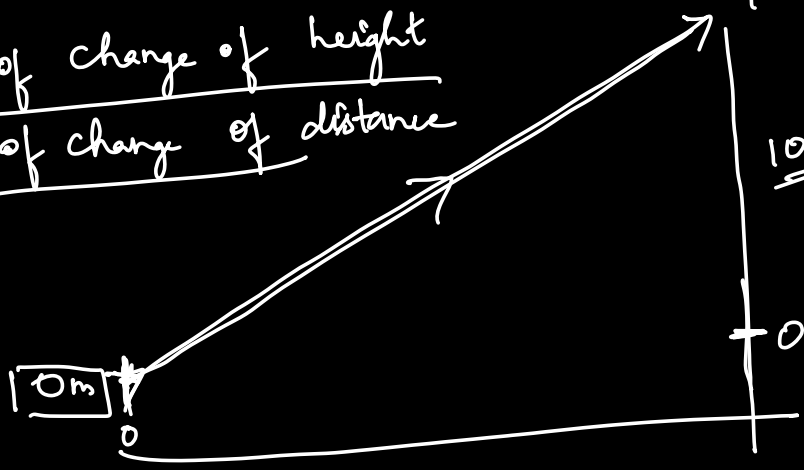
$y = 3x + 2$

intercept

Slope $= \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{\text{rate of rise}}{\text{rate of distance}}$

$\dfrac{\text{rate of change of height}}{\text{rate of change of distance}}$



$100 = \dfrac{100 - 0}{10 - 0}$

$100m = \dfrac{100}{10}$

$\Rightarrow = 10$

$\dfrac{0}{10} = 0$

$= 0$

$0 - 100$

-10

Independent
Number of Toppings
denominator

dollars
Cost of Pizza
numerator

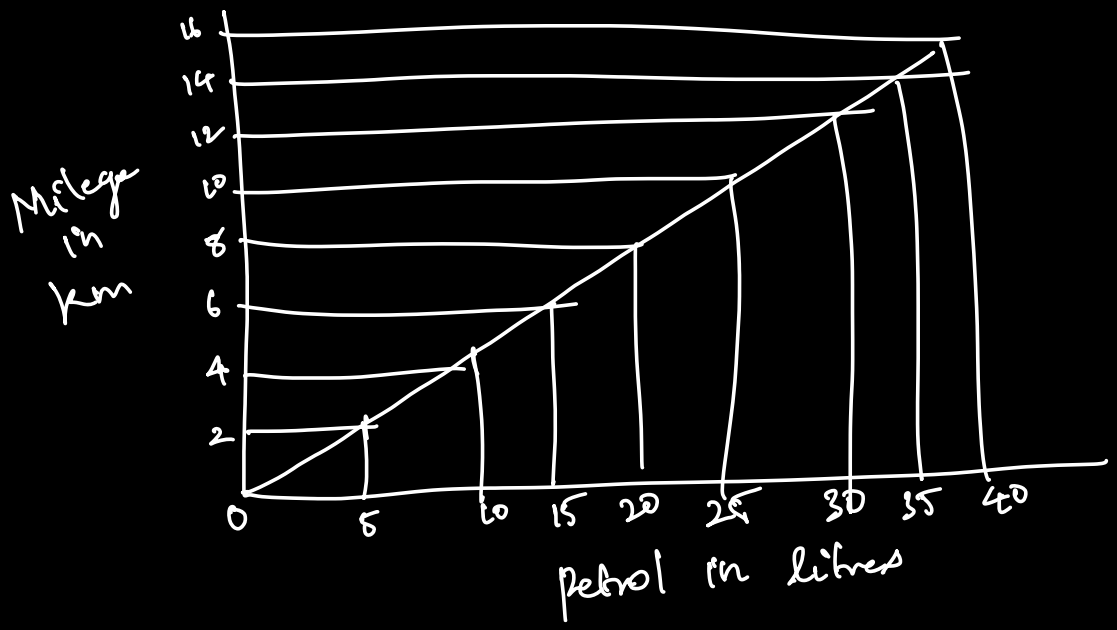
1	9.50
3	12.50
4	14.00

$$\frac{\text{rate of change of cost of pizza}}{\text{rate of change of Topping}}$$

