angka dibelakang koma**
- **Cari dari iterasi 1 sampai iterasi 3**
- **Tuliskan rumusnya terlebih dahulu**

Terima Kasih