# Least Squares

$$\min_{\beta_1,\beta_0} \sum_{i=1}^{n} (y_i - \beta_0 - \beta_1 x_i)^2$$

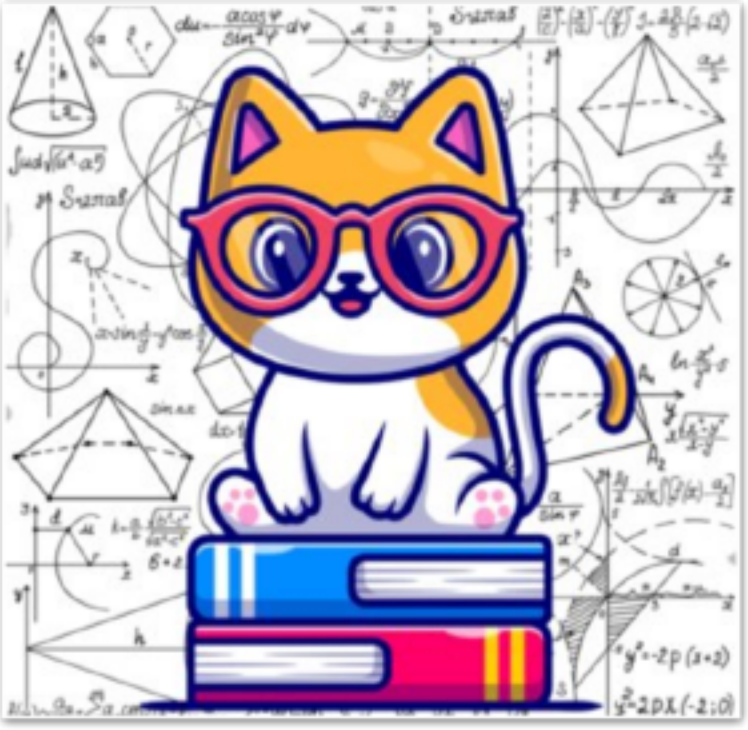
solved by taking partial derivatives
and setting equal to 0

$$\mathrm{RSS} = \sum_{i=1}^{n} (y_i - \hat{y}_i)^2$$

$$= \sum_{i=1}^{n} (y_i - \hat{\beta}_0 - \hat{\beta}_1 x_i)^2$$

$$\frac{\partial RSS}{\partial \beta_0} = -2\sum_{i=1}^{n}(y_i - \beta_0 - \beta_1 x_i) = 0$$

$$\frac{\partial SSR}{\partial \beta_1} = -2x_i \sum_{i=1}^{n} (y_i - \beta_0 - \beta_1 x_i) = 0$$