$$\frac{12.50 - 9.50}{3 - 1} = \frac{3}{2} = 1.5$$

$$\frac{14 - 12.50}{4 - 3} = \frac{1.5}{1} = 1.5$$

Slope


Mileage in km
16
14
12
10
8
6
4
2
0
5
10
15
20
25
30
35
40
petrol in litres

Target = y - axis

= Mileage

Independent = petrol

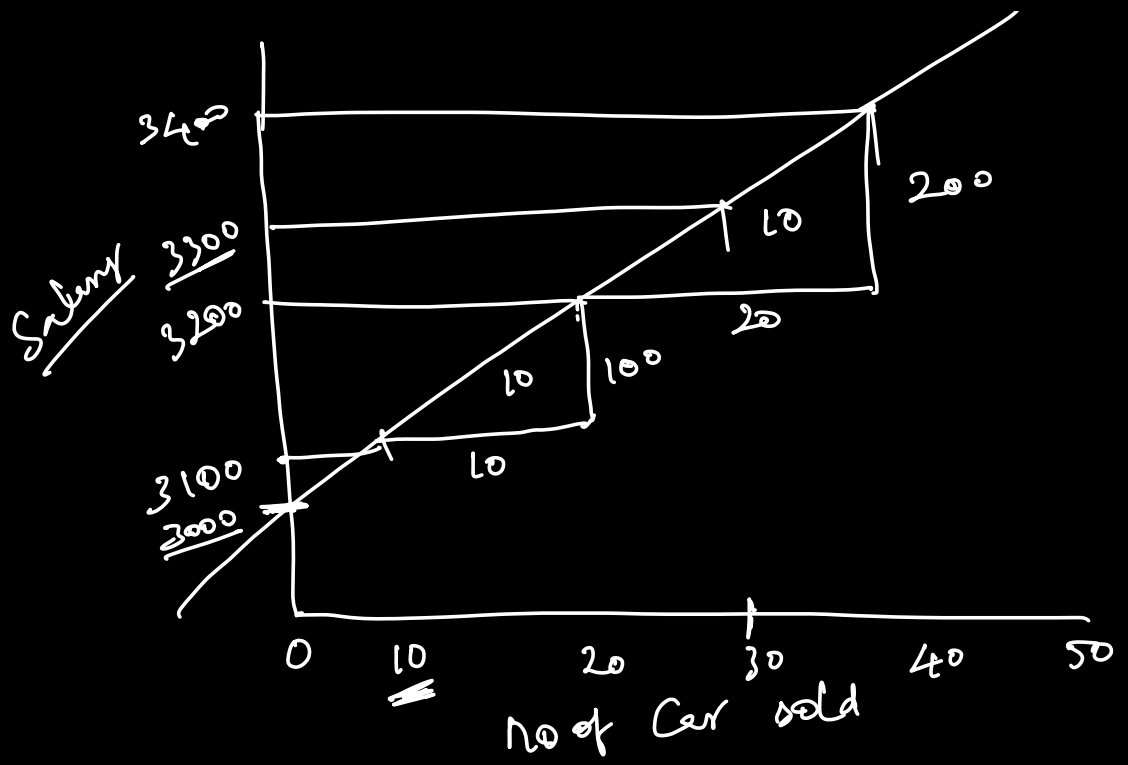
$$= \frac{\text{rate of Change of Mileage}}{\text{rate of Change of petrol}}$$

$$= \frac{14 - 10}{15 - 5}$$

$$= \frac{4}{10} = 0.4$$

for every 1 litre of petrol you can Drive 0.4 Km

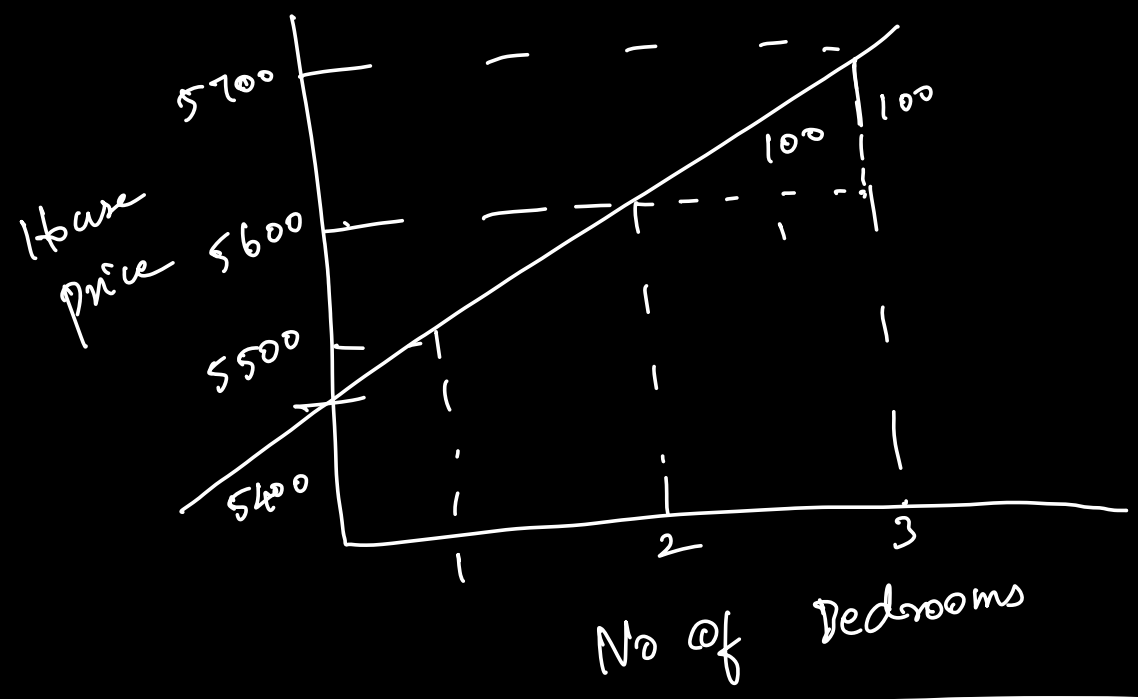
for every 10 liter of petrol you can drive 4 Km



