Welcome to our Presentation

Submitted to our honourable faculty

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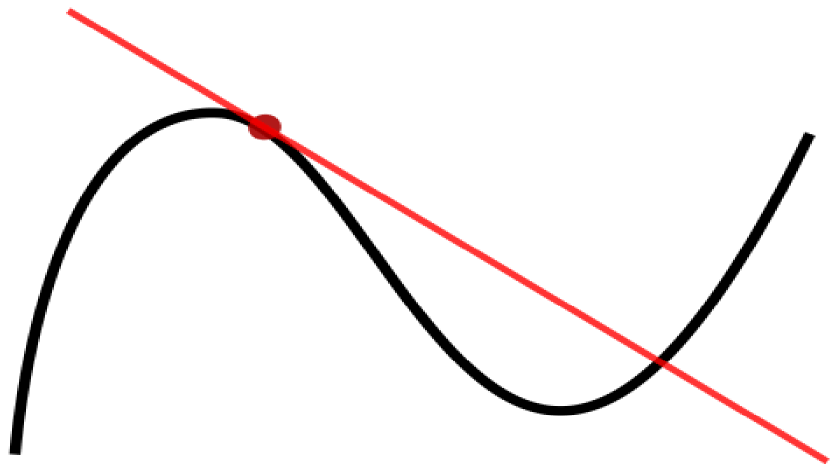
Differentiation

Content

- What is differentiation
- Why should we use differentiation
- Where we use differentiation
- Kinds of differentiation
- Some math of different techniques
- Application

What is differentiation

- process of finding the **derivative**, or rate of change, of a function.



Why should we use differentiation

- reveals the rate-of-change
- reveals the cumulative effect

Where we use differentiation

- **Increasing and Decreasing Functions**
- **Stationary Points**
- **Solving Practical Problems**
- **Maximum, Minimum or Point of Inflection?**

Kinds of differentiation

- **Product rule**
- **Chain rule**
- **Partial derivate**
- **Power rule**
- **Reciprocal Rule**
- **Quotient Rule**
- **Subtraction rule**
- **Implicit**
- **L’ Hopital rule**

Some problems

The power rule: The power rule is used to differentiate functions of the form,whenever is a real number.The power rule,one of the most commonly used rules in calculus,says:

The derivative of x^n is nx^{n-1}

Example:

$Y = 5x^2 + 2x^3$

Now differational with x,

$\frac{dy}{dx} = 5\,\frac{d}{dx}\,x^2 + 2\,\frac{d}{dx}\,x^3$

$= 5\,(2\,x^{2-1}) + 2\,(3\,x^{3-1})$

$= 5.2\,x + 2.\,3\,x^2$

$=10x + 6\,x^2$

Some problems

The Product Rule : Be able to differentiate the product of two function's using the product rule.

If , Y= UV then ,
$\frac{dy}{dx}$= $u(\frac{dv}{dx})$+v $(\frac{du}{dx})$
Example:
y= x^2(3x-9)
Let, u=x^2
du/dx= 2x
Or,. v= 3x- 9
dv/dx=3
Now, Using the product rule,
dy/dx= x^2. $\frac{d}{dx}(3x-9)$+ (3x-9). $\frac{d}{dx}(x^2)$
= x^2.3+ (3x-9).2x = 3x^2 + 6x^2-18x
=9x^2-18x
=9x(x-2)

Some problems

The Quotient rule: The Quotient rule is a method of finding the derivative of a function that is the ratio of two differentiable function's.

If,

y = u/v

$$\frac{dy}{dx} = \frac{v\frac{du}{dx} - u\,\frac{dv}{dx}}{v^2}$$

Example:

y = $\frac{e^x}{x^2}$

Let,

u = e^x

v = x^2

Some problems

Using the Quotient rule's ,

$$\frac{dy}{dx} = \frac{x^2 \frac{d}{dx} \ e^x - e^x \ \frac{d}{dx} x^2}{(x^2)^\wedge 2}$$

$$= \frac{e^x * \ x^2 - e^x * 2x}{x^4}$$

$$= \frac{e^x * x(x-2)}{e^x}$$

$$= \frac{e^x \ (x-2)}{x^3}$$

Some problems

Partial derivative:

A derivative of a function of two or more variables with respect to one variable, the other(s) being treated as constant.

Example: $z = 4e^{x^2y^3}$

Differentiating ***z*** with respect to ***x*** taking ***y*** as constant,

$$\frac{\partial z}{\partial x} = \frac{\partial}{\partial x}\left(4e^{x^2y^3}\right)$$

$$\frac{\partial z}{\partial x} = 4e^{x^2y^3} * \frac{\partial}{\partial x}(x^2y^3) \quad \textbf{(Using Chain Rule)}$$

$$\frac{\partial z}{\partial x} = 4e^{x^2y^3} * y^3\frac{\partial}{\partial x}(x^2) \quad \textbf{(Here, y is constant)}$$

$$\frac{\partial z}{\partial x} = 4e^{x^2y^3} * y^3 2x$$

$$\frac{\partial z}{\partial x} = 8xy^3e^{x^2y^3}$$

Some problems

Differentiating ***z*** with respect to ***y*** taking ***x*** as constant,

$$\frac{\partial z}{\partial y} = \frac{\partial}{\partial y}\left(4e^{x^2y^3}\right)$$

$$\frac{\partial z}{\partial y} = 4e^{x^2y^3} * \frac{\partial}{\partial y}(x^2y^3)$$ **(Using Chain Rule)**

$$\frac{\partial z}{\partial y} = 4e^{x^2y^3} * x^2\frac{\partial}{\partial y}(y^3)$$ **(Here, x is constant)**

$$\frac{\partial z}{\partial y} = 4e^{x^2y^3} * x^2 3y^2$$

$$\frac{\partial z}{\partial y} = 12x^2y^2e^{x^2y^3}$$

L’HOPITAL RULE

In mathematics, more specifically calculus, L'Hôpital's rule or L'Hospital's rule provides a technique to evaluate limits of indeterminate forms. Application of the rule often converts an indeterminate form to an expression that can be easily evaluated by substitution.

When we use It-

Some problems

- $\lim_{x \to +\infty} \frac{x}{e^x}$ = $\frac{\infty}{e^\infty}$ = $\frac{\infty}{\infty}$
- The numerator and denominator have a limit of ∞, so the limit is an indeterminate from of type ∞ /∞ .
- Appling L'Hopital's rules yields.
- $\lim_{x \to +\infty} \frac{x}{e^x}$
- $= \lim_{x \to +\infty} \frac{\frac{d}{dx}(x)}{\frac{d}{dx}(e^x)}$
- (note that the derivative of e^x is e^x)
- = $\lim_{x \to +\infty} \frac{1}{e^x}$
- =$\frac{1}{e^\infty}$
- =$\frac{1}{\infty}$
- =∞
- Answer=∞

Some problems

The Reciprocal Rule

Consider

y = $1u$ where (u) is a function in terms of x.

Therefore,

$\frac{dy}{dx} = \frac{-(\frac{d(u)}{dx})}{u^2}$

Example:

Given

Y = 12x find, dydx

Using reciprocal rule, we get.

U=2x $dudx$=2

$dydx$= -dudxu2

= -2(2x)2

=-2 4x2

Differentiating both sides of the equation

The chain rule was used here because y is a function of x

Application

- To calculate the profit and loss in business using graphs.
- To check the temperature variation.
- To determine the speed or distance covered such as miles per hour, kilometre per hour etc.
- Derivatives are used to derive many equations in Physics.
- In the study of Seismology like to find the range of magnitudes of the earthquake.