# Econ 361: Advanced Econometrics

"Panel Regressions"

# Regression Equation

$$Y_i = X_i'\beta + \epsilon_i \qquad \epsilon_i \text{ is regression error}$$

$$Y_i = X_i'b_{ols} + e_i \qquad e_i \text{ is regression residual}$$

Linearity Condition

$$E[Y|X] = X\beta = \begin{pmatrix} X_1'\beta \\ \vdots \\ X_N'\beta \end{pmatrix} \Rightarrow E[\epsilon|X] = \vec{0}$$

# **Panel** Regression Equation

$$Y_{it} = X_{it}'\beta + \epsilon_i \qquad \epsilon_i \text{ is regression error}$$

$$Y_{it} = X_{it}'b_{ols} + e_{it} \qquad e_i \text{ is regression residual}$$

Split regressors $X$ into two $X = (X_1 X_2)$ and similarly $\beta = \begin{pmatrix} \beta_1 \\ \beta_2 \end{pmatrix}$

$$Y_{it} = X_{1it}'\beta_1 + X_{2it}'\beta_2 + \epsilon_i$$

$$Y_{it} = X_{1it}'b_{1ols} + X_{2it}'b_{2ols} + e_{it}$$

- $X_1$ regressors are random variables that vary across both indices $(i, t)$

- $X_2$ regressors are random variables that vary **only** across one of the indices $(i, t)$

# Data Types

- When Sample only varies in one dimension (index)

  – **Cross-sectional** $(i)$

  – **Time Series** $(t)$

- When Sample varies in more than one dimension (index): **Panel**

Panel data allows for the estimation of **interaction** terms, including **fixed effects**

Fixed effects are the interaction terms with respect to the intercept

Fixed effects may be estimated directly or "indirectly" through **differencing**