Computing and using the derivative

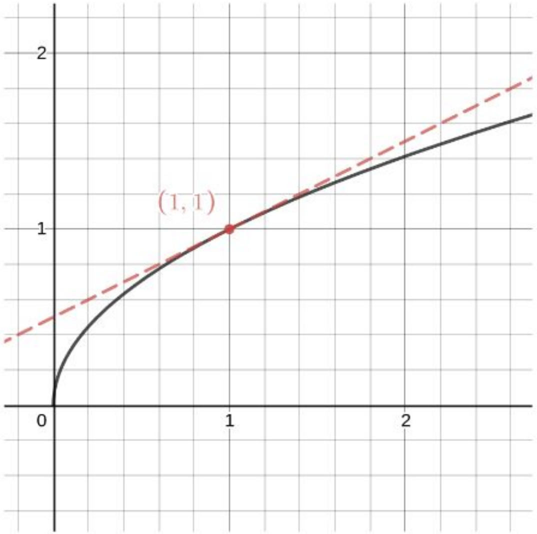
MTH 201 -- Module 2A

Today

- Review of the derivative at a point
- Finding the value of a derivative using the limit definition
- Finding the value of a derivative *without* formulas at all (graphs)

Review from day 1

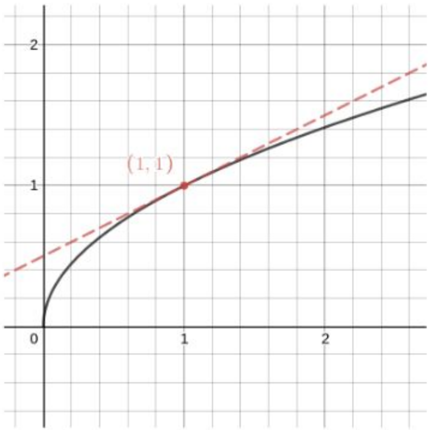
The graph of $y = f(x)$ is shown along with its tangent line at $(1, 1)$. The value of $f'(1)$ is



- 0
- 0.5
- 1
- 1.5
- None of the above

To 0

In fact, the function shown here is $f(x) = \sqrt{x}$. To compute the precise value of $f'(1)$, we would need to compute



- $\sqrt{1}$
- $\frac{\sqrt{1+h}}{h}$
- $\frac{\sqrt{1+h}-\sqrt{1}}{h}$
- $\lim_{h\to 0} \frac{\sqrt{1+h}}{h}$
- $\lim_{h\to 0} \frac{\sqrt{1+h}-\sqrt{1}}{h}$
- $\lim_{h\to 1} \frac{\sqrt{1+h}-\sqrt{1}}{h}$
- None of these

Tc 0

The **derivative** of the function y = f(x) at the point x = a:

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

The derivative of f(x) at x = a, f'(a), is all of the following things:

- The **instantaneous rate of change** in f(x) at x = a
- If f(t) is a position at time t, f'(a) is the **instantaneous velocity** at time t = a
- The **slope of the tangent line** to the graph of f(x) at x = a

ALL OF THE FOLLOWING ARE WRONG

$$f'(a) = \frac{f(a+h) - f(a)}{h}$$

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

$$f'(a)_{h \to 0} = \frac{f(a+h) - f(a)}{h}$$

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

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

The derivative

The value being approached as h approaches 0

Of the average rates of change.

is

Using the limit definition to compute a derivative value

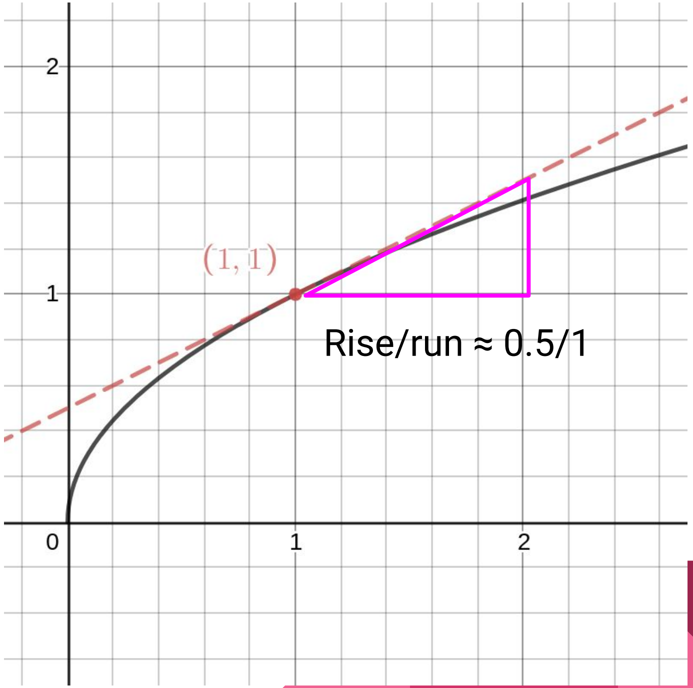
Jamboard

What if there’s no formula?

If f(x) doesn't have a formula

This happens more often than not.

- If f(x) is given as a **graph**: Estimate f'(a) by drawing the tangent line at x = a and using grid marks.
- If f(x) is given as a **table of data**: Take the statistical average of the two closest average rates of change. More on this in Module 3.



Recap

The derivative of a function y = f(x) at a point x = a:

- Is denoted f'(a) ("f prime of a")
- Gives the instantaneous rate of change in f(x) at x = a
- Gives the instantaneous velocity of an object at time t = a if f(t) is position
- Gives the slope of the tangent line to the graph of f(x) at x = a
- Can be computed algebraically using a limit (below) if f(x) has a formula
- Has units equal to (Units of y) "per" (Units of x)

Next Up

- Module 2B: The derivative as a function
- If f(x) is a formula: Coming up with formulas for derivative values
- If f(x) is a graph: Coming up with graphs of the derivative

Feedback:
http://gvsu.edu/s/1zJ