Question 1: Prediction for the first instance

Given Data:

w[0] = -59.50, w[1] = -0.15, w[2] = 0.60

Age = 41, HeartRate = 138, OxyCon = 37.99

Given formula:

$OxyCon = w[0] + w[1] \times Age + w[2] \times HeartRate$

Solve:

$OxyCon_{predicted} = -59.50 - 0.15 \times 41 - 0.60 \times 138$

$= -148.45$

Question 2: Calculate error, squared error, and error Delta

Given: Actual OxyCon value of #1 is 37.99

$OxyCon_{actual} = 37.99$

error:

$OxyCon_{actual} - OxyCon_{predicted} = error$

$error = 37.99 + 148.45 = 186.44$

Squared Error:

$Sq\ Error = error^2$

$Sq\ Error = 186.44^2$

$= 34759.8736$

Error Deltas:

errorDelta(w[0]) = error × (dummy column)

errorDelta(w[1]) = error × Age

errorDelta(w[2]) = error × HeartRate

Given formulas

Squared Error loss

$$L2(M_w, D) = \frac{1}{2} \sum_{j=1}^{n} (t_j - M_w(d_j))^2$$

Weight update for formula gradient descent

$$w[j] \leftarrow w[j] + \alpha \sum_{i=1}^{n} (t_i - M_w(d_i)) \times d[i][j]$$

ID	Age	HeartRate	~~Actual~~ OxyCon	~~Actual~~ Predicted OxyCon	Error	Squared Error	Error Delta w[0]	Error Delta w[1]	Error Delta w[2]	Question 5 Error 2 with new weights [error2]
①	41	138	37.99	17.15	-20.84	434.3056	+20.84	854.44	~~2875.92~~ 2675.92	453.9966
②	42	153	47.34	26	-21.34	455.3956	+21.34	896.26	3265.02	477.5118
③	37	151	44.38	25.55	-18.83	354.5689	+18.83	696.71	2843.33	373.5606
④	46	133	28.17	13.4	-14.77	218.1529	+14.77	679.42	1964.21	988.5614
⑤	48	126	27.07	8.9	-18.17	330.1489	+18.17	872.16	2289.42	346.5069
⑥	44	145	37.85	20.9	-16.95	287.3025	+16.95	745.8	2457.75	304.2398
⑦	43	158	44.72	28.85	-15.87	251.8569	+15.87	682.41	2507.46	268.8989
⑧	46	143	36.42	19.4	-17.02	289.6804	+17.02	782.92	2433.86	306.6057
⑨	37	138	31.21	17.75	-13.46	181.1716	+13.46	498.02	1857.48	193.775
⑩	38	158	54.85	29.6	-25.25	637.5625	+25.25	959.5	3989.5	604.0702
⑪	43	143	~~39.84~~ 39.84	19.85	-19.99	399.6001	+19.99	859.57	~~2858.57~~ 2358.57	419.2258
12	43	138	30.83	16.85	-13.98	195.4404	+13.98	601.14	1929.24	208.82

Question 4: Calculate New weight gradient Decent

Formula: $\theta_j := \theta_j - \alpha \frac{1}{m} \sum_{i=1}^{m} (h_\theta(x^{(i)}) - y^{(i)}) \cdot x_j^{(i)}$

Given

$W[0] = -59.50$, $W[1] = -0.15$, $W[2] = 0.60$, $\alpha = 0.000002$

Data from 1st row table:

Age = 41, HeartRate = 138, OxyCon = 37.99

Step 1: Compute Prediction for the 1st training instance

$h_\theta(x^{(i)}) = W[0] + W[1] \times Age + W[2] \times HeartRate$

$h_\theta(x^{(i)}) = -59.90 - 0.15(41) + 0.60(138)$

$= -59.90 - 6.15 + 82.8$

$= 17.15$

Step 2:

$h_\theta(x^{(i)}) - OxyCon^{(1)} = error$

$error = 17.15 - 37.99 = -20.84$

Step 3: Compute Weight Updates

$\delta W[0] = \alpha \times error = 0.000002 \times -20.84 = -0.00004168$

$\delta W[1] = \alpha \times error \times Age = 0.000002 \times -20.84 \times 41 = -0.00171544$

$\delta W[2] = \alpha \times error \times HeartRate = 0.000002 \times -20.84 \times 138 = -0.0028752$

Step 4: Update the weights

$W_{[0]new} = W[0] + \delta W[0] = -59.5 - 0.00004158 = -59.50004168$

$W[0]_{new} = W[1] + \delta W[1] = -0.15 - 0.00171544 = -0.15171544$

$W[2]_{new} = W[2] + \delta W[2] = 0.60 + 0.0028752 = 0.59712448$

Question 5 error²

Given weights from Q4

$W[0]_{new} = -59.50004168$

$W[1]_{new} = -0.15171544$

$W[2]_{new} = 0.59712448$

Formula

$Oc_p = W[0]_{new} + W[1]_{new} \times Age + W[2]_{new} \times HeartRate$

then

$error^2 = (Oc_p - OC_A)^2$

(1) 453.99662183

(2) 477.51185

(3) 373.56062

(4) 988.56138

(5) 376.50699

(6) 304.23980

(7) 268.89892

(8) 306.60539

(9) 193.77571

(10) 604.07025

(11) 419.22582

(12) 208.82063