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MC 3010 - Differential Equations and Numerical Methods

Tutorial-3

1. Consider the function $f(x) = x^3$. Calculate its first derivative at point x = 3 numerically with the forward, backward, and central finite difference formulas and using the h values of 1, 0.25. Also find the error percentages.

2. Use the three-point Gauss-Legendre rule to approximate $\int_1^5 \frac{dt}{t} = \ln(5) - \ln(1) \approx 1.609438$ and compare the result with Simpson and Trapezoidal rule for $h = 1$.

3. Calculate the integral value, to using Trapezoidal rule and Simpson rule .

   (a) $\int_1^2 x\ lnx\ dx$ with $h = 0.5$

   (b) $\int_0^1 (1 + e^{-x}cos(4x))\ dx$ with $h = 0.25$

   (c) $\int_{-2}^2 x^3 e^x dx$ with $h = 1$

4. Find the number m(no.of.sub interval) and the step size h so that the error $E_s(f, h)$ for the Simpson rule is less than 5×10^{-9} for the approximation $\int_2^7 \frac{dx}{x}$. The $f^{(4)}(x) = \frac{24}{x^5}$ and the maximum value of taken over [2,7] occurs at the end point $x = 2$.

5. Show that two integrals are equivalent and calculate $G_2(f)$ (Two-point Gauss-Legendre)

$$\frac{1}{\pi}\int_0^\pi \cos(0.6\sin(t))dt = 0.5\int_{-1}^1 \cos(0.6\sin((x+1)\frac{\pi}{2}))dx$$