



Introduction to Numerical Methods

Unit

12

12.1 Numerical Solution of Non-linear Equations

12.1.1 Describe importance of numerical methods

Till now, all the methods we have learnt to solve the non-linear equation and finding of the derivative or integration of functions are analytical methods.

When analytic approaches are failed to find the solution of a non-linear equation or require too many tedious computations then, mathematicians used numerical methods to compute approximate solution. Therefore, numerical methods have great importance in the field of mathematics.

12.1.2 Explain the basic principles of solving a non-linear equation in one variable

The basic principle of solving a non-linear equation is to find the interval (values of a and b) for a function $f(x)$, where $f(a)$ and $f(b)$ are of opposite signs such that $f(a) \cdot f(b) < 0$, then the root of $f(x) = 0$ lies in the interval $[a, b]$.

For example, $f(x) = x^3 - 2x - 5$, put the values of $x = 0, 1, 2, 3$ in $f(x)$, we get

$$f(0) = (0)^3 - 2(0) - 5 = -5$$

$$f(1) = (1)^3 - 2(1) - 5 = -6$$

$$f(2) = (2)^3 - 2(2) - 5 = -1$$

$$f(3) = (2)^3 - 2(3) - 5 = 16$$

Here $f(2) = -1 < 0$ (-ve) and $f(3) = 16 > 0$ (+ve), such that $f(2) \cdot f(3) = (-1) \cdot (16) = -16 < 0$.

Now, root lies in the interval $[a, b] = [2, 3]$.

12.1.3 Calculate the real roots of a non-linear equation in one variable by

- Bisection method
- regula-falsi method
- Newton-Raphson method

• Bisection Method

The bisection technique is a root-finding method which repeatedly bisects an interval and then selects a sub-interval in which a root must lie for further processing. It is a very easy and reliable procedure.

Algorithm of a Bisection method

If $f(x)$ is a continuous function over an interval, then to find the root of $f(x) = 0$ by bisection method, following steps are taken.

Numerical Methods Unit Guide

Michael Seilmaier



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