

# 1 | Calculating Derivatives

## unit1::derivatives

### 1.1 | Types of Formulas

Two kinds of formulas, specific (for specific functions) and general. Both are needed to solve polynomials.

### 1.2 | Derivative of $\sin(x)$

This only works with radians! Loose summary of derivation:

- $\lim_{x \rightarrow 0} \frac{\sin(x+\Delta x) - \sin(x)}{\Delta x}$
- Use trigonometric identities to expand the  $\sin(x+\Delta x)$  term.  $\sin(a+b) = \sin(a)\cos(b) + \cos(a)\sin(b)$ .
- Group the terms by plugging in the derivative at  $x = 0$  such that the resulting quotients end up cancelling.

$\sin(x) \left( \frac{\cos(\Delta x) - 1}{\Delta x} \right) + \cos(x) \left( \frac{\sin(\Delta x)}{\Delta x} \right)$  Right side's quotient goes to 1, left side goes to 0, so the entire equation goes to  $\cos(x)$  The derivatives of sin and cosine at  $x = 0$  give all values of the derivative of sine and cosine.

### 1.3 | Derivative of $\cos(x)$

Similar derivation to above which yields  $-\sin(x)$ .

### 1.4 | Some General Rules

- Product rule:  $(uv)' = u'v + uv'$
- Quotient rule:  $\left(\frac{u}{v}\right)' = \frac{u'v - uv'}{v^2}$

## 2 | Links

Differentiation Rules builds upon this.