MAXIMA AND MINIMA (1ST DERIVATIVE TEST)

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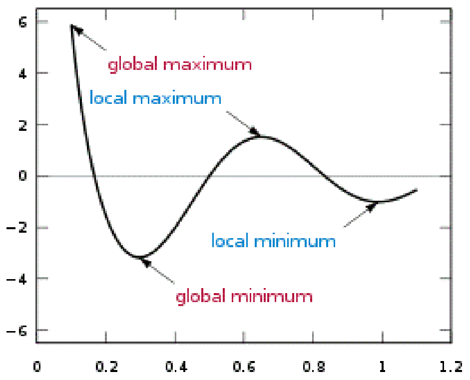
Introduction

Local maxima and local minima



Let ‘f’ be a real valued function and let ‘c’ be an interior point in the domain of ‘f’, then

- ‘c’ is called a point of local maxima if there is an h > 0 such that f(c) > f(x), for all x in (c - h, c + h). The value of f at x = c is called the **local maximum value**.
- ‘c’ is called a point of local minima if there is an h > 0 such that f(c) < f(x) for all x in (c - h, c + h). The value of ‘f’ at x = c is called the **local minimum value**.

Critical Point

A point ‘c’ in the domain of a function ‘f’ at which either f’(c) = 0 or ‘f’ is not differentiable is called a critical point of ‘f’.

First Derivative Test

Let ‘f’ be a function defined on an open interval I. Let ‘f’ be continuous at a critical point ‘c’ in I. Then

- If f’(x) > 0 at every point sufficiently close to the left of c and f’(x) < 0 at every point sufficiently close to the right of ‘c’ then ‘c’ is a point of local maxima.
- If f’(x) < 0 at every point sufficiently close to the left of c and f’(x) > 0 at every point sufficiently close to the right of c, then ‘c’ is a point of local minima.
- If f’(x) does not change sign as x increases through c, then c is neither a point of local maxima nor a point of local minima.

Such a point is calledpoint of inflection.

Solved Example:

Find all points of local maxima and local minima of the function ‘f’ given by

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

$f'(x) = 3x^2 – 3 = 3(x + 1)(x - 1)$

f’(x) = 0 implies x = 1 and x = -1

Values of x	Sign of f’(x)
Right to 1	>0
Left to 1	<0

Since the value of f'(x) < 0 to the left of 1 and f'(x) >0 to the right of 1, x = 1 is a point of local minima and f(1) is the local minimum value.
Since the value of f'(x) > 0 to the left of -1 and f'(x) < 0 to the right of -1, x = -1 is a point of local maxima and f(-1) is the local maximum value
Maximum value = 5
Minimum value = 1

Now try it yourself! Should you still need any help, click here to schedule live online session with e Tutor!

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Reference Links:

- http://en.wikipedia.org/wiki/Domain_(ring_theory)
- http://deadline.3x.ro/maxima-minima.html
- http://mathworld.wolfram.com/LocalMinimum.html
- http://en.wikipedia.org/wiki/Inflection_point
- http://en.wikipedia.org/wiki/First_derivative_test

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