Regression using GD

Our optimization problem for regression at hand is

$$w^*, b^* = \min_{w,b} \sum_{i=1}^{n} \left(y_i - (w^T x_i + b) \right)^2$$

we need to find best w^*, b^* which will minimiz the loss

So, lets writ it as a function.

Function with $d+1$ variables

$$\sum_{i=1}^{n} \left(y_i - (w^T x_i + b)\right)^2 = f(w,b) = f(w_1, w_2, \dots w_d, b)$$

$$f(w,b) = \sum_{i=1}^{n} \left(y_i - (w^T x_i + b)\right)^2$$

$$f(w,b) = \sum_{i=1}^{n} \left(y_i - (w_1 x_{i1} + w_2 x_{i2} + \dots\dots + w_d x_{id} + b)\right)^2$$

minimize above function $f(w,b)$ using GD

$$\frac{\partial f}{\partial w_1} = \sum_{i=1}^{n} \left(-x_{i1} \cdot 2 \cdot \left(y_i - (w^T x_i + b)\right)\right)$$

lly we will find $\frac{\partial f}{\partial w_2}, \dots\dots \frac{\partial f}{\partial w_d}$ and $\frac{\partial f}{\partial b}$

$$\frac{\partial f}{\partial b} = \sum_{i=1}^{n} \left((-1) \cdot 2 \left(y_i - (w^T x_i + b)\right)\right)$$

Initially pick a random (w^0, b^0)

$$w^0, b^0$$

$$w_1^0, w_2^0, w_3^0 \dots\dots\dots w_d^0, b^0 \longrightarrow \text{Pick randomly}$$

$$\left.\begin{aligned} w_i^1 &= w_i^0 + \alpha \left(\frac{-\partial f}{\partial w_i}\right)_{w^0, b^0} \\ b^1 &= b^0 + \alpha \left(\frac{-\partial f}{\partial b}\right)_{w^0, b^0} \end{aligned}\right\} \rightarrow$$

Repeat this step untill all partial derivatives are close to zero.

$w^0, b^0 \longrightarrow w^1, b^1 \longrightarrow w^2, b^2 \longrightarrow - - - - - \longrightarrow w^t, b^t$

Till all the partial derivatives $\left(\frac{\partial f}{\partial w_i}\right)_{w^t, b^t}$ & $\left(\frac{\partial f}{\partial b}\right)_{w^t, b^t}$ are close to ZERO

And finally $w^*, b^* = w^t, b^t$ which are the optimal params

Now we will use $\boxed{\hat{y}_i = w^{*T} x_i + b^*}$ to estimate incomes of unknown customers.

There are few more concepts in Calculus like

Integration $\longrightarrow$ Area under Curve

which will be covered when context arises