2.3 / Estimating Derivatives from Tables and Graphs

Watch the lesson ➤

Estimating derivatives of a function at a point

Learning goal

Estimate a derivative at a point from a table or a graph, show the difference quotient, give the units, and explain the value in context.

Key ideas

01 From a table, estimate $f'(c)$ with the two values **closest** to c, one on each side: $f'(c) \approx \dfrac{f(b) - f(a)}{b - a}$.

02 Show both the **difference** $f(b) - f(a)$ and the quotient. A number alone, or a formula alone, does not show the work.

03 The estimate is a **rate**, in units of f per unit of x. If f is already a rate, the units are "per ... per ...".

04 From a graph, the slope between two nearby points on the curve estimates $f'(c)$. Rising means **positive**, falling means negative.

05 A calculator can give $f'(c)$ for a formula. You still give its **meaning**: the time, the quantity, increasing or decreasing, the units.

Remember

estimate
A value close to the exact one, found from data such as a table or a graph.

closest interval
The two table values next to c, one on each side.

rate of a rate
The rate of change of something that is already a rate, such as acceleration (meters per second per second).

Class notes

2.3 / Write it clearly

What earns the point on the AP Exam, and the mistakes that lose it.

Writing checklist

Notation to use and to avoid

WRITE	AVOID
Show the difference and the quotient from the table: $D'(4) \approx \frac{D(5)-D(2)}{5-2} = \frac{17-11}{3} = 2$ centimeters per hour.	Do not write only the number, or only the formula $\frac{D(5)-D(2)}{5-2}$: show the values.
Give units of f per unit of x: "degrees Fahrenheit per minute", "meters per second per second".	Do not turn the estimate into a value of D: $D'(4) \approx 2$ is the answer, not $D(4)$.
Explain a negative rate with the word "decreasing" and the size without the sign: "decreasing at about $\frac{1}{3}$ centimeter per hour".	Do not use the units of f for f': not "degrees" but "degrees per minute".

Common mistakes

The mistake code is used in the answers and in My Mistakes

01 The answer is the rate, not a value of the function

Code D1

✗ $D'(4) \approx \frac{17-11}{5-2} = 2$, so $D'(4) \approx 11 + 2(4-2) = 15$ centimeters.

✓ Stop at the rate: $D'(4) \approx 2$ centimeters per hour.

02 The closest interval, in the same order

Code D2

✗ $R'(7) \approx \frac{R(10)-R(5)}{10-5}$, or $\frac{R(5)-R(9)}{9-5}$.

✓ $R'(7) \approx \frac{R(9)-R(5)}{9-5}$: the two times next to 7, later minus earlier on both.

03 Units of a rate

Code D3

✗ $v'(6) \approx 1.5$ meters per second.

✓ v is in meters per second, so $v'(6) \approx 1.5$ meters per second per second.

Real AP questions on this topic Free on AP Central. Try them after the practice.

- 2025 AB FRQ 3(a) – estimate from a table: computation mean 0.80, units mean 0.54
- 2024 AB FRQ 1(a) – estimate from a table with units
- 2026 AB FRQ 1(a) – estimate from a table with units

2.3 / Guided examples

Watch, pause, and write the reasoning. Full solutions are in the video.

Problem types

Read the problem, name the type, then use its method

Type	Method	Problems
Estimate $f'(c)$ from a table, with units	Take the two table values closest to c on either side: $f'(c) \approx \frac{f(b)-f(a)}{b-a}$. Show the difference and the quotient. Units: units of f per unit of x.	E01 · Practice 2, 7
Which interval gives the estimate	If c is between two table values, use those two. If c is a table value, use the values just before and just after it.	Practice 1, 4
Estimate $f'(c)$ from a graph	Pick two grid points on the curve on either side of c, close to c; their slope estimates $f'(c)$. Rising means positive, falling means negative.	E02 · Practice 3, 6
Units and meaning of an estimated rate, including a rate of a rate	At [the time], [the quantity] is increasing (decreasing) at about [the size] [units of f] per [unit of x]. If f is itself a rate, the units are "per ... per ...".	Practice 5
A derivative value from technology, read in context	The calculator gives the number. You give the meaning: the time, the quantity, increasing or decreasing, the units.	Practice 8, 9

Example 01

Video · E01

Snow depth $D(t)$ is in centimeters, t in hours; values in the table.
(a) Estimate $D'(4)$. Show the work, with units.
(b) Estimate $D'(10.5)$.
(c) Explain the meaning of (b).

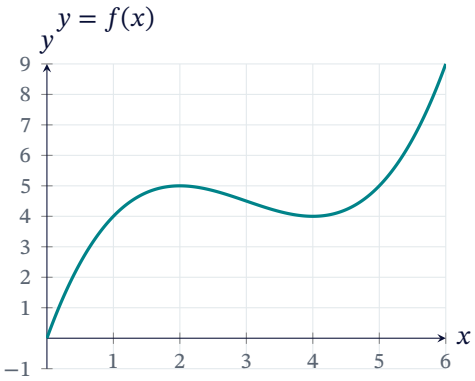
t (hours)	0	2	5	6	9	12
$D(t)$ (cm)	8	11	17	18	21	20

> Use the two times closest to 4, one on each side.

Example 02

Video · E02

The graph of a differentiable function f is shown.
Which is closest to $f'(5)$?



A. $\frac{5}{2}$
B. 5
C. $-\frac{5}{2}$
D. 1

> Read two grid points on the curve, one on each side of 5.

VIDEO COMPLETE Check your example answers at the end of this booklet.

2.3 / Example answers

Estimating Derivatives from Tables and Graphs

E01 (a) $D'(4) \approx \frac{D(5)-D(2)}{5-2} = \frac{17-11}{3} = 2$ centimeters per hour; (b) $D'(10.5) \approx \frac{D(12)-D(9)}{12-9} = -\frac{1}{3}$ centimeter per hour; (c) at $t = 10.5$ hours, the depth of the snow is decreasing at a rate of about $\frac{1}{3}$ centimeter per hour

E02 (A)