10 m ฿.

- Gold, Bond, Stocks (Invest).
- Travel.
- Gamble.
- Land & House.

Land (Rent)
Labor (Wage)
Capital (Interest)

→ Entrepreneur. (profit)

Example: Coffee shop owner.

Revenue = 200,000 ฿/month.

Costs of Labor, Land, capital = 150,000 ฿/mon.

⟹ Profit = 50,000 ฿/month → accounting profit.

If the owner could have worked in a company and earn 30,000 ฿

⟹ Economic Profit = 50,000 − 30,000
= 20,000 ฿/month.

If the salary at the company = 50,000 ฿ as well.

⇒ Economic Profit = 50,000 − 50,000

= 0 ฿.

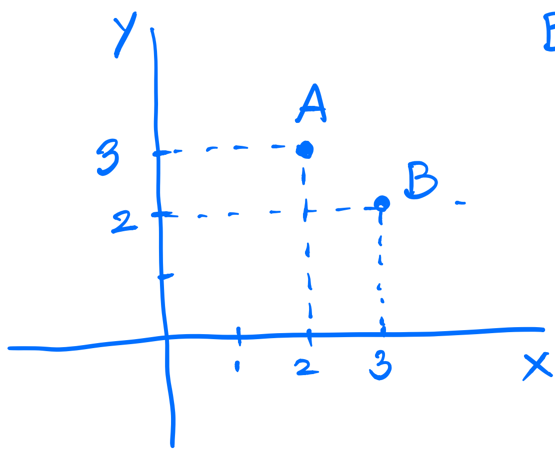
⇒ the owner receives **Normal Profit**.

If Economic Profit > 0 ⇒ Excess Profit.

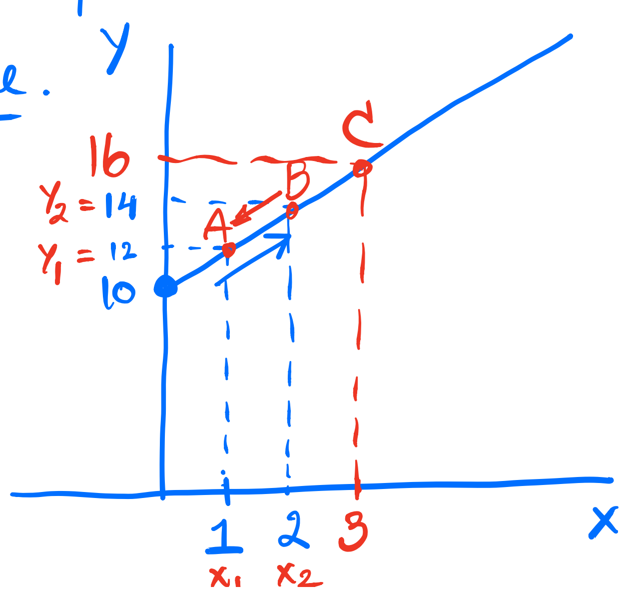
Graph.

A = (2, 3)

B = (3, 2)



Line.



x	y
0	10
1	12
2	14

a line tells us the relationship between x & y. – that as
x increases
y also increases.

we can write the function to describe this relationship as

$$Y = 10 + 2x.$$ — a straight line.
— linear function.

Slope = rate of change of Y per unit change of X.

Ex. from A to B. $\Delta X = X_2 - X_1 = 1$
$\Delta Y = Y_2 - Y_1 = 14 - 12 = 2$

$$\text{slope} = \frac{\Delta Y}{\Delta X} = \frac{2}{1} = 2.$$

From A to C $\left.\begin{array}{l}\Delta X = 2 \\ \Delta Y = 4\end{array}\right\}$ $\text{slope} = \frac{4}{2} = 2$

Linear $\Rightarrow$ Slope is constant
- X can change by any amount and we will have Y change in such a way that we have same slope.

$$\text{Slope} = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} \text{ from A to B.}$$

From B to A, x decreases.

