

Calculus: Numerical Differentiation, Step Size Exploration

Consider the function:

$$y(x) = \sin(x)$$

- a) Analytically determine the derivative, $\frac{dy}{dx}$. Plot both $y(x)$ and $\frac{dy}{dx}$ from 0 to π .
- b) At $x = 2$, compute the numerical derivative using the backward, forward, and central difference schemes. Use a step size of $\Delta x = 0.75$. Append these results to your plot from (a).
- c) At $x = 2$, compute the approximate derivative using the backward difference scheme. Use step sizes of $\Delta x = 0.1$ to 1 in increments of 0.1. Also compute the *percent error*, defined as:

$$\%error = \left| \frac{approx - exact}{exact} \right| * 100\%$$

Also plot the percent error versus the step size. Then, repeat using the central and forward differences.