

1 Heteroscedasticity

What is heteroscedasticity (Hd)?

- Heteroscedasticity is a nonconstant error variance
 - $E(u_i^2) = \text{var}(Y_i|X_i) = \sigma_i^2$
 - Draw figure of PRF and error distributions
 - Hd more common with cross-sectional data
 - Example: consumption function

OLS estimation in the presence of Hd

- $Y_i = \beta_1 + \beta_2 X_i + u_i$
- $\hat{\beta}_2 = \sum_i x_i y_i / \sum_i x_i^2$
- $\hat{\beta}_2$ is still linear and unbiased
- $\text{var}(\hat{\beta}_2)$ is not smallest $\implies \hat{\beta}_2$ is not efficient
 - To make matters worse, OLS standard errors in STATA or R are incorrect
 - Solution: OLS with White-corrected (robust) standard errors
- Draw figure of sampling distributions

Generalized Least Squares (GLS)

- GLS estimators transform the data so the classical assumptions hold
- $Y_i^* = \beta_1^* + \beta_2 X_i^* + u_i^*$, where $Y_i^* = Y_i/\sigma_i$; $\beta_1^* = \beta_1/\sigma_i$; $X_i^* = X_i/\sigma_i$; $u_i^* = u_i/\sigma_i$
- Example: Draw figure of consumption function

Detection of Hd

- Graphical method
- Goldfeld-Quandt test
- Breusch-Pagan-Godfrey test

- White's test

Solutions

- Example: Consumption function
- GLS or weighted least squares
- OLS with robust standard errors
- Log transformation of Y