global maxima

$f''(x) < 0$ local maximum
$f''(x) > 0$ local minimum

Linear Regression solved example

Sepal length X_1	Sepal width X_2	Petal length X_3	Petal Width y
5.1	3.5	1.4	0.2
4.9	3.0	1.4	0.2
4.7	3.2	1.3	0.2
4.6	3.1	1.5	0.2
5.0	3.6	1.4	0.2

Linear regression eq".

$$y = b_0 + b_1 X_1 + b_2 X_2 + b_3 X_3$$

1) Means of X_1, X_2, X_3

$$Mean(X_1) = \frac{5.1 + 4.9 + 4.7 + 4.6 + 5.0}{5}$$

$$= 4.86$$

$$\text{Mean} (x_2) = \frac{3.5 + 3.0 + 3.2 + 3.1 + 3.6}{5}$$

$$= 3.28$$

$$\text{Mean} (x_3) = \frac{1.4 + 1.4 + 1.3 + 1.5 + 1.4}{5}$$

$$= 1.4$$

$$\text{Mean} (Y) = \frac{0.2 + 0.2 + 0.2 + 0.2 + 0.2}{5}$$

$$= 0.2$$

2) Deviations from mean.

Deviations $(x_1) = x_1 - \text{Mean} (x_1)$

$$\text{Deviations} (x_1) = [5.1 - 4.86, \ 4.9 - 4.86,$$
$$4.7 - 4.86, \ 4.6 - 4.86, \ 5.0 - 4.86]$$

$$= [0.24, \ 0.04, \ -0.16, \ -0.26, \ 0.14]$$

Similarly
$$\text{Deviations} (x_2) = [0.22, \ -0.28, \ -0.06,$$
$$-0.18, 0.32]$$

$$\text{Deviations} (x_3) = [0, \ 0, \ -0.1, \ 0.1, \ 0]$$

$$\text{Deviations} (Y) = [0, \ 0, \ 0, \ 0, \ 0]$$

Deviations $(Y) =$

3)   Product of Deviations

Product of deviations (X_1, Y)
$= [0, \quad 0, \quad 0, \quad 0, \quad 0]$

Product of deviations (X_2, Y)
$= [0, \quad 0 + 0, \quad 0, \quad 0]$

Product of deviations (X_3, Y)
$= [0, \quad 0, \quad 0, \quad 0, \quad 0]$

4)   Sum (Product of deviations (X_1, Y))
$= 0$

Sum (Product of deviations (X_2, Y))
$= 0$

Sum (Product of deviations (X_3, Y))
$= 0$

5)   ~~Sum (Deviations X_1)^2~~
Sum(Deviation $(X_1)^2$)
$= ((0.24)^2 + (0.04)^2 + (-0.16)^2 + (-0.26)^2 + (0.14)^2)$
$= 0.176$

Similarly

$$\underline{Sum(\text{Product} \; Deviations \; (X_2)^2)}$$
$$= 0.268$$

$$\underline{Sum \; (Deviations \; (X_3)^2)}$$
$$= 0.02$$

$$\underline{Sum \; (Deviations \; (X_4)}$$
$$=$$

6) $$b_1 = \frac{Sum(\text{Product of deviations} (X_1, Y)}{Sum(Deviations \; (X_1)^2)}$$

$$= \frac{0}{0.176} = 0$$

similarly
$$b_2 = 0$$
$$b_3 = 0$$

7) $$b_0 = Mean(Y) - (b_1 * Mean(X_1))$$
$$+ (b_2 * (Mean(X_2)))$$
$$+ (b_3 \times (Mean(X_3)))$$
$$= 0.2 - (0 \times 4.86 + 0 \times 3.28$$
$$+ 0 \times 1.4)$$

$$b_0 = 0.2$$