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Assignment - 6

Estimate the bicarbonates of well water based on its pH value using polynomial regression model.

Manual calculations: degree => 2

step 1: Initialise $m_1 = 1$, $m_2 = 1$, $c = -1$, epochs = 1, $\eta = 0.1$, $n_s = 2$.

step 2: iter = 1

step 3: i = 1

step 4:

$$\frac{\partial E}{\partial m_1} = -(y_i - m_2 x_i^2 - m_1 x_i - c) x_i$$

$$= -(157 - (7.6)^2 - 7.6 + 1)(7.6)$$

$$= -(92.64)(7.6)$$

$$= -704.064$$

$$\frac{\partial E}{\partial m_2} = -(y_i - m_2 x_i^2 - m_1 x_i - c) x_i^2$$

$$= -(157 - (7.6)^2 - 7.6 + 1)(7.6)^2$$

$$= -5350.8864$$

$$\frac{\partial E}{\partial c} = -(y_i - m_2 x_i^2 - m_1 x_i - c)$$

$$= -(157 - (7.6)^2 - 7.6 + 1)$$

$$= -92.64$$

step 5:

$$\Delta m_1 = -\eta \frac{\partial E}{\partial m_1} = -(0.1)(-704.064)$$

$$= 70.4064$$

$$\Delta m_2 = -\eta \frac{\partial E}{\partial m_2} = -(0.1)(-5350.8864)$$

$$= 535.08864$$

$$\Delta c = -\eta \frac{\partial E}{\partial c} = -(0.1)(-92.64)$$

$$= 9.264$$

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step 6: $m_1 = m_1 + \Delta m_1$

$= 1 + 70.4064$

$= 71.4064$

$m_2 = m_2 + \Delta m_2$

$= 1 + 535.08564$

$= 536.08564$

$c = c + \Delta c$

$= -1 + 9.264$

$= 8.264$

step 7: $i = i + 1 = 1 + 1 = 2$

step 8: if ($i \leq ns$)

True → step 4

False → step (next)

step 4: $\frac{\partial e}{\partial m_1} = -(y_i - m_2 x_i^2 - m_1 x_i - c) x_i$

$= -(174 - (536.08564)(7.1)^2 - (71.4064)(7.1) - 8.264)(7.1)$

$= 194294.88$

$\frac{\partial e}{\partial m_2} = -(y_i - m_2 x_i^2 - m_1 x_i - c) x_i^2$

$= -(174 - (536.08564)(7.1)^2 - (71.4064)(7.1) - 8.264)(7.1)^2$

$= 1379493.69$

$\frac{\partial e}{\partial c} = -(y_i - m_2 x_i^2 - m_1 x_i - c)$

$= -(174 - (536.08564)(7.1)^2 - (71.4064)(7.1) - 8.264)$

$= 27365.477$

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step 5: $\Delta m_1 = -\eta \frac{\partial E}{\partial m_1} = -(0.1)(194294.88)$
$= (-19429.48)$

$\Delta m_2 = -\eta \frac{\partial E}{\partial m_2} = -(0.1)(1379493.69)$
$= -137949.36$

$\Delta c = -\eta \frac{\partial E}{\partial c} = -(0.1)(27365.47)$
$= -2736.547$

step 6: $m_1 = m_1 + \Delta m_1$
$= 71.4064 - 19429.48$
$= -19358.07$

$m_2 = m_2 + \Delta m_2$
$= 536.08864 - 137949.36$
$= -137413.27$

$c = c + \Delta c$
$= 8.264 - 2736.547$
$= -2728.283$

step 7: $i = i + 1 = 2 + 1 = 3$

step 8: if $(i \leq ns)$
True → step 4
false → Nextstep

step 9: iter = iter + 1 = 2

step 10: if (iter ≤ epochs)
True → step 3
false → nextstep

step 11: Read final model parameters
$m_1 = -19358.07$
$m_2 = -137413.27$
$c = -2728.283$

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