

Finding Extreme Points: Takeaways

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Concepts

- A derivative is the slope of the tangent line at any point along a curve.
- Let x be a point on the curve and h be the distance between two points, then the mathematical formula for the slope as h approaches zero is given as:
$$\lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$
- Differentiation is the process of finding a function's derivative.
- Finding the derivative of: $f(x) = x^2$:
 - $f'(x) = 2x$
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- Three ways of notating a curve's derivative:
 - $f'(x)$
 - $\frac{df}{dx}$ *Only use if derivative is a function
 - $\frac{d}{dx} f(x)$
- A critical point is a point where the slope changes direction from negative slope to positive slope or vice-versa. Critical points represent extreme values, which can be classified as a minimum or extreme value.
- Critical points are found by setting the derivative function to 0 and solving for x .
- Critical point classification:
 - When the slope changes direction from positive to negative it can be a maximum value.
 - When the slope changes direction from negative to positive, it can be a minimum value.
 - If the slope doesn't change direction, like at $x=0$ for $f(x) = x^3$, then it can't be a minimum or maximum value.

- Each maximum or minimum value points are known as local extrema.
- Classifying local extrema:
 - A point is a relative minimum if a critical point is the lowest point in a given interval.
 - A point is a relative maximum if a critical point is the highest point in a given interval.
- Instead of using the definition of the derivative, we can apply derivative rules to easily calculate the derivative functions.
- Derivative rules:
 - Power rule: Let x^n be some power, then
 - Example: Let $f(x) = x^3$. In our function, n would be 3. Using the power rule, it's derivative would be $3x^2$ or $f'(x) = 3x^2$.
 - Sum rule:
 - Example: $f(x) = x^2 + x$. $f'(x) = 2x + 1$.
 - Constant factor rule:
 - Example: $f(x) = 5x^2$. $f'(x) = 10x$.
- Derivative of $\sin(x)$ is always $\cos(x)$ and derivative of $\cos(x)$ is always $-\sin(x)$.
- Once you found the critical points of a function, you can analyze the direction of the slope around the points using a sign chart to classify the point as a minimum or maximum. We can test points around our points of interest to see if there is a sign change as well as what the change is.

Resources

- [Derivative rules](#)
- [Sign chart](#)

