

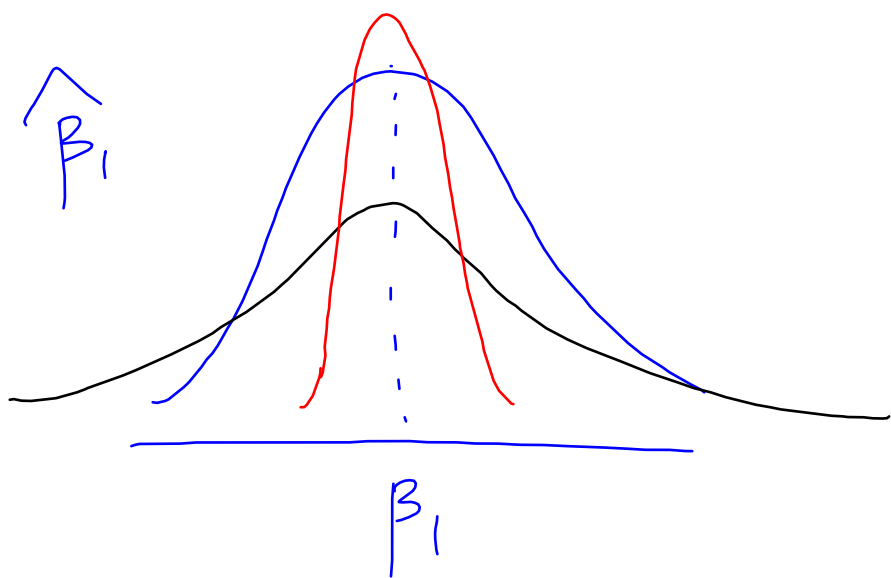
Ch. 2 (cont)

y	x	u
# followers (social media)	# hours per day	quality of posts

$$\text{Model: } y = \beta_0 + \beta_1 x + u$$

$$\text{OLS} \rightarrow \hat{\beta}_1$$

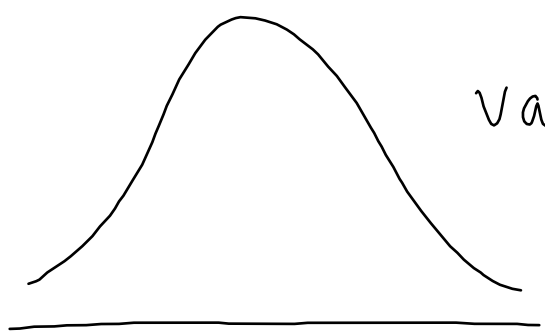
$$\text{unbiasedness} \Rightarrow E(\hat{\beta}_1) = \beta_1$$



What is $\text{var}(\hat{\beta}_1)$?

