Lect 8 $\boxed{2/26/18}$ 16

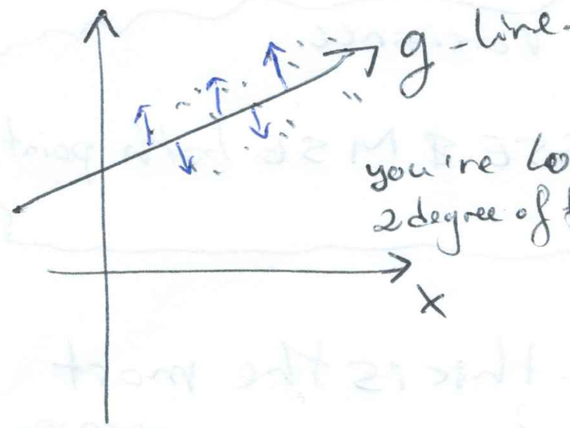
Recall

$P = 1$

$$\mathbb{D} = \left\{ \begin{bmatrix} x_{11} \\ x_{21} \\ \vdots \\ x_{n1} \end{bmatrix} \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{bmatrix} \right\} \quad y \in \mathbb{R}$$

$$g \in \mathcal{H} = \{ \vec{w} \cdot \vec{x} : \vec{w} \in \mathbb{R}^2 \}$$

$$\vec{x} = [1, x]$$



you're loosing 2 degree of freedom

$g = \mathcal{A}(\mathbb{D}, \mathcal{H})$ means $g = \mathcal{A}(\mathbb{D}, \mathcal{H})$

$$\boxed{\begin{bmatrix} b_0 \\ b_1 \end{bmatrix} = \text{argmin} \quad \begin{bmatrix} w_0 \\ w_1 \end{bmatrix} \in \mathbb{R}^2}$$ Called Ordina[ry] Least Squa[res]

You want to minimize to get a best fit.

$$SSE = \sum e_i = \sum (y_i - \hat{y}_i)^2 = \sum (y_i - (w_0 + w_1 x_i))^2$$

$$\Rightarrow \begin{bmatrix} b_0 \\ b_1 \end{bmatrix} = \begin{bmatrix} \bar{y} \cdot r \frac{s_y}{s_x} x \\ y \frac{s_y}{s_x} \end{bmatrix}$$: this is what you get if you minimise SSE

Sometimes we call $b_0 \sim \hat{\beta}_0$

$b_1 \sim \hat{\beta}_1$

How long this model do?

How well ~~g is h~~ does this model do?

(1) $SAE = \sum |e_i|$: is it good idea? Ans: Reasonabl[e]

1. $SAE = \sum_i |e_i|$: pretty good

2. $MAE = \frac{1}{2} \sum_i |e_i|$

3. $SSE = \sum e_i^2$

$$MSE = \frac{1}{n-2} \sum e_i^2 = \frac{SSE}{n-2}$$

<u>Note</u>: $S^2 = \frac{1}{n-1} \sum (Y_i - \bar{X})^2$: simple variance.
this is a point-squared $\Rightarrow$ SSE & MSE both point²

$RMSE = \sqrt{MSE}$ ← this is the most common regression model report.

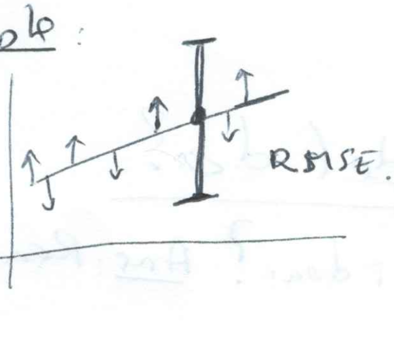
Root Mean Square Error

Do you remember $[\bar{X} \pm 2S_x]$?
This is the $CI_{RMSE} = [\bar{X} \pm 2S_x]$
what did this require? $\Rightarrow$ ans CLT.

Predict° 45

Kind of Standard deviation: $\pm 2\,RMSE \Rightarrow$ SSA of predict°.

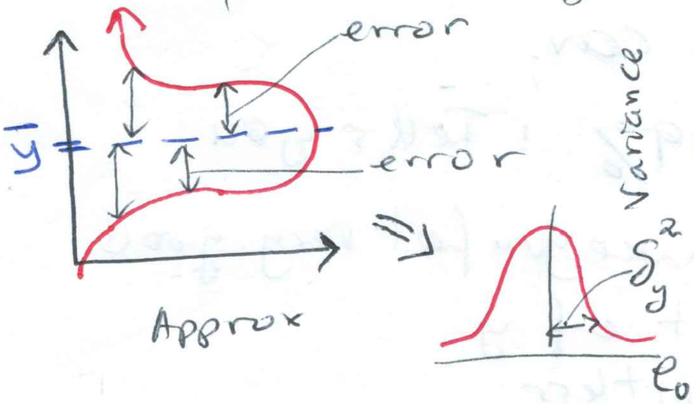
<u>Exple</u>:



R^2 : proposition of sample variance explained.

Consider the null model : $g(x) = \bar{Y}$

Take exple of selling used car.



using the null model you make mistake.

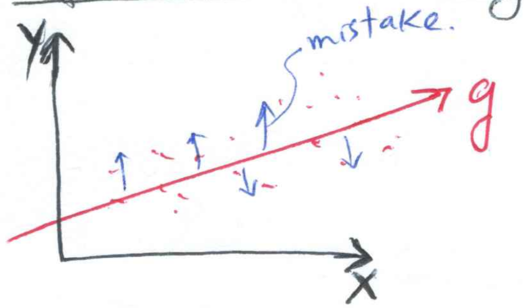
$$SSE_0 = \sum (y_i - \bar{y})^2$$

In many text book it is called

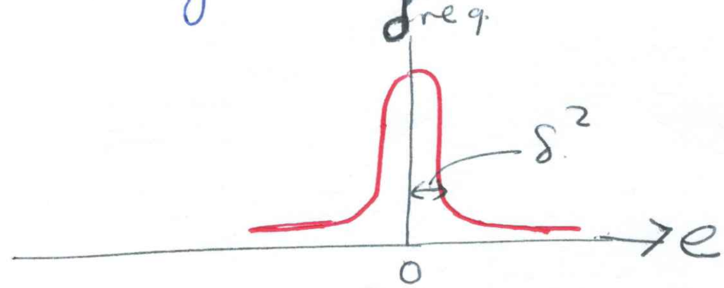
$$SST = SSE_0.$$

$$SST = SSE_0 = \sum (y_i - \bar{Y})^2 = (n-1) S_Y^2$$

> After modeling:



calculate $g = 1$.



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

$$= \sum (e_i - \bar{e})^2 = (n-1) S_e^2$$

$$R^2 = \frac{\overbrace{S_Y^2 - S_e^2}^{\Delta S_y^2}}{S_Y^2} = \frac{SSE_0 - SSE}{SSE_0} *$$

* Test + HW

If $R^2 \simeq 0 \Rightarrow$

$R^2 \simeq 1 \Rightarrow$ Predict: & y are similar.

Good models have no error.

If $R^2 \nearrow \Rightarrow RMSE \searrow$:

If $R^2 \searrow \Rightarrow RMSE \nearrow$:

$$S_e^2 \approx RMSE \approx RMSE^2$$

et y: be price of used car.

and tell you that $R^2 = 99\%$! Tells you
should make you feel very good.

so $RMSE = \$2000$ is unit of y
$R^2 = 99\%$ is unitless.