Base Salary = 3000

Incentive = $10 for each car

$$\text{Salary} = \underbrace{3000}_{\text{Intercept constant}} + \underbrace{10}_{\text{Slope}}(\text{Car sold})$$



Cost of house price = 5400 + 100 (Number of bedrooms)

Linear Algebra

$$2x + 3y = 6 \quad \times 3$$
$$3x + 2y = 9 \quad \times 2$$

$x = 5$ $\quad$ $y = 1$

$$6x + 9y = 18$$
$$6x + 4y = 18$$
$$5y = 0$$
$$y = 0$$

$$3x + 2y = 9$$
$$3x + 2(0) = 9$$
$$3x = 9$$
$$x = 3$$

$(3, 0)$

$$5x - 2y = 20 \quad \times 5$$
$$3x + 5y = 30 \quad \times 2$$

$$25x - 10y = 100$$
$$6x + 10y = 60$$

$$31x = 160$$

$$\boxed{x = 160/31} = \boxed{5.16}$$

$$5x - 2y = 20$$

$$5\left(\frac{160}{31}\right) - 2y = 20$$

$$-2y = 20 - 5\left(\frac{160}{31}\right)10$$

$$\boxed{y = \pm 2.9}$$

$$2x + 3y + z = 15$$
$$x + y + z = 10 \quad \times 2$$
$$x + 2y + z = 12 \quad \times 2$$

$$\begin{pmatrix} 2 & 3 & 1 \\ 1 & 1 & 1 \\ 1 & 2 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 15 \\ 10 \\ 12 \end{pmatrix}$$

$$\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 15 \\ 10 \\ 12 \end{pmatrix} \begin{pmatrix} \quad \\ \quad \\ \quad \end{pmatrix}^{-1}$$

$$\rightarrow$$

$$x + 2y + z = 12$$
$$2x - y + z = 1$$
$$x + y - 3z = -4$$

$$\begin{pmatrix} 1 & 2 & 1 \\ 2 & -1 & 1 \\ 1 & 1 & -3 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 12 \\ 1 \\ -4 \end{pmatrix}$$

$$A \quad X = B$$

$$A^{-1}(AX) = B(A^{-1})$$

$$\begin{pmatrix} 2/19 & 7/19 & 3/19 \\ & & \end{pmatrix} \begin{pmatrix} 1 & 2 & 1 \\ 2 & -1 & 1 \\ 1 & 1 & -3 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 12 \\ 1 \\ -4 \end{pmatrix} \begin{pmatrix} & \\ & \\ A^{-1} & \end{pmatrix}$$

$$\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 1 \\ -4 \\ 3 \end{pmatrix}$$

$$A^{-1} = \frac{1}{|A|} \text{adj}(A)$$

$$[\,A \mid I\,] \leftarrow \text{Identity matrix}$$

$$[\,I \mid A^{-1}\,]$$

$$A = \begin{bmatrix} 3 & 0 & 2 \\ 2 & 0 & -2 \\ 0 & 1 & 1 \end{bmatrix}$$

$$\left[\begin{array}{ccc|ccc} 3 & 0 & 2 & 1 & 0 & 0 \\ 2 & 0 & -2 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 \end{array}\right] \quad (I)$$

add $R_1 + R_2 = R_1$

$$\left[\begin{array}{ccc|ccc} 5 & 0 & 0 & 1 & 1 & 0 \\ 2 & 0 & -2 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 \end{array}\right]$$

