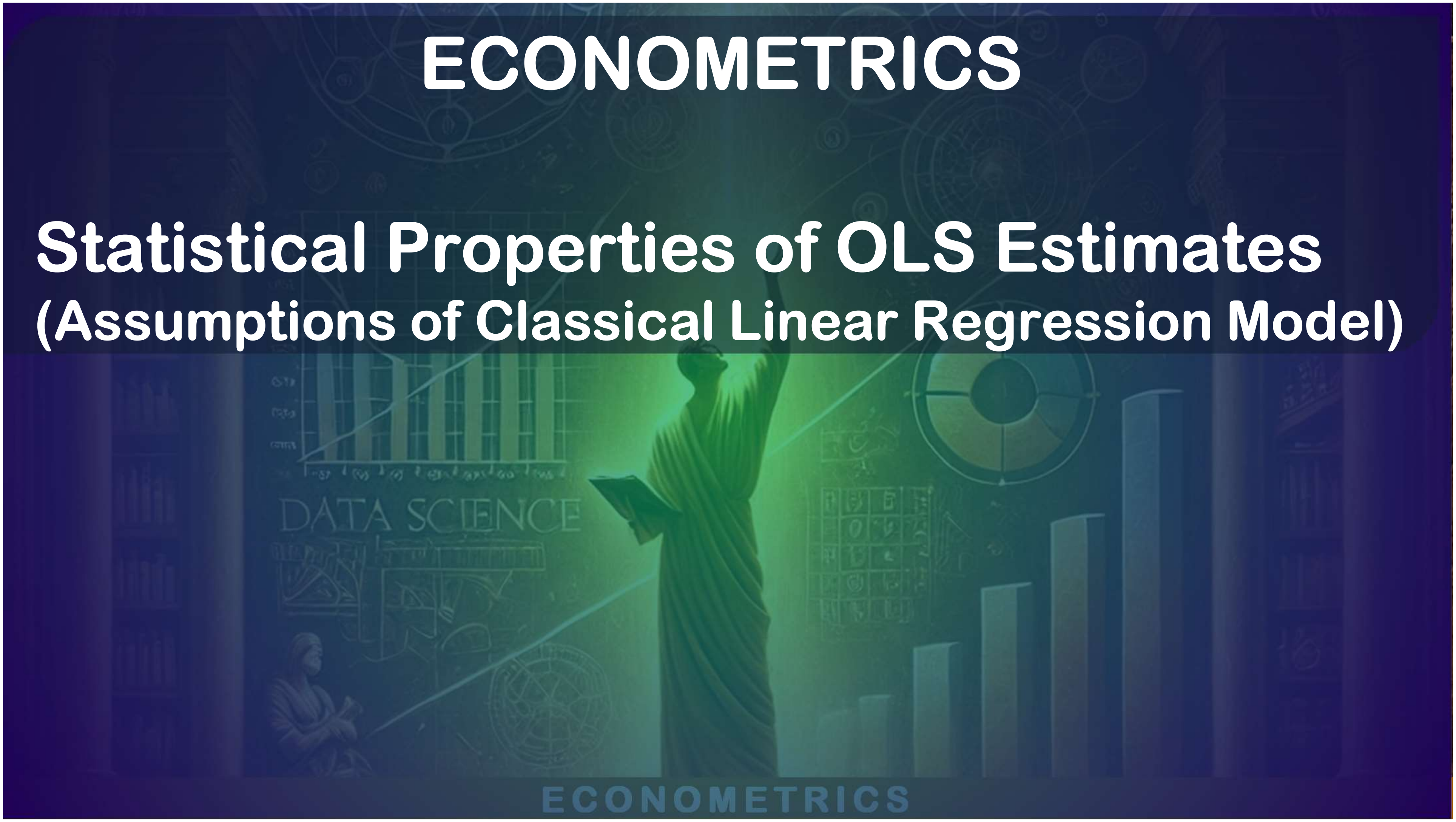
ECONOMETRICS

Statistical Properties of OLS Estimates
(Assumptions of Classical Linear Regression Model)



Lesson Goal

- Understand the statistical properties underpinning all linear regression models.

Assumptions of Classical Linear Regression Model (CLRM)

- The **Gaussian**, **standard**, or **classical linear regression model (CLRM)**, is the cornerstone of most econometric theory.

- We'll discuss **7 assumptions** in the context of the two-variable regression model.

Assumptions of Classical Linear Regression Model (CLRM)

Assumption 1: Linear Regression Model

- The regression model is **linear in the parameters**, though it may or may not be linear in the variables.

$$Y_i = \beta_1 + \beta_2 X_i + u_i$$

Assumptions of Classical Linear Regression Model (CLRM)

Assumption 2: Fixed *X* Values, or *X* Values Independent of the Error Term

- Values of X are fixed in repeated samples.
- It is assumed that the *X* variable(s) and the error term are independent.

$$cov(X_i, u_i) = 0$$

Assumptions of Classical Linear Regression Model (CLRM)

