Assignment – 05

Let consider a sample dataset have one input (x_i^9) & one o/p (y_i^9) and number of samples 4. Develop a simple linear regression model using MBGD.

sample(i)	x_i^9	y_i^9
1	0.2	3.4
2	0.4	3.8
3	0.6	4.2
4	0.8	4.6

- Do manual calculations for two iterations with batch size 2.

Sol:-

sample(i)	x_i^9	y_i^9
1	0.2	3.4
2	0.4	3.8

step1:- [x,y], m=1, c=1, η=0.1, epochs = 2, bs = 2, no of samples(ns) = 2

step2:- $n_b = \frac{n_s}{bs} = \frac{2}{2} = 1$

step3:- ~~bdebeed~~ iter = 1

step4:- batch = 1

step5:- $\frac{\partial E}{\partial m} = -\frac{1}{bs}\sum_{i=1}^{bs}(y_i - mx_i - c)(x_i)$

$= -\frac{1}{2}\left[[3.4 - (1)(0.2) - 1](0.2) + (3.8 - (1)(0.4) - 1)(0.4)\right]$

$= -\frac{1}{2}\left[(2.2)(0.2) + (2.4)(0.4)\right]$

$$\frac{\partial E}{\partial m} = \frac{-1}{2}(1.4)$$

$$\frac{\partial E}{\partial m} = -0.7$$

$$\frac{\partial E}{\partial c} = \frac{-1}{bs}\sum_{i=1}^{bs}(y_i - mx_i - c)$$

$$= \frac{-1}{2}\left[(3.4 - (1)(0.2) - 1) + (3.8 - (1)(0.4) - 1)\right]$$

$$= \frac{-1}{2}\left[2.2 + 2.4\right]$$

$$\frac{\partial E}{\partial c} = +2.3$$

step6:- $\Delta m = -\eta \frac{\partial E}{\partial m}$ $\Delta c = -\eta \frac{\partial E}{\partial c}$

$= -0.1(-0.7)$ $= -(0.1)(-2.3)$

$\Delta m = 0.07$ $\Delta c = 0.23$

step7:- $m = m + \Delta m$ $c = c + \Delta c$

$= 1 + 0.07$ $= 1 + 0.23$

$m = 1.07$ $c = 1.23$

step8:- batch = batch + 1

$= 1 + 1 = 2$

step9:- if (batch > nb):

$2 > 1$ ✓

True: goto next step ✓

false: goto step 5

step10:- iter = iter + 1

step11:- if (iter > epochs)

$2 > 2$ ✗

True: go to next step

false: go to step 4. ✓

step4:- batch = 1

step5:-

$$\frac{\partial E}{\partial m} = \frac{-1}{bs} \sum_{i=1}^{bs} (y_i - mx_i - c)(x_i)$$

$$= \frac{-1}{2}\left[[3.4 - (1.07)(0.2) - 1.23](0.2) + [3.8 - (1.07)(0.4) - 1.23](0.4)\right]$$

$$= \frac{-1}{2}\left[(1.956)(0.2) + (2.142)(0.4)\right]$$

$$\boxed{\frac{\partial E}{\partial m} = -0.624}$$

$$\frac{\partial E}{\partial c} = \frac{-1}{bs} \sum_{i=1}^{bs} (y_i - mx_i - c)$$

$$= \frac{-1}{2}\left[(3.4 - (1.07)(0.2) - 1.23) + (3.8 - (1.07)(0.4) - 1.23)\right]$$

$$= \frac{-1}{2}\left[1.956 + 2.142\right]$$

$$\boxed{\frac{\partial E}{\partial c} = -2.049}$$

step6:- $\Delta m = -\eta \frac{\partial E}{\partial m}$ $\quad \Delta c = -\eta \frac{\partial E}{\partial c}$

$= -(0.1)(-0.624)$ $\quad = -(0.1)(-2.049)$

$$\boxed{\Delta m = 0.0624} \qquad \boxed{\Delta c = 0.2049}$$

step7:- $m = m + \Delta m$

$= 1.07 + 0.0624$

$m = 1.1324$

$c = c + \Delta c$

$= 1.123 + 0.2049$

$c = 1.4349$

step8:- batch = batch + 1

$= 1 + 1$

$= 2$

step9:- if (batch > nb)

$2 > 1$ ✓

True: goto next step.

False: goto step 5.

step10:- iter = iter + 1

$= 2 + 1$

$= 3$

step11:- if (iter > epochs)

$3 > 2$ ✓

True: goto next step ✓

false: goto step 4.

step12:- print m and c values

$m = 1.1324, c = 1.4349.$