

MATH 170B: Discussion 6

May 2018

Numerical differentiation

1. Using Taylor series, derive the error term for the approximation,

$$f'(x) = \frac{1}{2h} [-3f(x) + 4f(x+h) - f(x+2h)]$$

Richardson Extrapolation

2. Given the formula,

$$f''(x) = \frac{1}{h^2} [f(x+h) - 2f(x) + f(x-h)]$$

- (1) First determine the error of the expression given above;

(2) Next use richardson extrapolation to develop a new scheme that has a truncation error of order $\mathcal{O}(h^4)$.

3. Take an approach to the Richardson extrapolation method for the $h = 0.1$ and $h = 0.05$ to determine the values of the derivative of function $f(x) = \ln(x)$ at $x = 1.8$. The leading order of error of your scheme should be $\mathcal{O}(h^4)$.