$R_1 = R_1 / 5$

$$\left[\begin{array}{ccc|ccc} 1 & 0 & 0 & 1/5 & 1/5 & 0 \\ 2 & 0 & -2 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 \end{array}\right]$$

$2R_1 - R_2 \Rightarrow R_2$

$$\left[\begin{array}{ccc|ccc} 1 & 0 & 0 & 0.2 & 0.2 & 0 \\ 0 & 0 & 2 & 0.4 & -0.6 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 \end{array}\right]$$

$R_2 \; 1/2 = R_2$

$$\left[\begin{array}{ccc|ccc} 1 & 0 & 0 & 0.2 & 0.2 & 0 \\ 0 & 0 & 1 & 0.2 & -0.3 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 \end{array}\right]$$

$R_2 \leftrightarrow R_3$

$$\left[\begin{array}{ccc|ccc} 1 & 0 & 0 & 0.2 & 0.2 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0.2 & -0.3 & 0 \end{array}\right]$$

$$R_2 = R_2 - R_3$$

$$\left[\begin{array}{ccc|ccc} 1 & 0 & 0 & 0.2 & 0.2 & 0 \\ 0 & 1 & 0 & -0.2 & 0.3 & 1 \\ 0 & 0 & 1 & 0.2 & -0.3 & 0 \end{array}\right]$$

$$A^{-1} = \begin{pmatrix} 0.2 & 0.2 & 0 \\ -0.2 & 0.3 & 1 \\ 0.2 & -0.3 & 0 \end{pmatrix}$$

X	Y
1	2
2	3
4	7
5	5
7	1

$y = mx + b$

Slope (m), Intercept (b)

$$(5\times 2)\quad \begin{pmatrix} 1 & 1 \\ 2 & 1 \\ 4 & 1 \\ 5 & 1 \\ 7 & 1 \end{pmatrix} \begin{pmatrix} m \\ b \end{pmatrix} = \begin{pmatrix} 2 \\ 3 \\ 7 \\ 5 \\ 11 \end{pmatrix}$$

$A \times B \Rightarrow C$

$A_{2\times 3}$ $B_{3\times 2}$ $C_{2\times 2}$

$m \times n$ $n \times i$

$$X \begin{pmatrix} m \\ b \end{pmatrix} = Y$$

$$X^T \cdot X \begin{pmatrix} m \\ b \end{pmatrix} = Y X^T$$

$$\begin{pmatrix} 1 & 1 \\ 2 & 1 \\ 4 & 1 \\ 5 & 1 \\ 7 & 1 \end{pmatrix} \times \begin{pmatrix} 1 & 2 & 4 & 5 & 7 \\ 1 & 1 & 1 & 1 & 1 \end{pmatrix}$$

$$\begin{pmatrix} 1 & 2 & 4 & 5 & 7 \\ 1 & 1 & 1 & 1 & 1 \end{pmatrix} \quad \begin{pmatrix} 1 & 1 \\ 2 & 1 \\ 4 & 1 \\ 5 & 1 \\ 7 & 1 \end{pmatrix}$$

$(2 \times 5) \qquad (5 \times 2)$

(2×2)

$$\begin{pmatrix} 1+4+16+25+49 & 1+2+4+5+7 \\ 1+2+4+5+7 & 1+1+1+1+1 \end{pmatrix}$$

$$\begin{pmatrix} 95 & 19 \\ 19 & 5 \end{pmatrix}$$

$$A_{i \times j} \cdot B_{m \times n} = C_{i \times n}$$

$$\begin{pmatrix} 95 & 19 \\ 19 & 5 \end{pmatrix}\begin{pmatrix} m \\ b \end{pmatrix} = \begin{pmatrix} 1 & 2 & 4 & 5 & 7 \\ 1 & 1 & 1 & 1 & 1 \end{pmatrix}\begin{pmatrix} 2 \\ 3 \\ 7 \\ 5 \\ 11 \end{pmatrix}$$

$$\begin{pmatrix} 95 & 19 \\ 19 & 5 \end{pmatrix}\begin{pmatrix} m \\ b \end{pmatrix} = \begin{pmatrix} 2+6+28+25+77 \\ 2+3+7+5+11 \end{pmatrix}$$

$$\begin{pmatrix} 95 & 19 \\ 19 & 5 \end{pmatrix}\begin{pmatrix} m \\ b \end{pmatrix} = \begin{pmatrix} 136 \\ 28 \end{pmatrix}$$

$$\begin{pmatrix} m \\ b \end{pmatrix} = \begin{pmatrix} 79/57 \\ 1/3 \end{pmatrix}$$

$$\approx \begin{pmatrix} 1.38 \\ 0.33 \end{pmatrix}$$

$$y = 1.38x + 0.33$$

X	Y
1	8
2	10
3	12

$$\begin{pmatrix} 1 & 1 \\ 2 & 1 \\ 3 & 1 \end{pmatrix} \begin{pmatrix} m \\ b \end{pmatrix} = \begin{pmatrix} 8 \\ 10 \\ 12 \end{pmatrix}$$

