Institute of Information Technology

Subject : Numerical Techniques Laboratory

Exp. No.-2

Name of the Exp.: Solution of Nonlinear Equation by Numerical Method: Method of False Position

Introduction:

In scientific and engineering work, a frequently occurring problem is to find the roots of equations of the form $y = f(x) = 0$, i.e finding the value of x where the value of $y = f(x)$ is equal to 0. In quadratic, cubic or a biquadratic equations, algebraic formulae are available for expressing the roots in terms of co-efficient. But in the case, where f(x) is a polynomial of higher degree or an expression involving transcendental functions, the algebraic methods are not applicable and the help of numerical method must be taken to find approximate roots.

Objective of the Experiment:

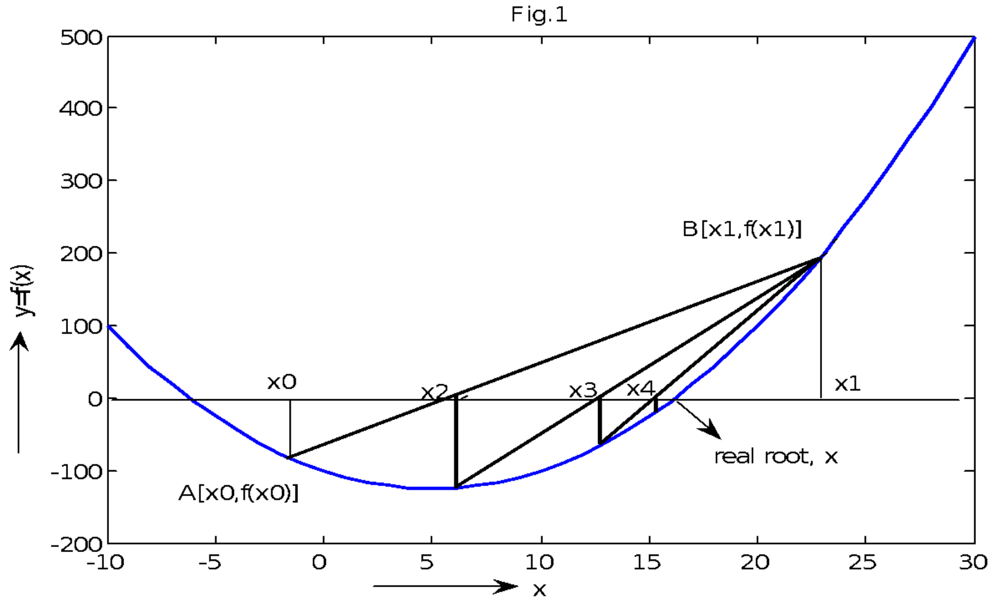
- To write a program in order to find out the roots of a nonlinear equation by the method of False Position..

Theory:

Method of False Position is the oldest method for finding the real root of an equation, and closely resembles the bisection method. In this method, we choose two points x_0 and x_1 such that $f(x_0)$ and $f(x_1)$ are of opposite signs. Since the graph of $y = f(x)$ crosses the $x-$ axis between these two points, a root must lie in between these points. Now, the equation of the chord joining the two points, A $[x_0, f(x_0)]$ and B $[x_1, f(x_1)]$ is:

$$\frac{y - f(x_0)}{x - x_0} = \frac{f(x_1) - f(x_0)}{x_1 - x_0} \qquad ----(1)$$

Fig.1



The method consists in replacing the part of the curve between the points A $[x_0, f(x_0)]$ and B $[x_1, f(x_1)]$ by means of the chord joining these points, and taking the point of intersection of the chord with the $x-$ axis as an approximation to the root . The point of intersection in the present case is given by putting $y = 0$ in (1).Thus, we obtain

$$x = x_0 - \frac{f(x_0)}{f(x_1) - f(x_0)}(x_1 - x_0) -----(2)$$

Hence the second approximation to the root of $f(x) = 0$ is given by

$$x_2 = x_0 - \frac{f(x_0)}{f(x_1) - f(x_0)}(x_1 - x_0) -----(3)$$

[Fig.-1]

If now $f(x_2)$ and $f(x_0)$ are of opposite signs, then the root lies between x_0 and x_2 ,and we replace x_1 by x_2 in (3), and obtain the next approximation. Otherwise, we replace x_0 by x_2 and generate the next approximation. The Procedure is repeated till the root is obtained to the desired accuracy. Fig.-1 gives a graphical representation of the method.

Accuracy Level: to correct a result upto N decimal point the the difference between (n+1)th result and nth result will be $0.5X10^{-N}$.

Problems/Reports:

1. Write programs to find the real root of the following equations by the Method of False Position:

   a) $f(x) = x^3 - 2x - 5 = 0$ correct to 5decimal point, between x=2 and x=3.

   b) $x\sin x + \cos x = 0$; correct to 5decimal point, between x=1 and x=2

   c) $x = e^{-x}$ correct to 5decimal point, between x=0 and x=1

2) Find out the number of iteration of 1(a). Now increase the accuracy level to 8 decimal point and then find the number of iteration.
3) Find out the real root of 1(a),(b), (c) correct to 3 decimal point by hand calculation and make a chart of x2 and fx2 in each iteration.
4) Write a program to solve 1 (a) using POLYVAL function
5)Comment on the results of your programs.

Matlab Function used in programs

1) **If**
end

IF Conditionally execute statements.
The general form of the IF statement is

```
IF expression
  statements
ELSEIF expression
  statements
ELSE
  statements
END
```

2) for
end

FOR Repeat statements a specific number of times.
The general form of a FOR statement is:

```
FOR I = 1:1:N,
      FOR J = 1:1:N,
        A(I,J) = 1/(I+J-1);
      END
    END
```

3) break
BREAK Terminate execution of WHILE or FOR loop.

4) **polyval(P,X)**
POLYVAL Evaluate polynomial.
Y = POLYVAL(P,X), when P is a vector of length N+1 whose elements are the coefficients of a polynomial, is the value of the polynomial evaluated at X.

Y = P(1)*X^N + P(2)*X^(N-1) + ... + P(N)*X + P(N+1)

Example:

For the polynomial , Y= $x^3 - 2x - 5 = 0$;to find Y(3) write:

P=[1 0 -2 -5]
Y=POLYVAL(P,3)

Ans:
Y=16.

Reference Book:
1)Introductory Methods of Numerical Analysis: by S.S. Sastry.
2)Numerical Methods for engineers-by Chapra/Kanal