$$l = \frac{1}{N}\sum_{i=1}^{N}(y_i - a - bx_i)^2$$

$$\frac{dl}{da} = \frac{1}{N}\sum_{i=1}^{N}\left[2(y_i - a - bx_i) * -1\right] = 0$$

$$= \frac{1}{N}\sum_{i=1}^{N} -y_i + \frac{1}{N}\sum_{i=1}^{N} a + \frac{1}{N}\sum_{i=1}^{N} bx_i = 0$$

$$\frac{1}{N}\sum_{i=1}^{N} y_i = \frac{1}{N}\sum_{i=1}^{N} a + \frac{1}{N}\sum_{i=1}^{N} bx_i \quad — (1)$$

$$\frac{dl}{db} = \frac{1}{N}\sum_{i=1}^{N}\left[2(y_i - a - bx_i) * (-x_i)\right] = 0$$

$$= \frac{1}{N}\sum_{i=1}^{N}\left[-2(x_i y_i - a x_i - b x_i^2)\right] = 0$$

$$= \frac{1}{N}\sum_{i=1}^{N} x_i y_i = \frac{1}{N}\sum_{i=1}^{N} a x_i + \frac{1}{N}\sum_{i=1}^{N} b x_i^2 \quad — (2)$$

Lets use $\overline{x}$ and $\overline{y}$ to denote

$$\overline{x} = \frac{1}{N}\sum_{i=1}^{N} x_i \qquad \overline{y} = \frac{1}{N}\sum_{i=1}^{N} y_i$$

$$\overline{xy} = \frac{1}{N}\sum_{i=1}^{N} x_i y_i \qquad \overline{x^2} = \frac{1}{N}\sum_{i=1}^{N} x_i^2$$

(1) $\rightarrow \overline{y} = a + b\overline{x}$

(2) $\rightarrow \overline{xy} = a\overline{x} + b\overline{x^2}$

Divide (2) by $\overline{x}$ on both sides $\rightarrow \dfrac{\overline{xy}}{\overline{x}} = a + \dfrac{b\overline{x^2}}{\overline{x}} \Rightarrow$ (3)

Solving (1) and (3) we get

$$b = \left(\frac{\overline{xy} - \overline{x}\,\overline{y}}{\overline{x^2} - \overline{x}\,\overline{x}}\right) \qquad a = \overline{y} - b\overline{x}$$

$$a = \frac{1}{N}\sum_{i=1}^{N} y_i - \frac{b}{N}\sum_{i=1}^{N} x_i$$

$$b = \frac{\sum_{i=1}^{N} x_i y_i - \frac{1}{N}\sum_{i=1}^{N} x_i \sum_{i=1}^{N} y_i}{\sum_{i=1}^{N} x_i^2 - \frac{1}{N}\sum_{i=1}^{N} x_i \sum_{i=1}^{N} x_i}$$