Homoskedasticity

$$\text{Ass'n: } \text{var}(u|x) = \text{var}(u) = \sigma^2$$



$$\text{var}(\text{quality of posts} | x=1) = \text{due to homosk.}$$

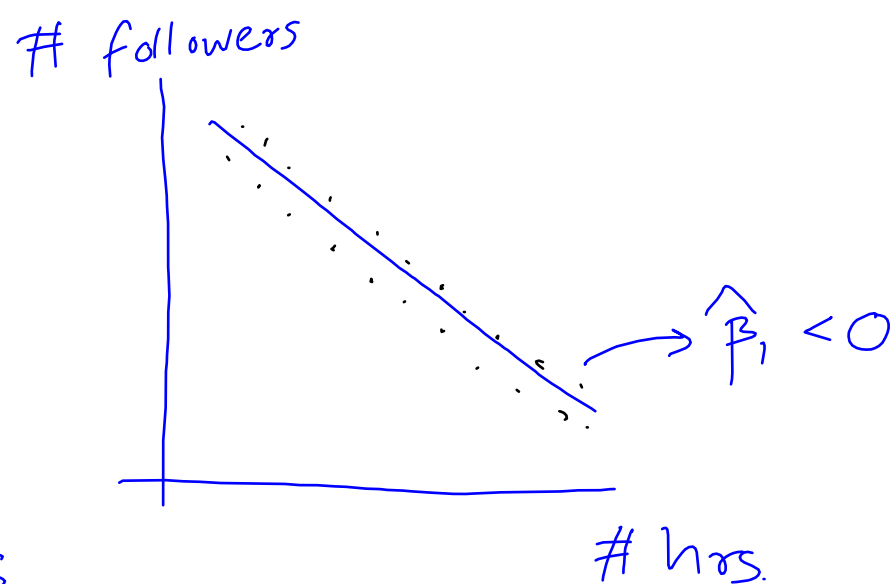
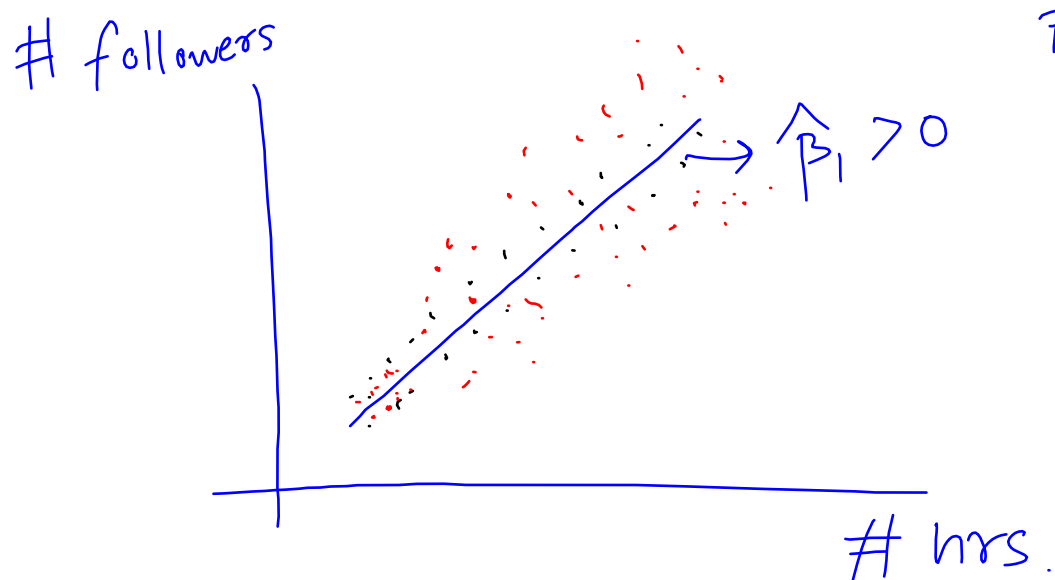
$$\text{var}(\text{qual. of posts} | x=3)$$

Homosk. $\Rightarrow$

$$\text{var}(\# \text{ followers} | x=1)$$

$$= \text{var}(\# \text{ followers} | x=3)$$

$$\text{var}(y|x) = \text{var}(y) = \sigma^2$$



Heteroskedasticity

Homoskedasticity

$$\text{var}(\hat{\beta}_1) = \frac{\sigma^2}{\text{variation in } x} = \frac{\sigma^2}{SST_x} = \frac{\sigma^2}{\sum_{i=1}^n (x_i - \bar{x})^2}$$

$$\text{sd}(\hat{\beta}_1) = \frac{\sigma}{\sqrt{SST_x}} \rightarrow \text{unknown}$$

unbiased estimator of σ^2 : $\hat{\sigma}^2 = \frac{SSR}{(n-2)}$

$$\text{std. error } se(\hat{\beta}_1) = \frac{\hat{\sigma}}{\sqrt{SST_x}} = \frac{\sum_{i=1}^n \hat{u}_i^2}{(n-2)}$$

Final Thoughts

unlikely that $\hat{\beta}_1$ from simple regression captures the true effect of X on Y .

↓
unbiased

Need $u \perp x$ to be uncorrelated.