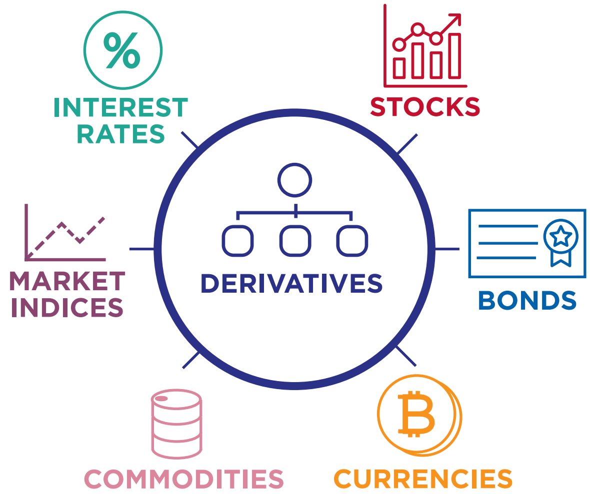
CALCULUS APPLICATIONS
DERIVATIVES

CONCEPT The derivative of a function represents the instantaneous rate of change of the function. In other words, it is the slope of a function, even when that function is curved.



LIMITS FORMULA

$$f(x) = \lim_{h \to 0} \frac{f(x+h)-f(x)}{h}$$

REAL WORLD CONNECTIONS

The derivative represents the rate of change of one variable with respect to another, and while that may seem abstract, many common phenomena can be related with derivatives. Velocity is the rate distance changes with time.

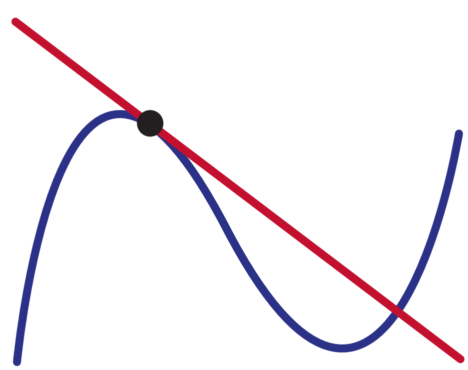
Example: If you drive 120 miles in 2 hours, you were going 60 mph. This is just a derivative. Velocity is the derivative of position with respect to time. If you know an equation which gives position as a function of time, the derivative will give you the velocity as a function of time.

BACKGROUND

Derivative: The instantaneous slope of a function.

Tangent Line: A line that intersects a curve at exactly one place.

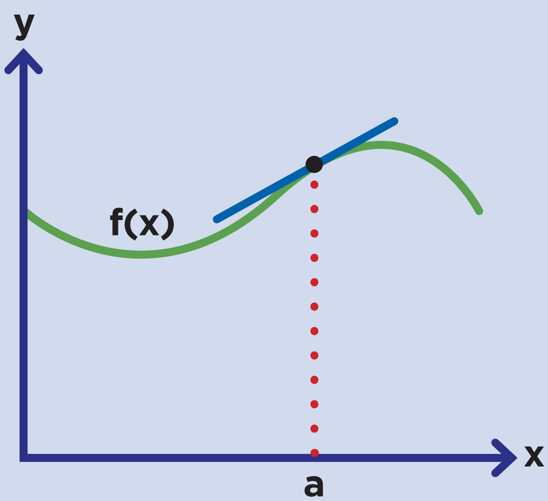
Isaac Newton and Gottfried Leibniz both independently discovered the key principles of calculus in the late 1600s. Their work has laid the foundation for much of modern mathematics, and without their work much of modern technology would be impossible.

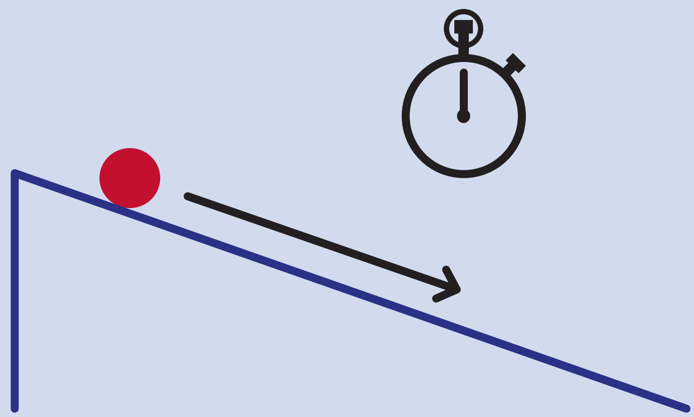


Make sure it measures up

APPLICATION

Place strips of tape about 1 meter apart on an inclined surface. Release a ball from the top, and with a stopwatch, measure the time at which it reaches each piece of tape. You can use these data points to create a scatter plot of distance versus time. Extrapolate to connect the dots and see if you can identify the slope of the distance vs. time graph. This is the derivative, which is also the velocity of the object in this case.





EXAMPLES

For the function $f(x) = x^2$, the derivative is 2x.
We can denote this in a few ways: $f'(x) = 2x$

This means that we can find the slope at any x-value. For example, the derivative at x=3 is just, so the slope of the tangent line at that place is 6.

$$\lim_{\partial \to 0} \frac{(x+\partial)^2 - x^2}{\partial}$$

$$\lim_{\partial \to 0} \frac{x^2 + \partial^2 + 2\partial x - x^2}{\partial}$$

$$\lim_{\partial \to 0} \frac{\partial^2 + 2\partial x}{\partial}$$

$$\lim_{\partial \to 0} \partial + 2x$$

$$\Rightarrow 2x$$