Minima & Maxima

Concepts

Topics covered are:

1. Local Minima and Maxima
2. Absolute Minima and Maxima
3. First & Second Derivative Tests

Local Minima and Maxima

For a function $f(x)$, all the points where the function forms a peak is a local maxima, and all the deepest points of a dip is a local minima.

Mathematically, if the derivative of the function at a point is 0, and it has a *positive* slope before the point and a *negative* slope after the point, it is a **local maxima**.

Similarly, if the derivative of the function at a point is 0, and it has a *negative* slope before the point and a *positive* slope after the point, it is a **local minima**.

Absolute Minima and Maxima

The maximum value of all the local maxima of a function is called the **absolute maxima** of the function.

The minimum value of all the local minima of a function is called the **local minima** of the function.

First & Second Derivative Tests

These tests are used to check minima and maxima for a given function. For the **first derivative test**:

1. Find the derivative of $f(x)$ .i.e. $f’(x)$
2. Find critical points (points where $f’(x) = 0$)
3. For each critical point, use the mathematical way to find minima and maxima.

For the **second derivative test**:

1. Find the derivative of $f(x)$ .i.e. $f'(x)$
2. Find critical points
3. Find second derivative .i.e. $f''(x)$
4. If $f''(k) > 0$ where k is a critical point, then k is a local maxima. If $f''(k) < 0$, then k is a local minima. Use the first derivative test in case of 0.

Uses

This concept can be really useful to find the highest point and the least point of any given function without using graphs.

This makes it useful to find thecontainers that best fits what is required.
Example:

- Containers that stores every given entity and cost-efficient to produce
- Rooms with a given light that is supposed to have every part of it lit