$$\frac{\partial l}{\partial \beta_0} = \sum_{i=1}^{n}(y_i - (\beta_0 + \beta_1 x_i)) = 0 \tag{3a}$$

$$\frac{\partial l}{\partial \beta_1} = \sum_{i=1}^{n}(y_i - (\beta_0 + \beta_1 x_i))x_i = 0 \tag{3b}$$

$$\frac{\partial l}{\partial \sigma} = \frac{n}{\sigma} - \frac{1}{\sigma^3}\sum_{i=1}^{n}(y_i - (\beta_0 + \beta_1 x_i))^2 = 0 \tag{3c}$$

3a) : $\bar{y} = \beta_0 + \beta_1 \bar{x}$

3b) $\sum x_i y_i = \beta_0 \sum x_i + \beta_1 \sum x_i^2$

$\sum x_i y_i = (\bar{y} - \beta_1 \bar{x}) \sum x_i + \beta_1 \sum x_i^2$

$\sum x_i y_i = \frac{1}{n} \sum y_i \sum x_i - \beta_1 \frac{1}{n} (\sum x_i)^2 + \beta_1 \sum x_i^2$

$\sum x_i y_i = \frac{1}{n} \sum y_i \sum x_i + \underbrace{\beta_1 \left(\sum x_i^2 - n\bar{x}^2\right)}_{\beta_1 \underbrace{\sum (x_i - \bar{x})^2}_{S_{xx}}}$

$$\boxed{\begin{array}{l} \sum x_i y_i - \frac{1}{n} \sum x_i \sum y_i \\ \sum x_i y_i - n\bar{x}\bar{y} = S_{xy} \end{array}}$$

$S_{xy} = \beta_1 S_{xx}$

$SSE = \sum (\hat{y}_i - y_i)^2$

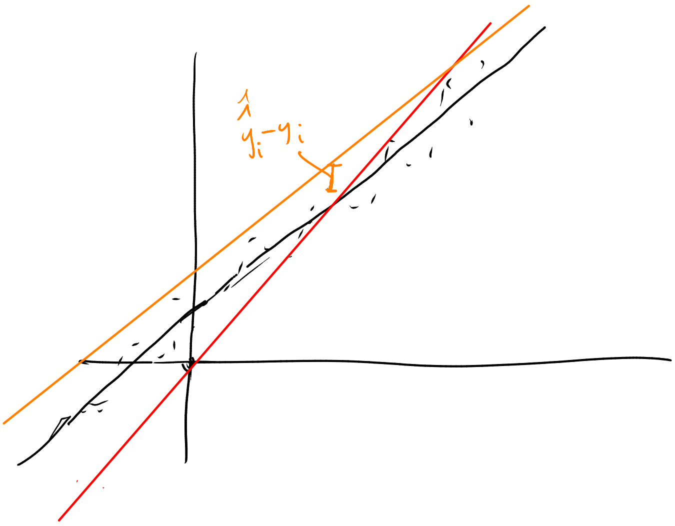
$SSM = \sum (\hat{y}_i - \bar{y})^2$

$SST = \sum (y_i - \bar{y})^2$

$\frac{SSM}{SST}$

Akaike Information Criterion

AIC



$$\sum (y_i - \hat{y}_i)^2 < \sum (y_i - \hat{\hat{y}}_i)^2$$