Heterosk.

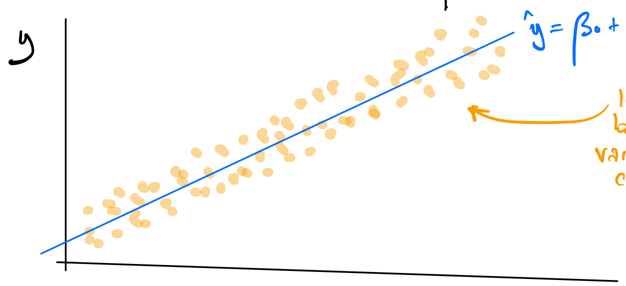
↳ violation of assump. homosk. ($Var(u_i) = \sigma^2$ for all i)

↳ Typically $Var(u_i) \neq Var(u_j)$ for some inds i and j

Problem: We don't observe u_i or $Var(u_i)$

disturbance: $y_i - \hat{y}_i = y_i - (\beta_0 + \beta_1 x)$

Solution: Het.-robust SEs



Why care about heterosk.?

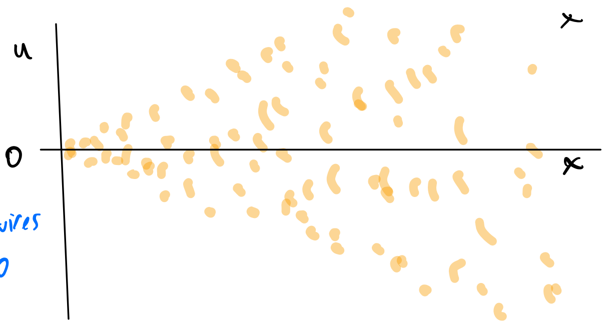
1. OLS is biased for SEs
   ↳ bad inferences (eg, CIs, t-tests, ...)

2. ~~OLS is inefficient for $\hat{\beta}$~~

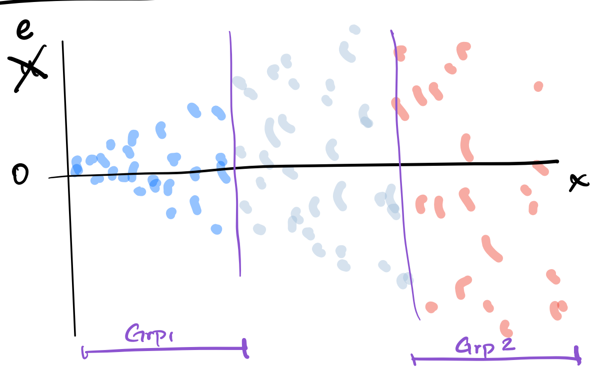
WLS is more eff.

requires knowing $\sigma_i^2 = Var(u_i)$

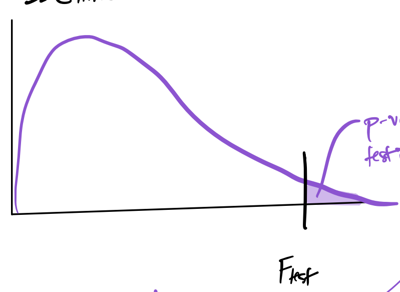
Exog. requires $E[u|X]=0$



Goldfeld-Quandt : use e to learn about u. Test SSE_{Big} vs. SSE_{little}



$$F_{test} = \frac{SSE_{Big}}{SSE_{little}} \sim F_{n-k,n-k}$$



H_0: Homosk.

White test for heterosk. $3\chi^2_3$

$$y_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + u_i$$

get resids...

Adequate test for heterosk.

$$e_i^2 = \alpha_0 + \boxed{\alpha_1 x_1 + \alpha_2 x_2 + \alpha_3 x_3}$$ orig. regressors

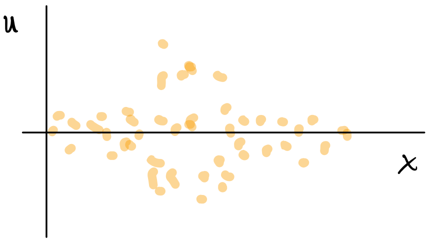
$$+ \boxed{\alpha_4 x_1^2 + \alpha_5 x_2^2 + \alpha_6 x_3^2}$$ sqr. regressors

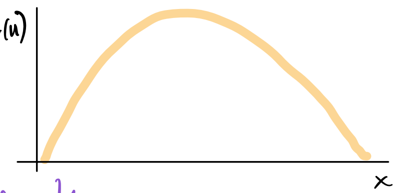
$$+ \boxed{\alpha_7 x_1 x_2 + \alpha_8 x_1 x_3 + \alpha_9 x_2 x_3}$$ interactions btn regressors

$$+ v$$

estimate of $Var(u_i)$

↳ $n \times R^2$ = test stat against χ^2_9





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samplesize → ∞

Asymptotics: $n \to \infty$

probability limit $\hat\beta$: where does the estimator "end up" as $n \to \infty$

$\text{plim}\ \hat\beta_{OLS} = \beta \Rightarrow$ OLS is consistent

$$\text{plim}\ \hat\beta_{OLS} = \beta + \frac{Cov(u, x)}{Var(x)}$$

exogeneity gives $= 0$

$Var(x) \neq 0$ is an assumption (but clear in data)

In the past: $\mathbb{E}[\hat\beta] \leftarrow = \beta$ then unbiased

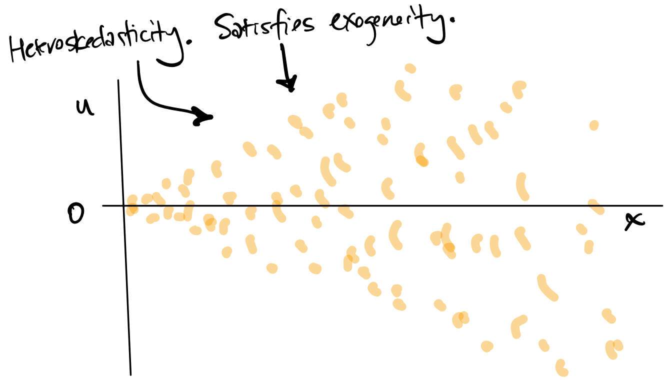
$Var(\hat\beta) \leftarrow$ efficient or inefficient

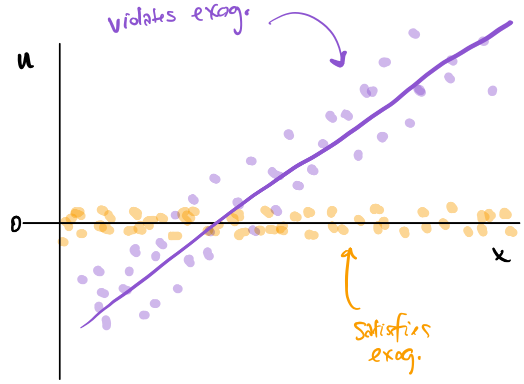
holding n (sample size) fixed, repeating many samples (all size n)

$$\text{plim}\ f(x) = f(\text{plim}\ x)$$

we need f to be continuous @ plim x

$$SSE = \sum e_i^2$$





Homosk.: $\mathrm{Var}(u_i) = \sigma^2$ for every i

Exog.: $\mathbb{E}[u_i | X_i] = 0$

violation: (omitted variable bias)

1. om. var. affect y
2. om. var. corr. w/. x

↳ biases OLS for β