Bisection Method

Theory:

The Bisection Method is a bracketing method that relies on the continuity of the function and the Intermediate Value Theorem. If a continuous function $f(x)$ satisfies

$$f(a)f(b) < 0$$

then at least one root lies in the interval $[a, b]$.

The method works by repeatedly dividing the interval into two equal parts. The midpoint of the interval is calculated using the formula

$$x = \frac{a + b}{2}$$

The subinterval in which the sign change occurs is selected for the next iteration. With each iteration, the interval containing the root becomes smaller, and the midpoint approaches the actual root. Although the method converges slowly, it is extremely reliable because the root always remains within the chosen interval.

When compared with other non-linear methods such as Newton-Raphson or Secant, the Bisection Method sacrifices speed in favor of certainty. It is often used when reliability is more important than fast convergence.