X Y

$$X \begin{pmatrix} m \\ b \end{pmatrix} = Y$$

$$X^T \cdot X \begin{pmatrix} m \\ b \end{pmatrix} = X^T \cdot Y$$

A

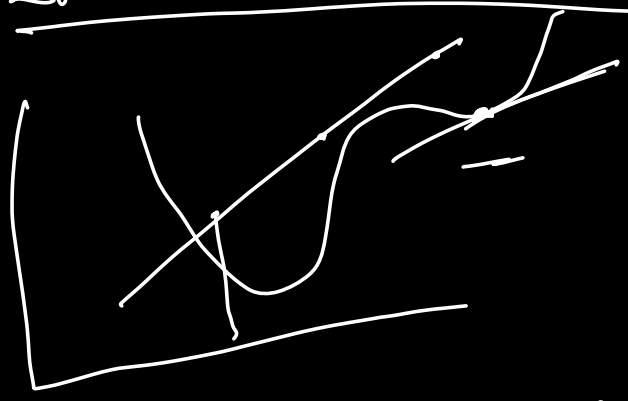
$$\begin{pmatrix} & \\ & \end{pmatrix} \begin{pmatrix} m \\ b \end{pmatrix} = \begin{pmatrix} & \\ & \end{pmatrix}$$

# Bed Room	House Price
2	45
1	40
3	60
5	75

Derivative

Manufacture Biscuit

$$Cost(x) = 2500 - 10x - 0.01x^2 + 0.0002x^3$$



$$0 - 10 - 2(0.01)x^1 + 3(0.0002)x^2$$

$$\frac{d}{dx} = x^2 + x^3 + 500 + x$$

$$= 2x + 3x^2 + 0 + 1$$

$$x^n \Rightarrow nx^{n-1}$$

$$\frac{d}{dx} = -10 - 2(0.01)x + 6(0.00)x^2$$

$$= -10 - 0.02x + 0.0006x^2$$

$$\frac{d(200)}{dx} = -10 - 0.02(200) + 0.0006(200)^2$$

$$= -10 - 4 + 24$$

$$= -14 + 24$$

$$= 10$$

$$\frac{f(300)}{dx} = -10 - 0.02(300) + 0.0006(300)^2$$

$$= -10 - 6 + 54$$

$$= -16 + 54$$

$$= 38$$ ✓

$y = 6x^2 + 2x - 10$ ✓

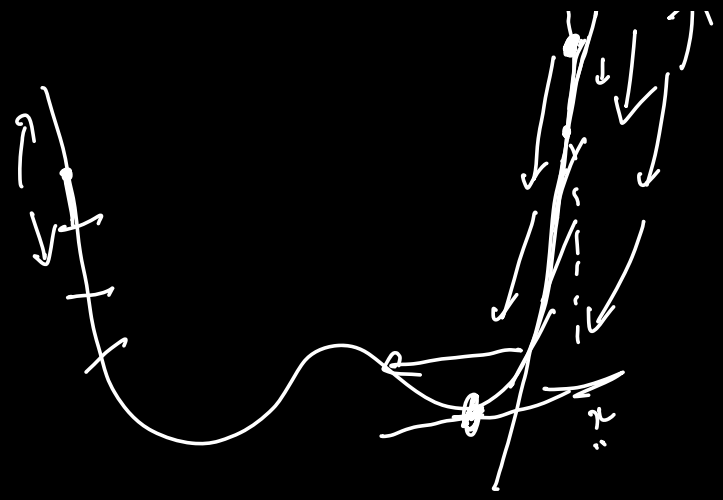
what is the value of x where y is minimum ?

$$\frac{dy}{dx} = 2(6x^{2-1}) + 1(2x^{1-1}) - 0$$

$$= 2(6x) + 1(2x^0)$$

$$= 12x + 2(1)$$

$$= 12x + 2$$



learning rate

$$\frac{d(0)}{dx}$$

+0 ←

→

− 0

derivate → direction

learning rate → magnitude

start = 0

find derivative → direction + or −

learning rate → 0.01 → 0.5