ASSIGNMENT-5

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Let consider a sample dataset have one input (x_i^2) and one output (y_i^2), and number of samples 4. Develop a simple linear regression model using MBGD.

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

Manual Calculations:

Step 1: Read dataset [x, y]

$\eta = 0.1$, $m = 1$, $c = -1$, epochs = 2, batchsize = 2

Step 2: Split training data into batches

Batch 1

0.2	3.4
0.8	4.6

Batch-2

0.4	3.8
0.6	4.2

Step 4: Batch = 1

Step 43: ifr = 1

step5: $\frac{\partial E}{\partial m} = -\frac{1}{2}\Big((3.4 - (1)(0.2) - (-1))(0.2) + ((4.6 - (1)(0.8) - (-1))(0.8)\Big)$

$= -\frac{1}{2}\big((4.2)(0.2) + (4.8)(0.8)\big)$

$= -2.34$

$\frac{\partial E}{\partial c} = -\frac{1}{2}\big[4.2 + 4.8\big]$

$= -4.5$

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

$= -(0.1)(-2.34) = 0.234$

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

$= -(0.1)\cdot(-4.5) = 0.45$

step7: $m = m + \Delta m$

$= 1 + 0.234 = 1.234$

$c = c + \Delta c$

$= -1 + 0.45 = -0.55$

step8: batch = batch + 1

$= 1 + 1 = 2$

step9: if batch > nb

false

goto step 5

Step5: $\frac{\partial E}{\partial m} = -\frac{1}{2}\left((3.8 - (1.034 \times 0.4) + 0.55)(0.4) + (4.2 - (1.034 \times 0.6) + 0.55)(0.6) \right)$

$= -\frac{1}{2}\left((3.8564)(0.4) + (4.0096)(0.6) \right)$

$= -1.97416$

$\frac{\partial E}{\partial c} = -\frac{1}{2}\left((3.8564)(0.4) + (4.0096)(0.6) \right)$

$= -3.933$

Step6: $\Delta m = -\eta \frac{\partial E}{\partial m} = -(0.1)(-1.97416)$

$= 0.197416$

$\Delta c = -\eta \frac{\partial E}{\partial m} = -(0.1)(-3.933)$

$= 0.3933$

Step7: $m = m + \Delta m$

$= 1.234 + 0.197416 = 1.43414$

$c = c + \Delta c$

$= -0.55 + 0.3933 = -0.1567$

Step8: batch = batch + 1

$= 2 + 1 = 3$

Step9: If batch > nb

$3 > 2$

go to next step

step10: epochs = epochs + 1

= 1+1 = 2

step11: if (epochs > epochs)

2 > 2

false → goto step 4.

step4: batch = 1

step5: $\frac{\partial E}{\partial m} = -\frac{1}{2}\Big((3.4 - (1.4314)(0.2) + 0.1567)(0.2) + (4.6 - (1.4314)(0.8) + 0.1567)(0.8) \Big)$

$= -\frac{1}{2}\Big((3.27042)(0.2) + (3.61158)(0.8) \Big)$

$= -1.77167$

$\frac{\partial E}{\partial c} = -\frac{1}{2}\Big(3.27042 + 3.61158 \Big)$

$= -3.441$

step6: $\Delta m = -\eta \frac{\partial E}{\partial m} = 0.177167$

$\Delta c = -\eta \frac{\partial E}{\partial c} = 0.3441$

step7: $m = m + \Delta m = 1.4314 + 0.177167$

$= 1.60856$

$c = c + \Delta c = -0.1567 + 0.3441$

$= 0.1874$

step8: batch = batch + 1

= 1+1 = 2

Step 9: if batch > n_b

2 > 2

goto step 5

Step 5: $\frac{\partial E}{\partial m} = -\frac{1}{2}\Big((3.8 - (1.60856)(0.4) - 0.1874)(0.4) +$

$(4.2 - (1.60856)(0.6) - 0.1874)(0.6) \Big)$

$= -\frac{1}{2}\Big((2.96917)(0.4) + (3.047464)(0.6) \Big)$

$= -1.50807$

$\frac{\partial E}{\partial c} = -\frac{1}{2}(2.96917 + 3.047464)$

$= -3.00831$

Step 6: $\Delta m = -\eta \frac{\partial E}{\partial m} = 0.150807$

$\Delta c = -\eta \frac{\partial E}{\partial c} = 0.300831$

Step 7: $m = m + \Delta m$

$= 1.60856 + 0.150807 = 1.759067$

$c = c + \Delta c$

$= 0.1874 + 0.300831 = 0.488231$

Step 8: batch = batch + 1

$= 2 + 1 = 3$

Step 9: if (batch > n_b)

3 > 2

goto next step

step10: $ep = ep + 1$

$= 2+1 = 3$

step11: if $(ep > epochs)$

$3 > 2$

goto next step

step12: print m, c

$m = 1.759067$

$c = 0.488231$

step13: MSE

$$= \frac{(3.4 - 0.84004) + (3.8 - 1.19181) + (4.2 - 1.54367) + (4.6 - 1.89548)}{4}$$

$= 2.63224$