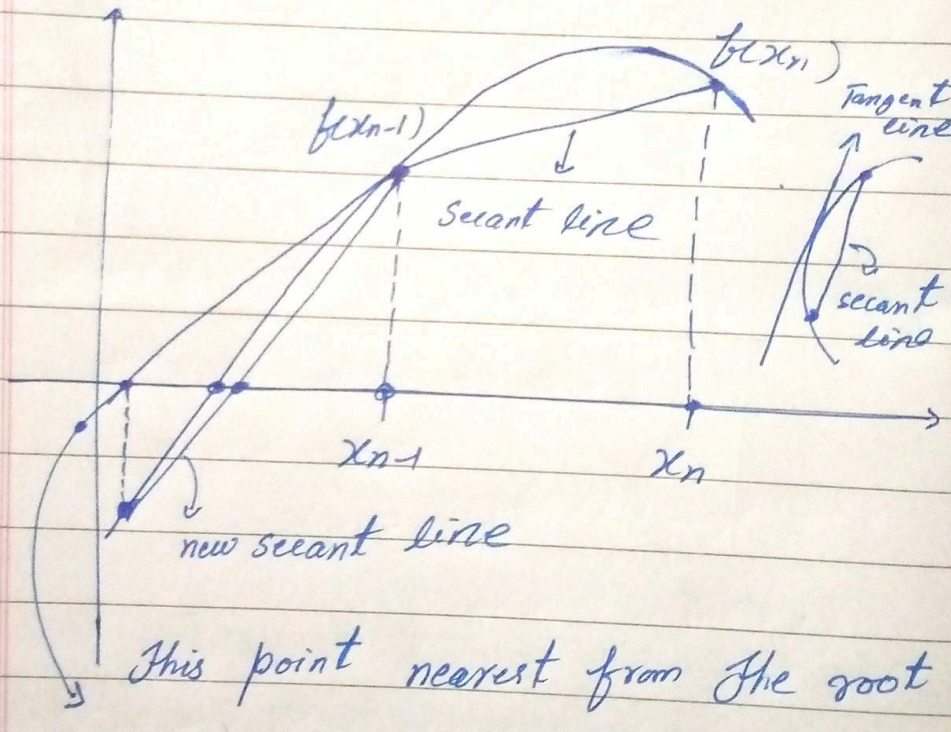
MTH603 Lec# 7 Date:

Secant Method :-

By Newton Rephson Method

Formula.

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$$



This point nearest from the root

slope of ℓ Secant line.

$$f'(x_n) = \frac{y_2 - y_1}{x_2 - x_1}$$

slope formula b/w two points

$$f'(x) = \frac{f(x_n) - f(x_{n-1})}{x_n - x_{n-1}}$$

New Secant formula :-

$$x_{n+1} = \frac{x_{n-1} f(x_n) - x_n f(x_{n-1})}{f(x_n) - f(x_{n-1})}$$

Example :- Use Secant method to find root to 4D places of the Equation

$$\sin x = 5x - 2$$

Sol:

$$\sin x - 5x + 2 = 0$$

$$f(x) = \sin x - 5x + 2$$

(By Hit & trail method)

$$f(0) = \sin(0) - 5(0) + 2 = 2 > 0$$

$$f(0.5) = \sin(0.5) - 5(0.5) + 2 = -0.0206 < 0$$

so root lies b/w 0 & 0.5

Now

$$f(0.3) = \sin(0.3) - 5(0.3) + 2$$

$$= 0.7955 > 0$$

$$f(0.5) = \sin(0.5) - 5(0.5) + 2 = -0.0206 < 0$$

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So root lies b/w 0.3 & 0.5

Let $x_0 = 0.3$, $x_1 = 0.5$

Using formula Secant'

$n = 0, 1, 2, 3, \dots$

$n=1$

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

$$x_2 = \frac{(0.3)(-0.0206) - (0.5)(0.7955)}{(-0.0206) - (0.7955)}$$

$$x_2 = 0.4950$$

$$f(x_2) = \sin(0.4950) - 5(0.4950) + 2$$

$$f(x_2) = 0.0002$$

$n = 2$

$$x_3 = \frac{x_1 f(x_2) - x_2 f(x_1)}{f(x_2) - f(x_1)}$$

$$x_3 = \frac{(0.5)(0.0002) - (0.4950)(-0.0206)}{0.0002 + 0.0206}$$

$$x_3 = \frac{0.0103}{0.0208} = 0.4951$$

$$f(x_3) = -0.0008$$

So, approximate root is 0.4951

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Q:- Use Secant method to evaluate to 4D places the root of Equation

$$e^x - 3x = 0$$

Sol! $f(x) = e^x - 3x$

$f(0) = e^0 - 3(0) = 1 > 0$

$f(0.5) = e^{0.5} - 3(0.5) = 0.148720$

$f(1) = e^1 - 3(1) = -0.2817 < 0$

root lies b/w 0.5 & 1

Using Secant formula :-

$$x_{n+1} = \frac{x_{n-1} f(x_n) - x_n f(x_{n-1})}{f(x_n) - f(x_{n-1})}$$

let

$$x_0 = 0.5 \;,\; x_1 = 1$$

$n = 0, 1, 2, 3, 4, 5, - - - - - -$

$n = 1,$ $$x_2 = \frac{x_0 f(x_1) - x_1 f(x_0)}{f(x_1) - f(x_0)}$$

$$x_2 = \frac{(0.5)(-0.2817) - (1)(0.1487)}{-0.2817 - 0.1487}$$

$$x_2 = 0.6727$$

$$f(x_2) = e^{0.6727} - 3(0.6727)$$

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$f(x_2) = -0.0586$

$n = 2$

$$x_3 = \frac{x_1 f(x_2) - x_2 f(x_1)}{f(x_2) - f(x_1)}$$

$$x_3 = \frac{(1)(-0.0886) - (0.6727)(0.2817)}{-0.0586 + 0.2817}$$

$x_3 = 0.5867, \quad f(x_3) = 0.0379$

$n = 3$

$$x_4 = \frac{x_2 f(x_3) - x_3 f(x_2)}{f(x_3) - f(x_2)}$$

$$x_4 = \frac{(0.6727)(0.0379) - (0.5867)(-0.0586)}{0.0379 + 0.586}$$

$$x_4 = \frac{0.0599}{0.0379 + 0.586} = 0.6205$$

$x_4 = 0.6205$

$f(x_4) = -0.0016$

$n = 4$

$$x_5 = \frac{x_3 f(x_4) - x_4 f(x_3)}{f(x_4) - f(x_3)}$$

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$$x_5 = \frac{0.5867(-0.0016) - 0.6205(0.0379)}{-0.0016 - 0.0379}$$

$x_5 = 0.6191$, $f(x_5) = -0.0001$

So, approximate root is 0.6191