Computing Derivatives Numerically

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Theory

We are using a set of methods to numerically approximate function derivatives. Here are the methods used for approximations (you can use this list as a transcript of plots shown later):

$$f'(x) = \frac{f(x+h) - f(x)}{h} \tag{0}$$
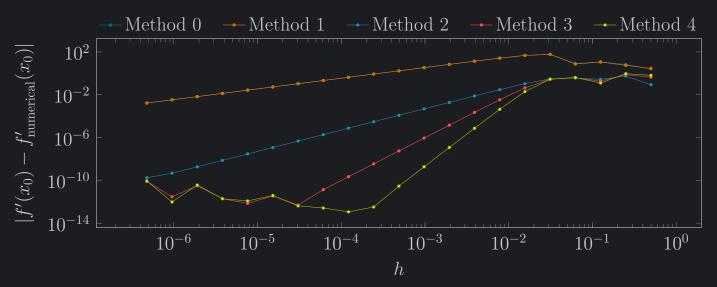
$$f'(x) = \frac{f(x) - f(x-h)}{h} \tag{1}$$

$$f'(x) = \frac{f(x+h) - f(x-h)}{2h} \tag{2}$$

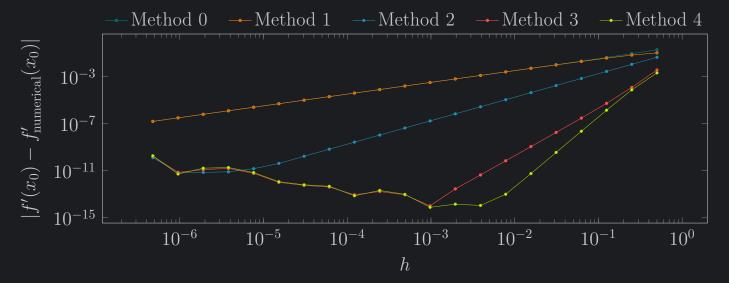$$f'(x) = \frac{4}{3}\frac{f(x+h) - f(x-h)}{2h} - \frac{1}{3}\frac{f(x+2h) - f(x-2h)}{4h} \tag{3}$$

$$f'(x) = \frac{3}{2}\frac{f(x+h) - f(x-h)}{2h} - \frac{3}{5}\frac{f(x+2h) - f(x-2h)}{4h}$$
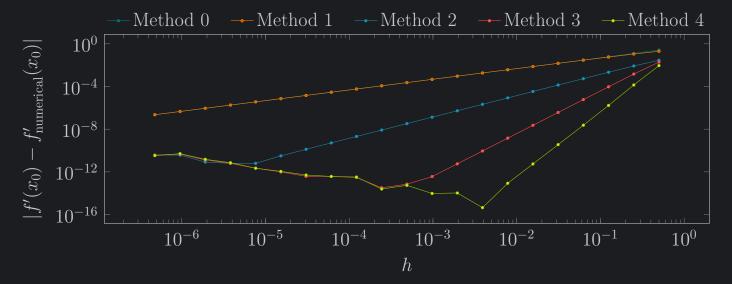$$+ \frac{1}{10}\frac{f(x+3h) - f(x-3h)}{6h} \tag{4}$$

Results

Numerical derivative approximation error for $\sin x^2$

Numerical derivative approximation error for $\cos\left(\sin x\right)$
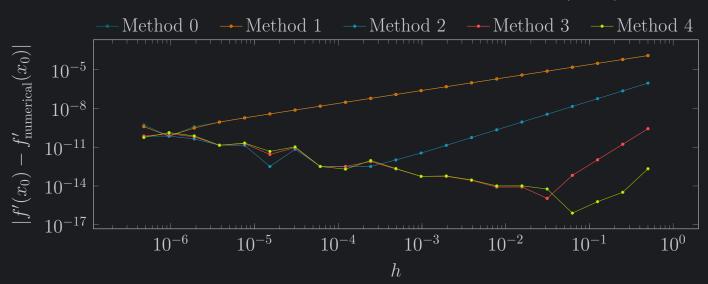
Numerical derivative approximation error for $e^{\cos(\sin x)}$

Numerical derivative approximation error for $\log(x + 3)$

Numerical derivative approximation error for $\sqrt{x + 3}$