HW #10 due Tues. 9/29:
2.5 # 1-39 odd; 43, 47 - Implicit Differentiation

HW #11 due Fri. 10/2:
2.6 # 15-23 odd - Related Rates
2.6 # 25, 27, 35 - Related Rates (more challenging problems)

HW #12 due Mon. 10/5
3.1 # 17-31 odd - Absolute Extrema on an Interval
3.2 # 7-19 odd - Rolle's Theorem
3.2 # 31-37 odd - Mean Value Theorem

HW #11 due Wed. 10/7
3.3 # 11-31 odd - Increasing, Decreasing, and Relative Extrema
3.4 #11-25 odd - Inflection Points and Concavity

Test #3 - Fri. 10/9

Does the Mean Value Theorem apply?
If so, find all values of c guaranteed by the theorem.
32. $f(x) = x(x^2 - x - 2) \quad [-1, 1]$

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Is $f(x)$ continuous on $[-1,1]$? yes
Is $f(x)$ differentiable on $(-1,1)$? yes
Yes! The MVT applies

$f(x) = x^3 - x^2 - 2x$

$f'(x) = 3x^2 - 2x - 2$

$$\frac{f(1) - f(-1)}{1-(-1)} = \frac{1(1-1-2) - (-1)(1+1-2)}{1+1} = \frac{-2}{2} = -1$$

$3x^2 - 2x - 2 = -1$

$3x^2 - 2x - 1 = 0$

$(3x+1)(x-1) = 0$

$\boxed{x = -1/3}$, $\cancel{x=1}$ not in $(-1,1)$

Given a function $f(x)$ that is continuous at a point $(c, f(c))$, explain in as many different ways as possible (in clear sentences), the meaning of $f'(c)$ and what is necessary for $f'(c)$ to be defined.

$f'(c)$ is:

- the derivative of $f(x)$ @ $(c, f(c))$
- the slope of the tangent line to f @ $(c, f(c))$
- the (instantaneous) rate of change of f with respect to x @ $(c, f(c))$
- $f'(c) = \lim_{h \to 0} \frac{f(c+h) - f(c)}{h}$ * formal definition
- $f'(c) = \lim_{x \to c} \frac{f(x) - f(c)}{x - c}$ * alternate definition

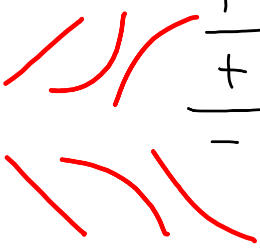
$$= \lim_{x \to c^-} \frac{f(x) - f(c)}{x - c}$$

$$= \lim_{x \to c^+} \frac{f(x) - f(c)}{x - c}$$

3.3-3.4 Increasing, Decreasing, Concavity, and the 1st and 2nd Derivative Tests

What do f' and f'' tell us about f?

Recall that f' is the rate of change or slope of f,
f'' is the slope or rate of change of f'.

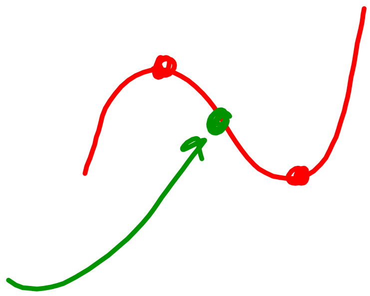


f'	f
+	↗ increasing
−	↘ decreasing

f''	f'	f
+	↗ increasing	concave up
−	↘ decreasing	concave down

f'(x)=0 when f has a relative maximum or minimum.
These x-values (and those where f'(x) is undefined) are called critical numbers.

f''(x)=0 when f changes concavity.
The points where concavity changes are called inflection points.

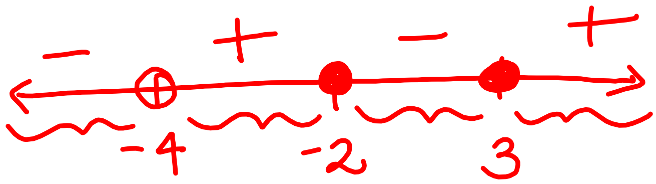


To solve problems involving concavity, increasing/decreasing, etc., we should recall how to solve polynomial inequalities.

$$\frac{(x+2)(x-3)}{x+4} \geq 0$$

zeros: $-2, 3$

vertical asymptote: -4



$$\boxed{(-4,-2] \cup [3,\infty)}$$

- Find all critical numbers and state the open intervals on which f is increasing and/or decreasing.
- Find all inflection points and state the open intervals on which f is concave up and/or concave down.
- Use these results to determine all relative and absolute extrema.

3.3

16. $f(x) = x^3 - 6x^2 + 15$