OMEGA ACADEMY, NUMERICAL METHODS COURSE.

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Numerical Methods

Universidad de San Buenaventura Cali

2014

Guide numerical methods.
Multimedia Engineering and Systems Engineering

UNIT SEVEN

Secant method

To find the zeros of a function iteratively, this method uses Newton-Raphson formula but prevents derivative calculation using the following approach:

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

Image 1: formula approach used in the secant method

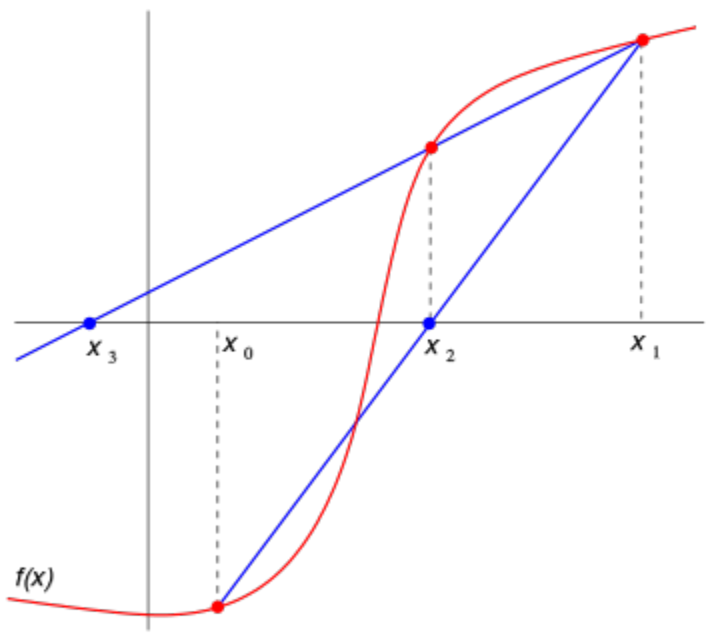

Image 2: Graph of the secant.

Replacing the Newton-Raphson formula, we obtain:

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

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

Image 3: replacing values

What is the formula of secant method? The formula calculates Xi + 1, which means it takes the previous two Xi.

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

Image 3: formula used for solving the function formula through the secant

Example:

Function F (x) = x ^ 3 + 2 = 2 points x_0, x_1 = 4, where x_0 and x_1 be replaced in the function must

Then F (x_0) = 10, and F (x 1) = 66 is substituted into the formula to calculate x_2 secant

First iteration:

$$F(x_0) = 2^3 + 2 = 10$$

$$F(\ x_1) = 4^3 + 2 = 66$$

$$x_2 = \ 4 - 2{,}3571$$

$$x_2 = 1{,}6429$$

Second iteration:

The value of x_2 is replaced in order to find original function f (x2)

$$f(x_2) = (1.6429)^2 + 2 = 6.434$$

The new intervals or starting points are:

$$x_1 = 4 \qquad f(x_{1)} = 66$$

$$x_2 = 1.6429 \qquad f(x_2) = 6.434$$

A value for x_3 is found through the proposed formula.

$$x_3 = x_2 - [\frac{F(x_2) * (x_1 - x_2)}{F(x_1) - F(x_2)}]$$

$$x_3 = 1.6 - \frac{6.4 * (4 - 1.6)}{66 - 6.4} = 1.342$$

Is obtained as the value of x_3, 1342

$$x_2 = 1.6429 \qquad f(x_{2)} = 6.434$$

$$x_3 = 1.342 \qquad f(x_3) = 268.3$$

To be more precise we can perform more iterations using the same procedure.

Now the relative error is calculated.

- First error relative.

$$Er1 = \frac{|x2 - x1|}{x2}$$

$$Er1 = \frac{|1.6 - 4|}{1.6} = 1.5$$

- Second relative error

$$Er2 = \frac{|x3 - x2|}{x3}$$

$$Er1 = \frac{|1.3 - 1.6|}{1.3} = -0.2$$