$$\Delta x = x_1 - x_2 = 1 - 2 = -1$$

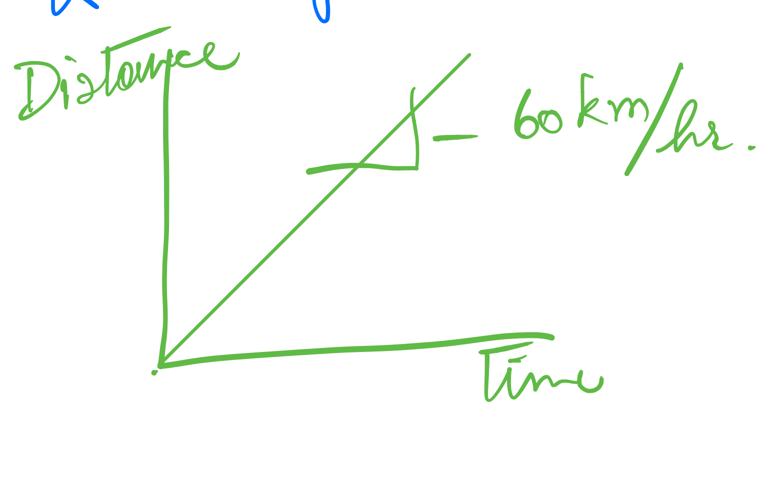
$$\Delta y = y_1 - y_2 = 12 - 14 = -2$$

$$\text{slope} = \frac{\Delta y}{\Delta x} = \frac{-2}{-1} = 2$$

$$= \frac{y_1 - y_2}{x_1 - x_2} = \frac{-(y_2 - y_1)}{-(x_2 - x_1)} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$y = 10 + 2x$$

$\frac{dy}{dx} = 2$ — slope when $\Delta x \to 0$.



If we know the slope, we can estimate how much y will change if we allow x to change (slightly)

