

Programming Assignment 1: Nonlinear Equations

1. Write a computer program for finding a root of the non-linear equation, $f(x) = 0$, using the following methods:
 - a. Bisection
 - b. False-position
 - c. Fixed-Point
 - d. Newton-Raphson
 - e. Secant

The program should have the facility for providing the following input – (i) non-linear equation, (ii) option to choose one of the five methods mentioned above [for Fixed-Point method, also providing the $\phi(x)$; for Newton-Raphson method, also providing the $f'(x)$], (iii) starting values, and (iv) stopping criteria in form of maximum iterations and maximum relative approximate error (in %).

It should provide as an output (i) Plot of $f(x)$ vs x , (ii) Plot of relative approximate error vs iteration number, and (iii) Roots of the equation.

Test functions:

(1) $f(x) = x - \cos x$

Use the initial bracket as (0,1) or the initial guess as 0; maximum iterations 50; and maximum $\epsilon_r = 0.01\%$. For Fixed-Point method, use $\phi(x) = \cos x$.

(2) $f(x) = \exp(-x) - x = 0$

Use the initial bracket as (0,1) or the initial guess as 0; maximum iterations 50; and maximum $\epsilon_r = 0.05\%$. For Fixed-Point method, use $\phi(x) = \exp(-x)$.

2. Write a computer program for finding roots of a polynomial $f(x)$ using the following methods: (a) Muller (b) Bairstow

The program should have the facility for providing the following input – (i) polynomial, (ii) option to choose one of the two methods, (iii) starting values, and (iv) stopping criteria in form of maximum iterations and maximum relative approximate error (in %).

It should provide as an output (i) Plot $f(x)$ vs x and (ii) Roots of the equation.

Test polynomial:

$$f(x) = x^4 - 7.4x^3 + 20.44x^2 - 24.184x + 9.6448 = 0$$

Muller method: Start with $(-1,0,1)$ and then $(0,1,2)$

Bairstow method: Start with $(\alpha_0 = -5, \alpha_1 = 4)$ and then $(\alpha_0 = -2, \alpha_1 = 2)$

Maximum iteration: 50

Maximum relative approximate error: 0.01%

Due date: Friday, September 1, 2017, 11:59 pm

Submit a single zip folder in the Brihaspati server under Assignment1. The name of the zip-folder should be your roll-number (e.g., If your roll no. is 123456, the folder name should be '123456.zip'). The folder should include -

- (i) All the computer program file(s)
 - (ii) A PDF file of the plots and the solution of the test cases (given in the assignment).
- Comment on the convergence and stability of different methods.