Math 317 - Numerical Analysis

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Caveat in numerical differentiation

Let $f(x) = sin(x)$ and $D_h f$ be central finite difference approximation

$$D_h f(x_0) = \frac{f(x_0 + h) - f(x_0 - h)}{2h}.$$

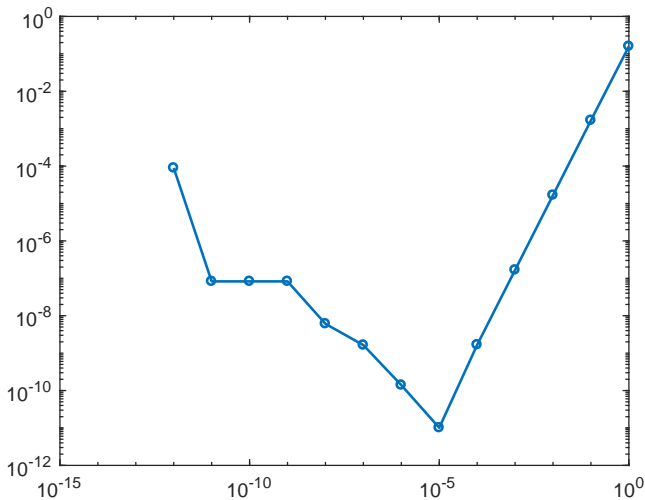| h	$|Df(\pi) - D_h f(\pi)|$
10^0	1.585×10^{-1}
10^{-1}	1.666×10^{-3}
10^{-2}	1.667×10^{-5}
10^{-3}	1.667×10^{-7}
10^{-4}	1.665×10^{-9}
10^{-5}	1.012×10^{-11}
10^{-6}	1.396×10^{-10}
10^{-7}	1.637×10^{-9}
$\vdots$	$\vdots$
10^{-11}	8.274×10^{-8}
10^{-12}	8.890×10^{-5}

Figure: Plot of $\log(h)$ vs $\log\left(|Df(\pi) - D_h f(\pi)|\right)$