

My Presentation

Lab 4 work

XXX, 2051XXXX

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Outline

- 1 Introduction
- 2 Example
- 3 Application

Stationary Point

x_0 is a stationary point of $f(x)$ if $f'(x_0) = 0$.

Second order derivative

If x_0 is a stationary point of $y = f(x)$, then $f(x)$ may achieve its maximum/minimum value at $x = x_0$.

Second Derivative Test

- If $f''(x_0) < 0$, then f has maximum value at $x = x_0$.
- If $f''(x_0) > 0$, then f has minimum value at $x = x_0$.

Question

Find the (local) **maximum/minimum** values of function

$$f(x) = 3x^4 - 20x^3 + 36x^2 - 15$$

Solution:

$$f'(x) = 12x^3 - 60x^2 + 72x \quad (1)$$

$$f''(x) = 36x^2 - 120x + 72 \quad (2)$$

$f'(x) = 0 \Rightarrow x = 0, 2, 3$ are stationary points of $f(x)$.

Below is a table for summarizing the test result:

$(x_0, f(x_0))$	$f''(x) _{x=x_0}$	classification
$(0, -15)$	> 0	point of minimum
$(2, 17)$	< 0	point of maximum
$(3, 12)$	> 0	point of minimum

Table: Second Derivative Test

Function plot

Below is a plot of $y = f(x)$ in **GeoGebra**:

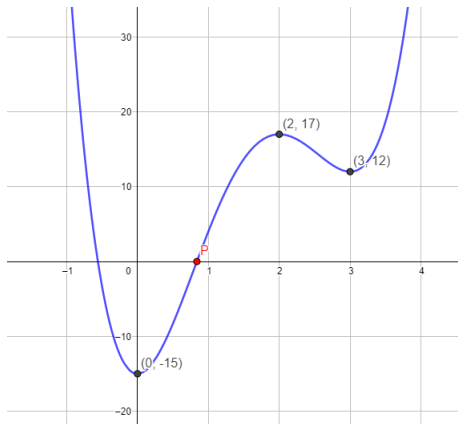


Figure: $f(x) = 3x^4 - 20x^3 + 36x^2 - 15$

N-R method

Use Newton-Raphson Method to find one approximate root at P (correct to 5 d.p.), with $x_0 = 1$.

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)} \quad (3)$$

$$= \dots$$

$$= \frac{9x_n^4 - 40x_n^3 + 36x_n^2 + 15}{12x_n^3 - 60x_n^2 + 72x_n} \quad (4)$$

n	x_n
0	1.0000
1	0.8333
2	0.8384
3	0.8384

\therefore the desired root $x^* = 0.8384$.

The iteration formula in [previous frame](#) is typeset by the following command lines:

```
\begin{eqnarray}
x_{n+1} &=& x_n - \frac{f(x_n)}{f'(x_n)} \\
&=& \cdots \\
&=& \frac{9x_n^4 - 40x_n^3 + 36x_n^2 + 15}{12x_n^3 - 60x_n^2 + 72x_n}
\end{eqnarray}
```

Thank you!

Any questions?