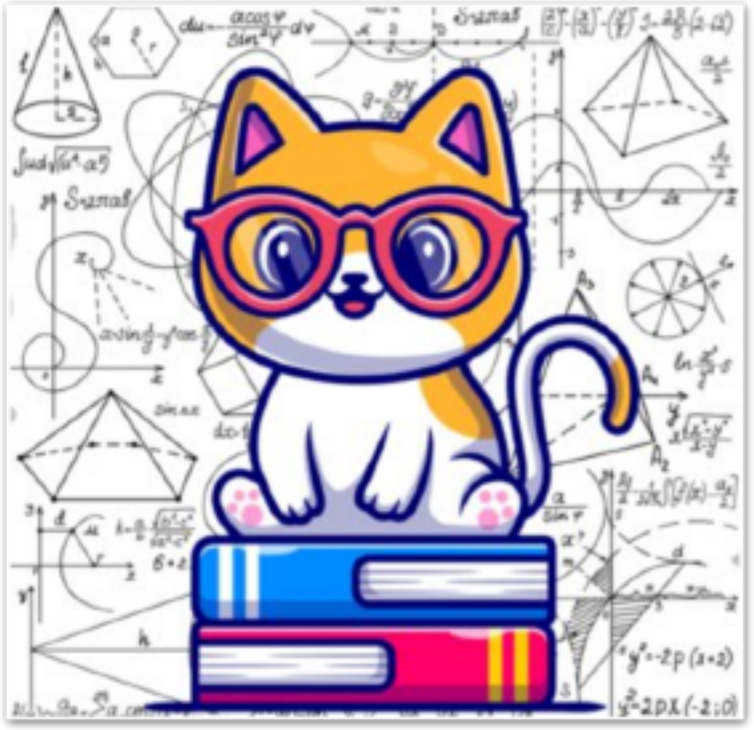

$y^2=-2p\,(x+2)$
$y^2=2px\,(-2;0)$

$$\Longrightarrow \hat{\beta}_0 = \bar{y} - \hat{\beta}_1 \bar{x}$$

$$\Longrightarrow \hat{\beta}_1 = \frac{\sum_{i=1}^{n} x_i y_i - n\overline{y}\overline{x}}{\sum_{i=1}^{n} x_i^2 + n\overline{x}} = \frac{Cov(x, y)}{Var(x)}$$

[full proof: https://statproofbook.github.io/P/slr-ols]

# Least Squares



$$\mathrm{RSS} = \sum_{i=1}^{n} (y_i - \hat{y}_i)^2$$

$$= \sum_{i=1}^{n} (y_i - \hat{\beta}_0 - \hat{\beta}_1 x_i)^2$$

$$\min_{\beta_1, \beta_0} \sum_{i=1}^{n} (y_i - \beta_0 - \beta_1 x_i)^2$$

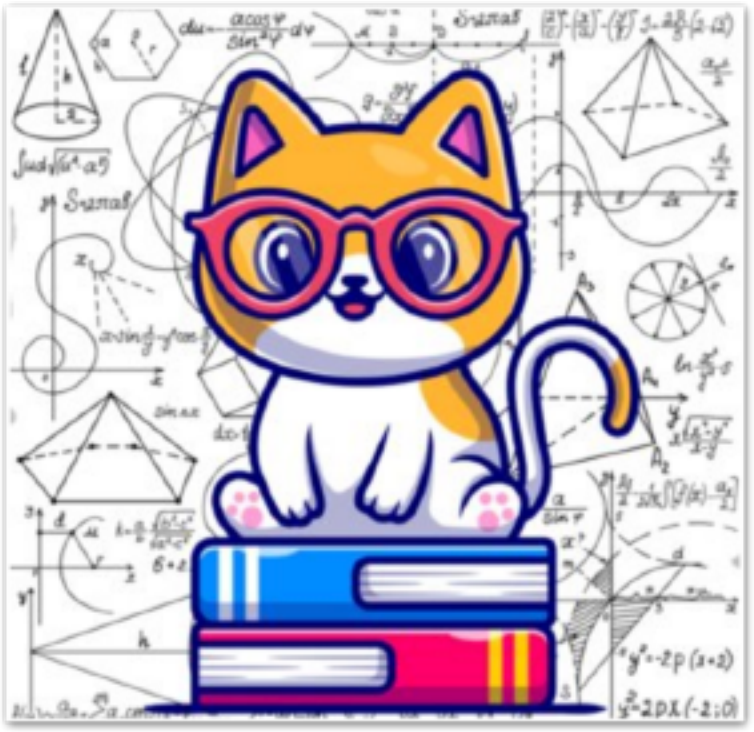
***solved by taking partial derivatives and setting equal to 0***

$$\frac{\partial RSS}{\partial \beta_0} = -2 \sum_{i=1}^{n} (y_i - \beta_0 - \beta_1 x_i) = 0 \implies \hat{\beta}_0 = \bar{y} - \hat{\beta}_1 \bar{x}$$

$$\frac{\partial SSR}{\partial \beta_1} = -2x_i \sum_{i=1}^{n} (y_i - \beta_0 - \beta_1 x_i) = 0 \implies \hat{\beta}_1 = \frac{\sum_{i=1}^{n} x_i y_i - n\bar{y}\bar{x}}{\sum_{i=1}^{n} x_i^2 + n\bar{x}} = \frac{Cov(x, y)}{Var(x)}$$

[full proof: https://statproofbook.github.io/P/slr-ols]

# Maximum Likelihood Estimation



[full proof: https://statproofbook.github.io/P/slr-mle]