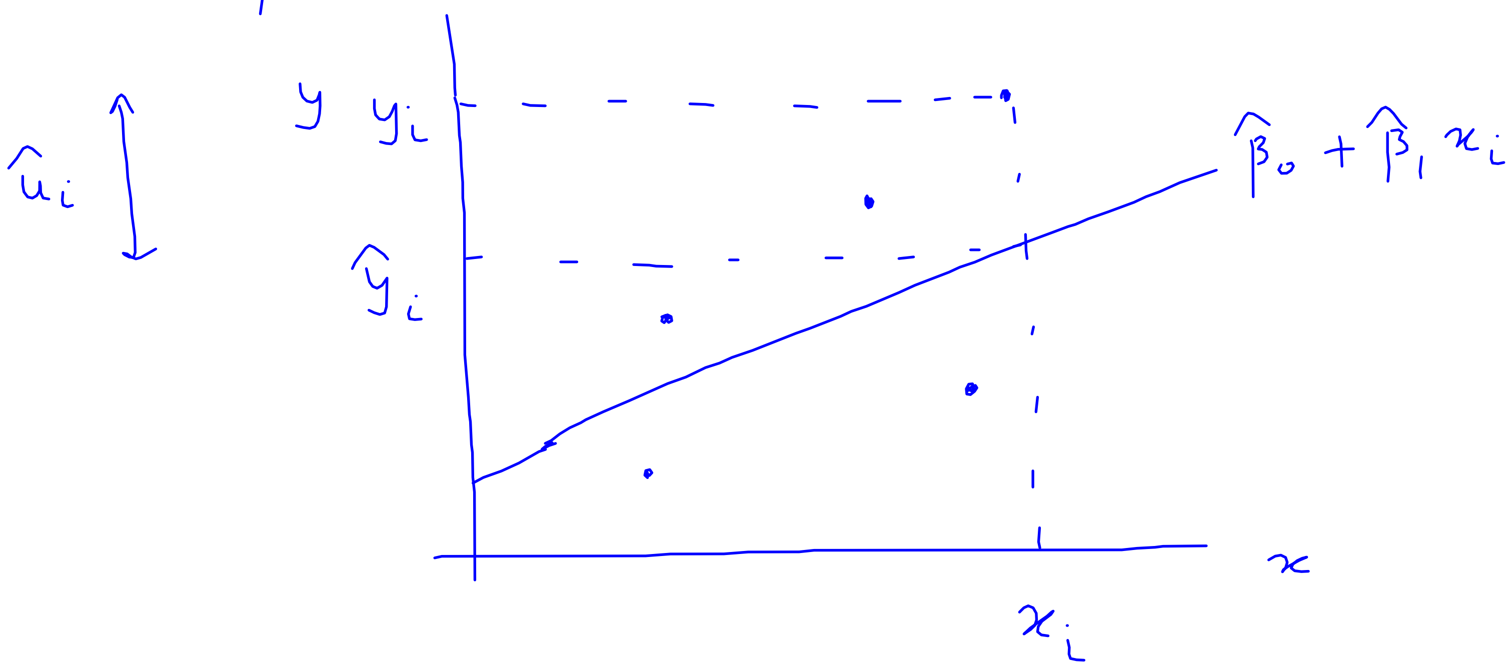
Estimated regression line:

$$\hat{\beta}_0 + \hat{\beta}_1 x_i = \hat{y}_i$$



For ith obs. y_i: dep. var. value

$\hat{y}_i$: fitted value

$\hat{u}_i$ (residual) $= y_i - \hat{y}_i$

$\hat{\beta}_0$ and $\hat{\beta}_1$ also minimize the sum of squared residuals (SSR) $\longrightarrow \sum_{i=1}^{n} \hat{u}_i^2$

Method $\longrightarrow$ also called ordinary least Squares (OLS)

$$\hat{\beta}_1 = \frac{\text{how } x \text{ \& } y \text{ covary}}{\text{how } x \text{ varies}}$$

$$= \frac{\sum_{i=1}^{n} (x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^{n} (x_i - \bar{x})^2} \quad ; \ \bar{x}, \bar{y} : \text{sample means}$$

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

Properties of OLS

Sum / avg. of OLS residuals

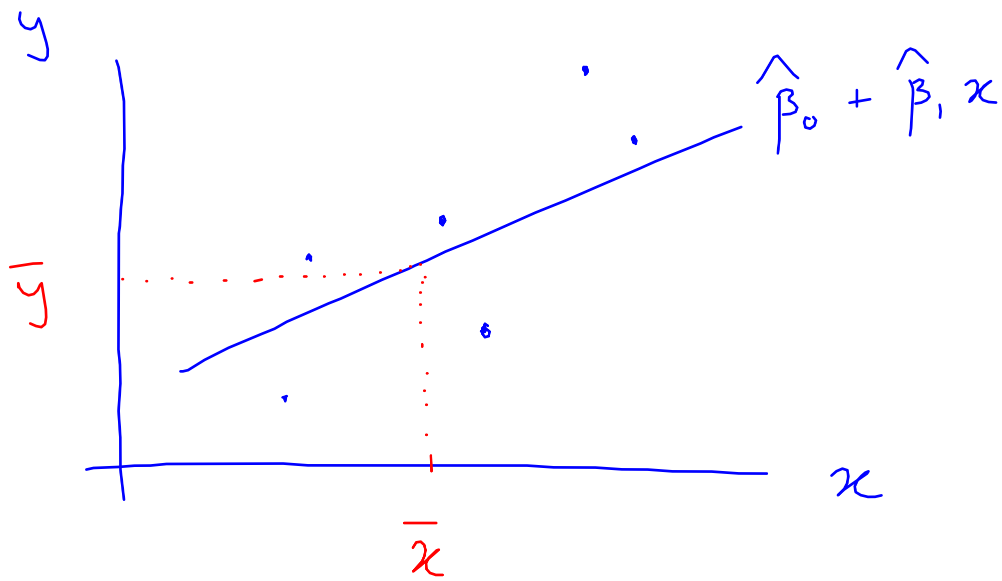
$$\sum_{i=1}^{n} \hat{u}_i = 0$$

Sample correlation b/w x and $\hat{u}$

$$\sum_{i=1}^{n} x_i \hat{u}_i = 0$$

Sample correl^n b/w $\hat{y}$ and $\hat{u}$

$$\sum_{i=1}^{n} \hat{y}_i \hat{u}_i = 0$$



$(\bar{x}, \bar{y}) \longrightarrow$ on the OLS regression line

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

For each obs.

$$y_i = \hat{y}_i + \hat{u}_i$$

Total variation (sum of squares)

$$\sum_i (y_i - \bar{y})^2$$

SST : total sum of squares

explained variation

$$\sum_i (\hat{y}_i - \bar{y})^2$$

SSE : explained sum of squares

residual variation

SSR

$$\sum_i \hat{u}_i^2$$

$$R^2 = \frac{SSE}{SST} = 1 - \frac{SSR}{SST}$$

$0 \leq R^2 \leq 1$

also = square of correl^n b/w y and $\hat{y}$

High R^2 : not the ultimate objective