$$\frac{dy}{dx} = 2.$$

$$\Delta y \approx 2 \cdot \Delta x.$$

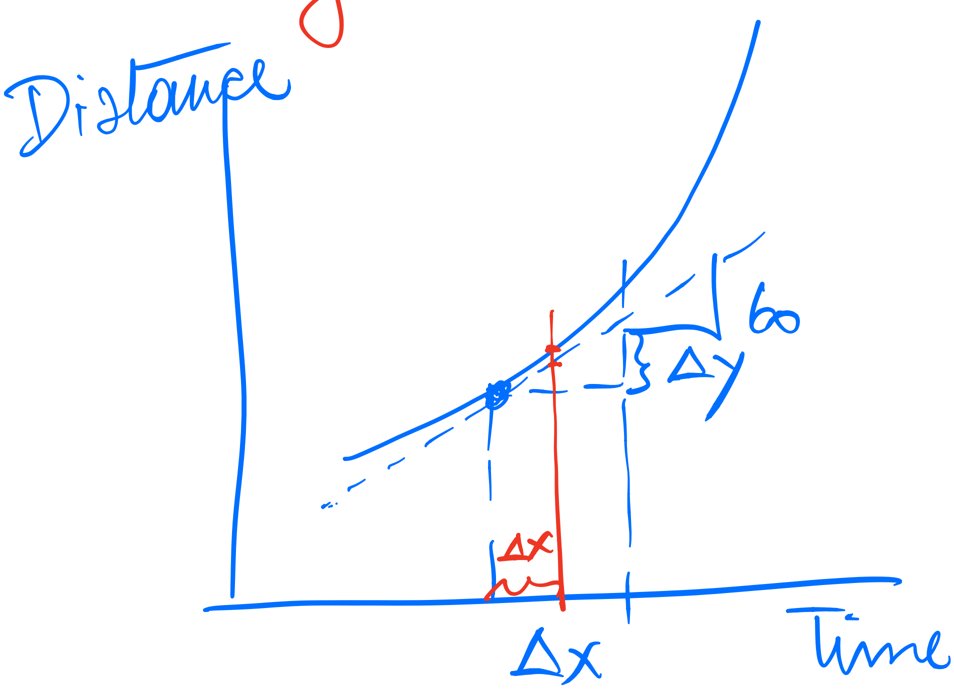
if $\Delta x \to 0$ $\quad dy = 2\,dx.$

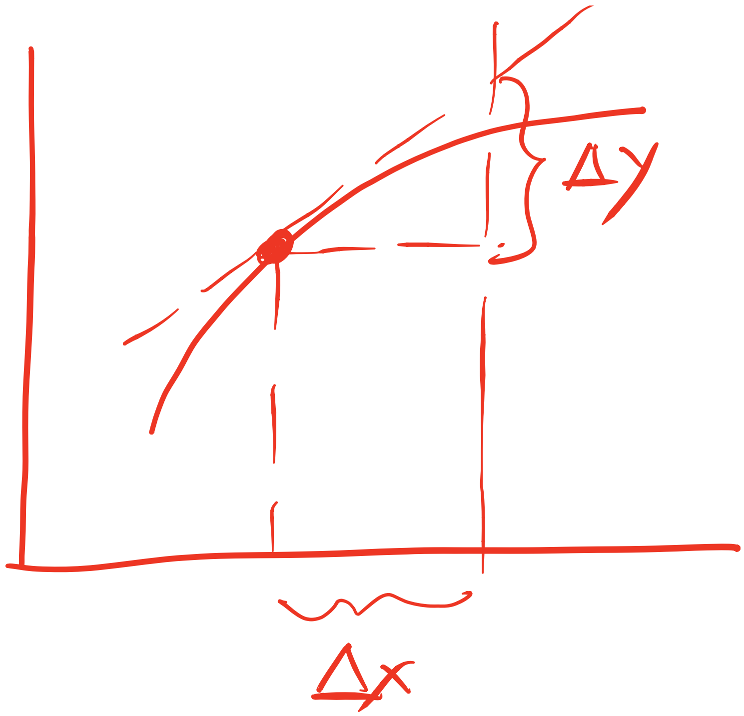
$y = f(x)$

$\frac{dy}{dx} = f'(x)$

$dy = f'(x)\,dx.$

$y = 10 + 2x.$

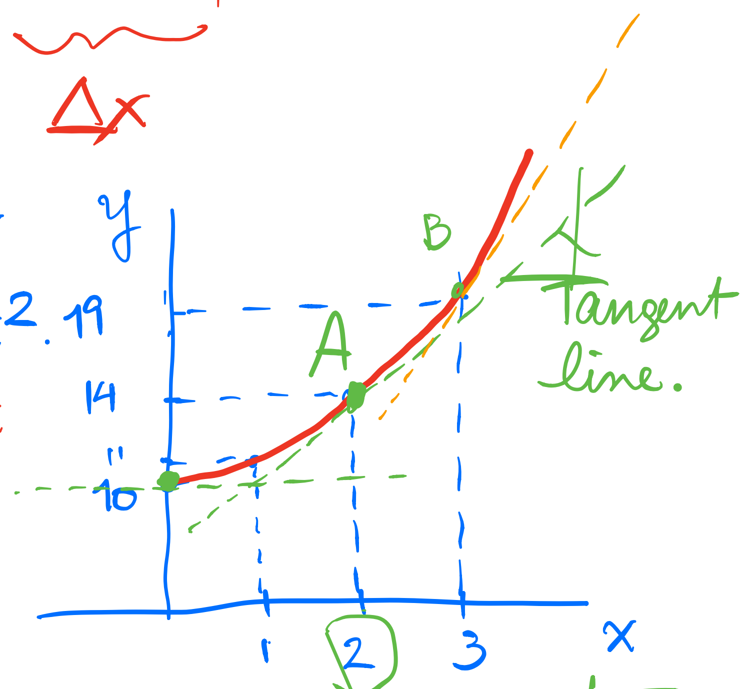




Nonlinear line.

$y = 10 + x^2.$

x	y	$dy/dx = 2x$
0	10	0
1	11	2
2	14	4
3	19	6



Slope at a point $x = 2$. = slope of tangent line touching the graph at $x=2$.

$$\frac{dy}{dx}\ \frac{d}{dx}\left(10+x^2\right) = 2x$$

$x=2$ | $\frac{dy}{dx} = 2x = 2(2) = 4.$

- as x increases, the slope is increasing.
- when $\boxed{x=2,\ y=14.}$ (slope $= 4$).

$\Delta x = 0.1$ — x increases from 2 to 2.1

$$\Delta y \approx \frac{dy}{dx} \cdot \Delta x$$

$$= 4 \times (.1) = 0.4.$$

what is the real change in y?

$$\boxed{x = 2.1,\ y = 10 + (2.1)^2 = 14.41}$$

$\therefore \Delta y = 14.41 - 14 = 0.41$

H.W. $y = 10 + \sqrt{x}$.

x	y	dy/dx
0		
1		
2		
3		

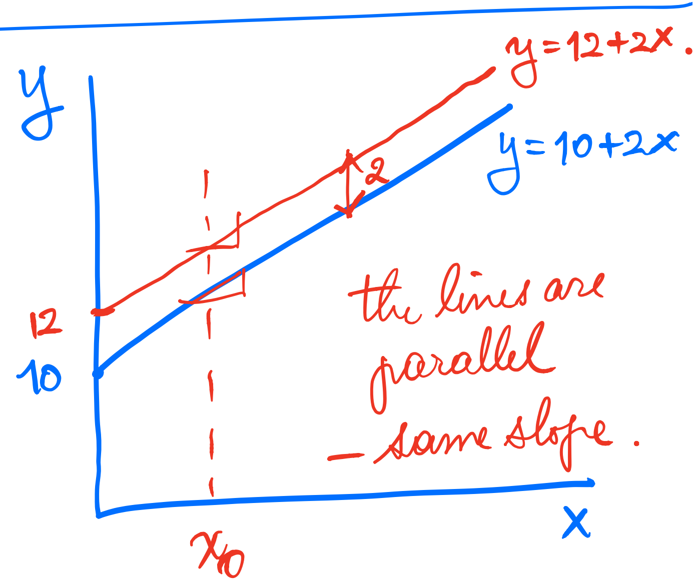
Find $\frac{dy}{dx}$.

