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logit d educ exper

$$\log\left(\frac{\hat{p}}{1-\hat{p}}\right) = \underbrace{\beta_0 + \beta_1 x}_{z}$$

$$\log\left(\frac{\hat{p}}{1-\hat{p}}\right) = z \implies p = \frac{e^z}{1+e^z}$$

If educ = 5, you will put $x = 5$ to find z and then use z to find $\hat{p}$.

STATA: margins, at(educ = (1(2)30))

start → increment → end

to graph: marginsplot

Heteroskedasticity (Het.)

- What is Het?
- Consequences?
- Detection – visual
  - formal test
    - Breusch Pagan
    - White

- Solutions

  GLS/WLS

  FGLS

  Robust S.E.

~~LM~~ L.M. Test
(Lagrange Multiplier Test)

1. $y = \beta_0 + \beta_1 x_1 + \hat{u}$

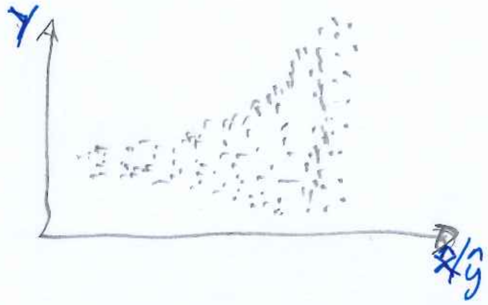
2. $\hat{u} = \delta_0 + \delta_1 x_1 + \delta x_2 + v_i$

3. $N \cdot R^2_{\hat{u}} \sim \chi^2$ [Chi-Squared Test]

A4 $\Rightarrow$ $Var(u_i | x_i) = \sigma^2$

$$Var(\hat{\beta}_1) = \frac{\sigma^2}{SST_x}$$

If ~~A4~~ $\Rightarrow$ $V(v_i | x_i) = \sigma_i^2$



$(t\text{-stat})^2 = F\text{-stat}$

Het. $\Rightarrow$ OLS is not BLUE

STATA Use rvfplot to observe residuals.

$$Var(\hat{u}) = \delta_0 + \delta_1 x_1 + \delta_2 x_2 +$$

$$H_0 : \delta_1 = 0, \delta_2 = 0$$

$$\sigma_i^2 = E[u_i^2]$$

$\hat{u}^2$ as a proxy for variance

$$\hat{u}^2 = \delta_0 + \delta_1 x_1 + \delta_2 x_2 + v_i$$

1. reg y x1 x2
2. $\hat{u}$
   $\hat{u}^2$
3. reg $\hat{u}^2$ x1 x2
4. test $\delta_1 = \delta_2 = 0$

   (F-test or L.M. test)

$$Var(u) = \sigma^2$$

$$Var(\bar{u}) = \frac{\sigma^2}{n_j}$$

We might feel that we have OVB if we cannot ~~observe~~ detect het.

All other assumptions hold for het. (apart from homo. assumption).

STATA

```
reg y educ expec
predict uhat, res
gen uhat2 = uhat^2
reg uhat2 educ exper
```

$\chi^2 \sim \underline{N \cdot R^2_{\hat{u}}} = F\text{-stat}$

STATA: hettest (after ~~reg~~ wage educ exper)

Problem with Breusch-Pagan Test

$\Rightarrow$ Only looks at the linear relation

White Test

$$\hat{u}^2 = \delta_0 + \delta_1 x_1 + \delta_2 x_2 + \delta_3 x_1^2 + \delta_4 x_2^2 + \delta_5 x_1 x_2 + v$$

1. reg y x1 x2
2. $\hat{u} \to \hat{u}^2$
3. reg $\hat{u}^2$ x1 x2 x_1^2 x_2^2 $x_1 x_2$
4. F-test or L.M.

Problem: You loose degrees of freedom

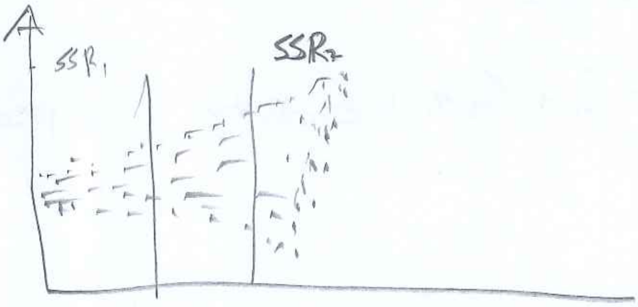
Park Test

Uses log-log specification.

Special Case of White Test

3. reg $\hat{u}^2$ $\hat{y}$ $\hat{y}^2$

Goldfeld-Quandt Test



Test for $\frac{SSR_1}{SSR_2} \sim 1$.

Solutions

$$Var(u|x) = \underbrace{x_1 \sigma^2}_{\sigma_1^2}$$

$\boxed{\text{Weighted-Least Squares}}$

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + u$$

$$\frac{y}{\sqrt{x_1}} = \frac{\beta_0}{\sqrt{x_1}} + \frac{\beta_1 x_1}{\sqrt{x_1}} + \frac{\beta_2 x_2}{\sqrt{x_1}} + \frac{u}{\sqrt{x_1}}$$ (Divide by $\sqrt{x_1}$)

$$E\left[\left(\frac{u}{\sqrt{x_1}}\right)^2\right] = \frac{x_1 \sigma^2}{x_1} = \sigma^2$$

Feasible Generalized Least Squares

Suppose: $Var = \sigma^2 \underbrace{e^{\delta_0 + \delta_1 x_1 + \delta_2 x_2 + u}}_{h_i}$

1. reg y x_1 x_2
2. $\hat{u} \rightarrow \hat{u}^2 \rightarrow \ln(\hat{u}^2)$
3. reg $\ln(\hat{u}^2)$ x_1 x_2
4. $\hookrightarrow \hat{g} = \delta_0 + \delta_1 x_1 + \delta_2 x_2 + u$ [predict ghat, ~~res~~]
5. $\hat{h} = e^{\hat{g}}$
6. reg $\frac{y}{\sqrt{h_i}}$ $\frac{x_1}{\sqrt{h_i}}$ $\frac{x_2}{\sqrt{h_i}}$