Khulna University of Engineering & Technology, Khulna

Department of Biomedical Engineering

SESSIONAL REPORT

Course No: **BME 2152**

Experiment No : **07**

Name of the Experiment: **Finding the root of polynomial equation using Secant Method.**

Remarks:

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Year : **2nd**

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Objectives:

The main objectives of the equations are-

- To understand and implement the Secant Method for finding the roots of polynomial equations using MATLAB.
- To learn how iterative numerical methods work and their application in solving nonlinear equations.

Introduction:

The **Secant Method** is a numerical technique used to find the roots of a function, meaning the points where the function equals zero. It works by taking two initial guesses close to the root and drawing a straight line (a secant) between them. The next approximation is found where this line crosses the x-axis. This process is repeated iteratively, with each new approximation replacing one of the previous guesses until the solution reaches a desired level of accuracy. Unlike **Newton Raphson Method**, which requires the calculation of derivatives, the Secant Method only relies on function values, making it useful for functions where derivatives are difficult to compute. Compared to the **Bisection Method**, which systematically narrows the interval containing the root, the Secant Method is often faster but does not always guarantee convergence. One of its biggest advantages is that it converges more quickly than simple bracketing methods like Bisection, and it avoids the complexity of differentiation required in Newton's Method. However, its main drawback is that it may fail if the function behaves irregularly, leading to division by zero or divergence instead of convergence. Despite these limitations, the Secant Method is widely used in numerical analysis due to its balance between efficiency and simplicity, especially when solving equations where derivatives are impractical to obtain.

Formula:

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

Algorithm of Secant Method:

Step 1: input equation

Step 2: Input guess value 1(x1) and guess value 2(x2)

Step 3: Find f(x1) and f(x2)

Step 4: x3 = x2 – ((f2*(x2-x1))/ (f2-f1))

Step 5: Find f(x3)

Step 6: If f(x3) = 0; print: the root is x3 and terminate the loop

Step 7: If | (x3 – x2)/x3 | < eps; print: the root is x3 and terminate the loop

Else x1 = x2 and f(x1) = f(x2)

x2 = x3 and f(x2) = f(x3)

Step 8: Go to Step 5 and repeat

Task 1 || Find the root of the polynomial equation by using Secant Method.

Code:

```
clc;
clear all;

a = input("Co-efficients of equation: ");
x1 = input("Guess value 1: ");
x2 = input("Guess value 2: ");

eps =0.000001;

f1 = polyval(a, x1);
f2 = polyval(a, x2);

for n =1:50
  x3 = x2 - ((f2*(x2 -x1)/(f2-f1)));

  f3 = polyval(a, x3);

  if f3 == 0
     fprintf("The root is x3: %g\n",x3);
     return;
  end
```

```
 if(abs((x3-x2)/x3)<eps)
      fprintf("Root is x3: %g\n", x3);
      fprintf("Iteration number: %d\n", n);
      return;

   else
      x1= x2;
      f1=f2;
      x2= x3;
      f2=f3;
   end
end
```

Output:

```
Co-efficients of equation: [1 -4 -10]
Guess value 1: -1
Guess value 2: -2
Root is x3: -1.74166
Iteration number: 5
>>

Co-efficients of equation: [1 -2 1 -1]
Guess value 1: 1
Guess value 2: 2
Root is x3: 1.75488
Iteration number: 7
>>
```

Comment:
The Secant Method effectively approximates roots without requiring derivatives, making it efficient for complex functions. However, its convergence depends on well-chosen initial guesses and may fail in certain cases.

Conclusion:

The Secant Method is a powerful numerical technique for finding the roots of polynomial equations. It provides a faster alternative to the Bisection Method and does not require derivatives like Newton's Method. By implementing this method in MATLAB, we have gained practical knowledge of how iterative methods work to approximate solutions. The experimental results demonstrate that the method converges to the root within a reasonable number of iterations when appropriate initial guesses are provided. However, caution should be taken in selecting initial values, as improper choices may lead to divergence. Overall, the Secant Method is a useful tool in numerical analysis, balancing efficiency and simplicity.

References:

1. Numerical Methods by E Balagurusamy
2. MathWorks. (n.d.). *MATLAB Documentation*. Retrieved from www.mathworks.com