Approximate Δy when $x = 2$, $\Delta x = 0.1$ and $\Delta x = -0.2$. Compare the actual Δy to find the errors.

Shift of graph.

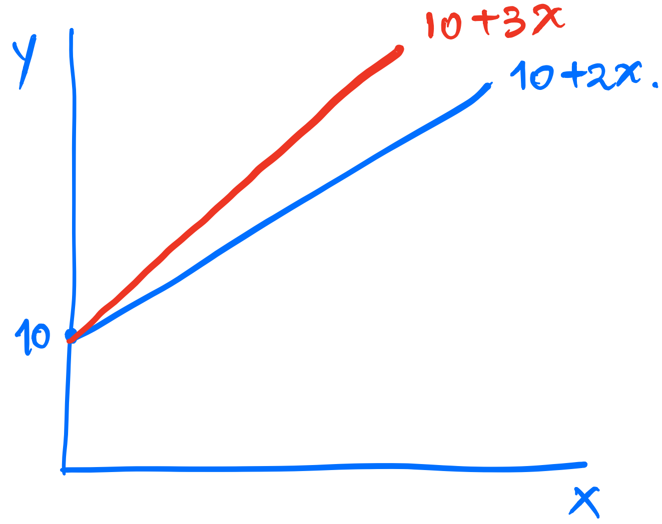
$y = 10 + 2x$. y-intercept slope

$y = 12 + 2x$.



$y = 10 + 2x$

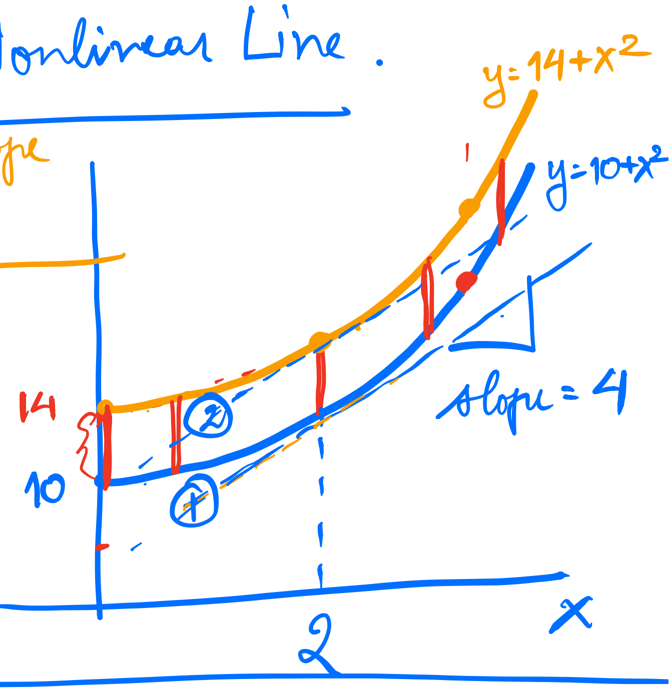
$y = 10 + 3x$



Shift of graph of Nonlinear Line.

		Slope
$y = 10 + x^2$	14	4
$y = 14 + x^2$	18	

when $x = 2.$



Slope > 0 ⇒ when x increases, y also increases
(decreases) (decreases)

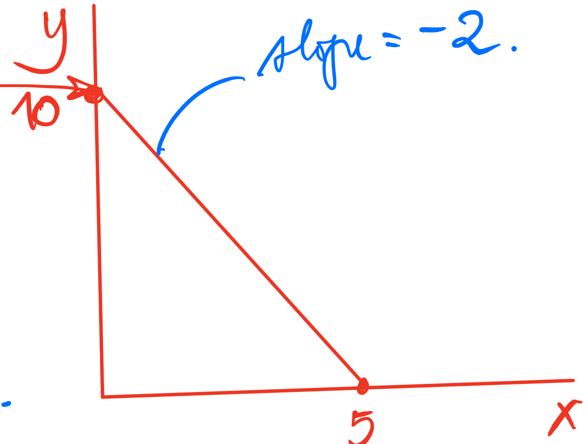
i.e. x + y have positive relation.

