2nd Derivative Test

1/20

ES: Can the $f''(x)$ be used to find relative max and min?

Concave upward
Relative min

Concave downward
Relative max

Theorem

Second Derivative Test

If $f'(c)=0$ and 2nd derivative exist on (a,b) then:

① If $f''(c)>0$, then $f(x)$ has a relative min at $(c, f(c))$.

② If $f''(c)<0$, then $f(x)$ has a relative max at $(c, f(c))$.

③ If $f''(c)=0$, then test fails. use 1st derivative test.

ex

Find Relative Extrema

$f(x) = -3x^5 + 5x^3$

Step 1 Find $f'(c)=0$, critical numbers.

$f'(x) = -15x^4 + 15x^2$

$0 = -15x^4 + 15x^2$

$0 = -15x^2(x^2-1)$

$-15x^2 = 0$ $\qquad\qquad$ $x^2 - 1 = 0$

$x = 0$ $\qquad\qquad$ $x^2 = 1$

$x = \pm\sqrt{1}$

critical numbers $\quad x = -1, 1$

Step 2 Find $f(c)$ for each c.

$f(-1) = -2$ $\qquad$ $f(0) = 0$ $\qquad$ $f(1) = 2$

$(-1,-2)$ $\qquad$ $(0,0)$ $\qquad$ $(1,2)$

critical points

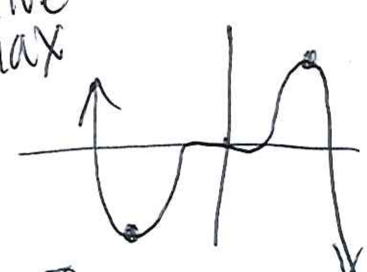
Step 3 Find $f''(x)$

$$f''(x) = -60x^3 + 30x$$

Step 4 Set up table

Point	$(-1,2)$	$(0,0)$	$(1,2)$
Sign of $f''(x)$	$f''(-1) = 30$ CU	$f''(0) = 0$	$f''(1) = -30$ CD
Conclusion	Relative min	test fails	Relative max

use 1st derivative test



No max or min at $x=0$

Summary

Homework #11c pg 192 # 31, 33, 35, 37, 39, 46
Due Monday 1/23