Author 1 _____

Author 2 _____

23 – Finding Extrema & Inflection Points

Author 3 _____

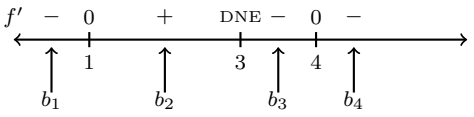
Strategy: Finding Increasing/Decreasing, Concavity, Extrema, & Inflection Points

Suppose you want to determine when f is increasing/decreasing, where f concave up/down, what are the local extrema, or what are the inflection points.

I. **Increasing/Decreasing** & **Local Extrema**.

1. Compute $f'(x)$.
2. Find all x-values where $f'(x) = 0$ or $f'(x)$ DNE, and put them on a number line. Here's an example if $f'(1) = 0$, $f'(3)$ DNE, and $f'(4) = 0$.

3. Choose x-values on either side of the values you found in the previous step. Compute f' at each of these values to determine if f' is positive $(+)$ or negative $(-)$ on each interval.

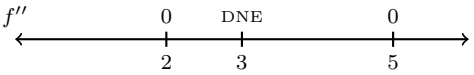


$f'(b_1) > 0$ $-$
$f'(b_2) > 0$ $+$
$f'(b_3) < 0$ $-$
$f'(b_4) > 0$ $-$

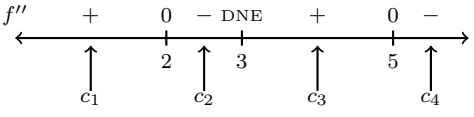
4. **Increasing/Decreasing**: f is *increasing* if f' is $+$; f is *decreasing* if f' is $-$.
5. **Local Extrema**: *local max* at $x = a$ if f' changes from $+$ to $-$ (and a is in domain of f); *local min* if f' changes from $-$ to $+$ at a (and a is in domain of f).

II. **Concave Up/Down** & **Inflection Points**.

1. Compute $f''(x)$.
2. Find all x-values where $f''(x) = 0$ or $f''(x)$ DNE, and put them on a number line.



3. Choose x-values on either side of the values you found in the previous step. Compute f'' at each of these values to determine if f'' is positive $(+)$ or negative $(-)$ on each interval.



$f''(c_1) < 0$ $+$
$f''(c_2) > 0$ $-$
$f''(c_3) > 0$ $+$
$f''(c_4) < 0$ $-$

4. **Concave Up/Down**: f is *concave up* if f'' is $+$; f is *concave down* if f'' is $-$.
5. **Inflection Points**: *inflection point* at $x = a$ if f'' changes sign (and a is in domain of f).

1. Let $f(x) = x^4 e^{-x}$. Find all intervals of increasing or decreasing, all intervals where the graph is concave up or concave down, all local extrema, and all inflections points. (Your answers go below.) *Also, use this information to sketch the graph of* $y = f(x)$.

- Intervals where f is increasing
- Intervals where f is decreasing
- Local extrema
- Intervals where f is concave up
- Intervals where f is concave down
- Inflection points