Slope can be negative.

$y = 10 - 2x.$

$x = 0;\ y = 10$

$y = 0,\ x = 5$



slope = −2.

if x increases by 1

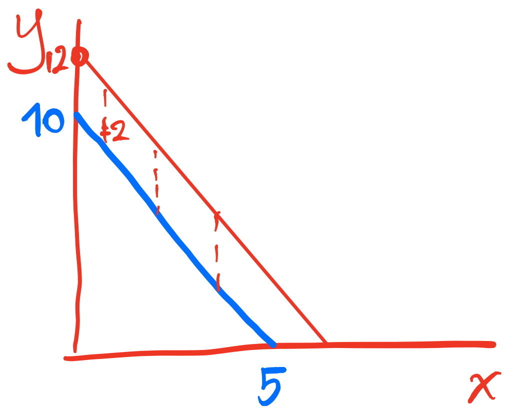
y decreases by 2.

x & y have negative relationship when slope < 0.

Shift of graph with negative slope.

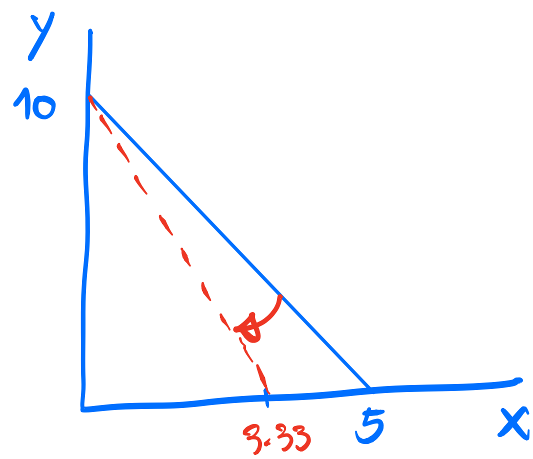
$y = 10 - 2x$

$y = 12 - 2x$



$y = 10 - 2x$

$y = 10 - 3x$

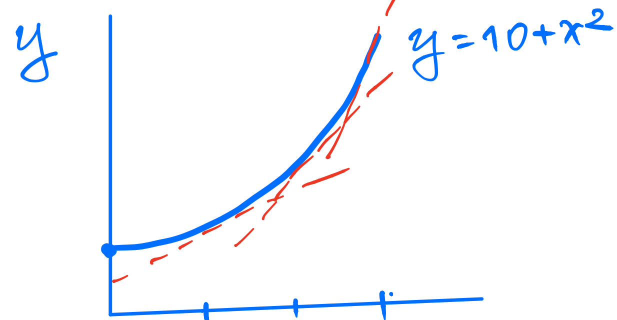


$y = 10 + x^2$

$$\frac{d^2y}{dx^2} = \frac{d}{dx}\left(\frac{dy}{dx}\right) = \frac{d}{dx}2x = 2$$

= slope of slope.

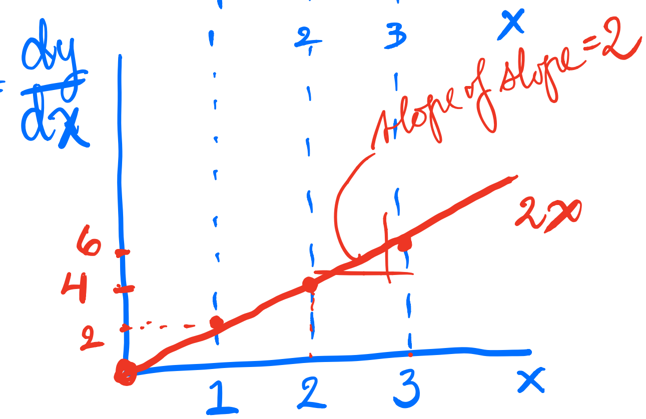
x	y	$\frac{dy}{dx} = 2x$, slope	$\frac{d^2y}{dx^2} = 2$
0	10	0	2
1	11	2	2
2	14	4	2
3	19	6	2



Here slope of slope $= 2 > 0$

It means as x increases the slope is increasing

slope $= \frac{dy}{dx}$



H.W. Find 2^{nd} order derivative of $y = 10 + \sqrt{x}$ and plot the graph of y and $\frac{dy}{dx}$.

Is the slope of slope a constant.