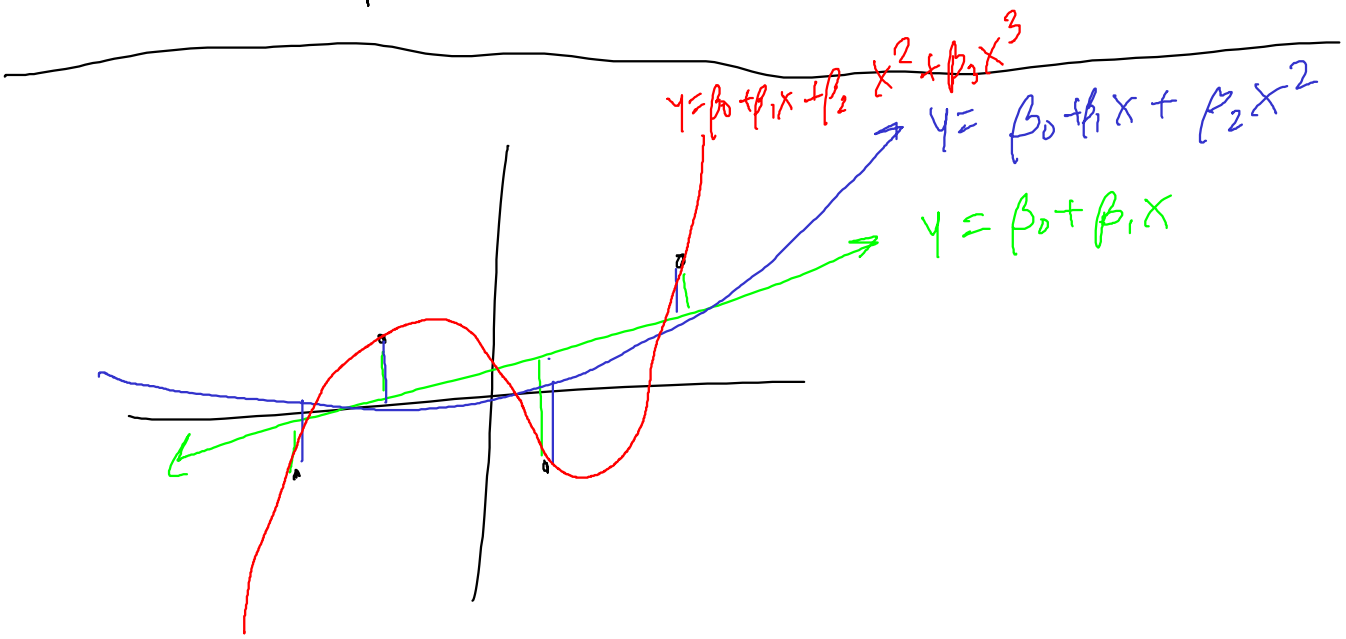
Say we have n rows

$$y_1 = \hat{\beta}_0 + \hat{\beta}_1 x_{1,1} + \cdots + \hat{\beta}_p x_{1,p}$$

$$\vdots$$

$$y_n = \hat{\beta}_0 + \hat{\beta}_1 x_{n,1} + \cdots + \hat{\beta}_p x_{n,p}$$

if $p = n-1$



Say 3 numbers and their average is 10

17 12 ?

$$\frac{17 + 12 + ?}{3} = 10$$

Null Model $Y_i = \beta_0 + \varepsilon_i$ say RSS = 122

Full Model $Y_i = \beta_0 + \beta_1 X_{i,1} + \cdots + \beta_p X_{ip} + \varepsilon_i$

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note

$$(a+b)^2 \neq a^2 + b^2$$

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

$$= \sum_{i=1}^{n}\left((y_i-\hat{y}_i)+(\hat{y}_i-\bar{y})\right)^2$$

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

$$2\sum_{i=1}^{n} y_i\hat{y}_i - y_i\bar{y} - \hat{y}_i^2 + \hat{y}_i\bar{y}$$

$$= 2\left(\sum y_i\hat{y}_i - n\bar{y}^2 - \sum\hat{y}_i^2 + \bar{y}\sum\hat{y}_i\right)$$

$= 0$ eventually