IS5306: NUMERICAL METHODS

TAKE HOME ASSIGNMENT 1

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1. Calculations

Using newton Raphson method find the solution of x^3-5x^2+7x+3=0 ? In this equation use interval as [-1,0]?

- **MATLAB Code**

```
% Define the function and its derivative
f = @(x) x^3 - 5*x^2 + 7*x + 3;
df = @(x) 3*x^2 - 10*x + 7;

% Set the interval
interval = [-1, 0];

% Check if the interval contains a root
if f(interval(1)) * f(interval(2)) > 0
    error('No root in the specified interval.');
end

% Set tolerance for convergence
tolerance = 1e-6;

% Set maximum number of iterations
maxIterations = 100;

% Initialize variables
x0 = (interval(1) + interval(2)) / 2; % Start with the midpoint of the interval
iterations = 0;

% Perform Newton-Raphson iterations
while iterations < maxIterations
    x1 = x0 - f(x0) / df(x0);

    % Display iteration and current approximation
    fprintf('Iteration %d: x = %.8f\n', iterations, x1);

    % Check for convergence
    if abs(x1 - x0) < tolerance
        fprintf('Root found: %f\n', x1);
        break;
    end

    x0 = x1;
    iterations = iterations + 1;
end

% Display a message if the method does not converge
if iterations == maxIterations
    fprintf('Newton-Raphson method did not converge within %d iterations\n', 
maxIterations);
end
```

- **Answer**

Iteration 0: x = -0.35294118

Iteration 1: x = -0.34034013

Iteration 2: x = -0.34025083

Iteration 3: x = -0.34025083

Root found: -0.340251

- **Analytical Method**

$$PUT\ X_0 = 0, \qquad f(0) = +3 > 0\ \&$$
$$X = -1, \qquad f(1) = -10 < 0$$

So, we shall take $X_0 = m_1 = \frac{0+(-1)}{2} = -0.5$

Now,

$$f(x) = x^3 - 5x^2 + 7x + 3$$
$$f^/(x) = 3x^2 - 10x + 7$$
$$x_{n+1} = x_n - \frac{f(x_n)}{f^/(x_n)} = x_n - \frac{x_n^3 - 5x^2{}_n + 7x_n + 3}{3x_n^2 - 10x_n + 7}$$

n	x_n	$f(x_n)$	$f^/(x_n)$	x_{n+1}
0	-0.5	-0.5	2.5	-0.352941
1	-0.352941	0.176	4.34	-0.340340
2	-0.340340	0.008390	3.298	-0.340250
3	-0.340250	7.399×10^{-6}	3.9068	-0.340250

$$\underline{\therefore The\ root = -0.340250}$$

2. Conclusion

Whether employing MATLAB code or employing analytical methods, the result obtained as the root is the same. However, these approaches do not yield the exact solution; instead, they provide a root that is very close to the true answer.