Assumption 3: Zero Mean Value of Disturbance u_i

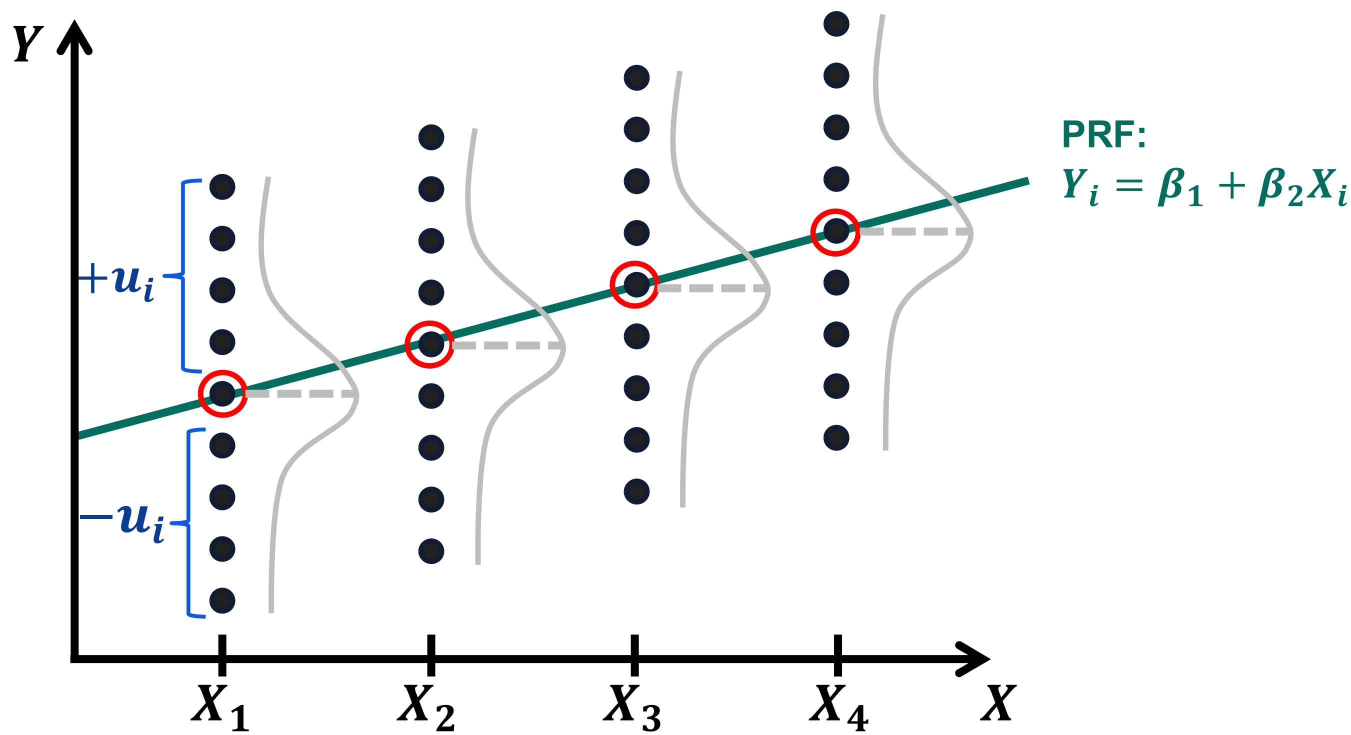
- Given the value of X_i, the mean, or expected, value of the random disturbance term u_i is zero.

$$E(u_i|X_i) = 0$$

$$E(u_i) = 0 \quad \text{(if } X \text{ is non-stochastic)}$$

Assumptions of Classical Linear Regression Model (CLRM)

Assumption 3: Zero Mean Value of Disturbance u_i



Assumptions of Classical Linear Regression Model (CLRM)

Assumption 4: Homoscedasticity or Constant Variance of u_i

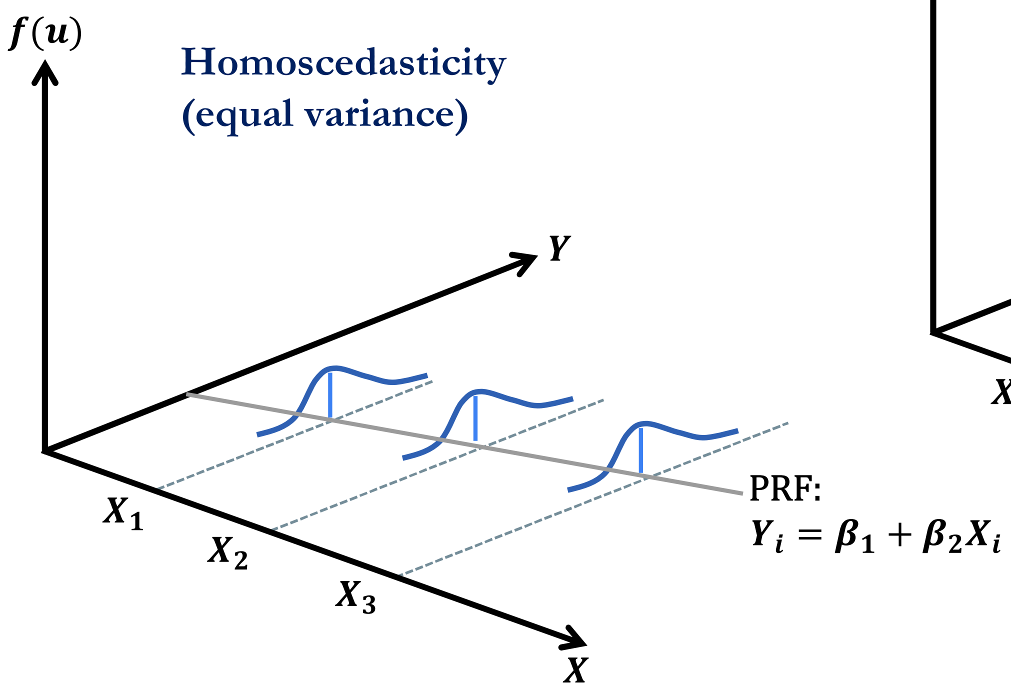
- The variance of the error, or disturbance, term is the same regardless of the value of X.

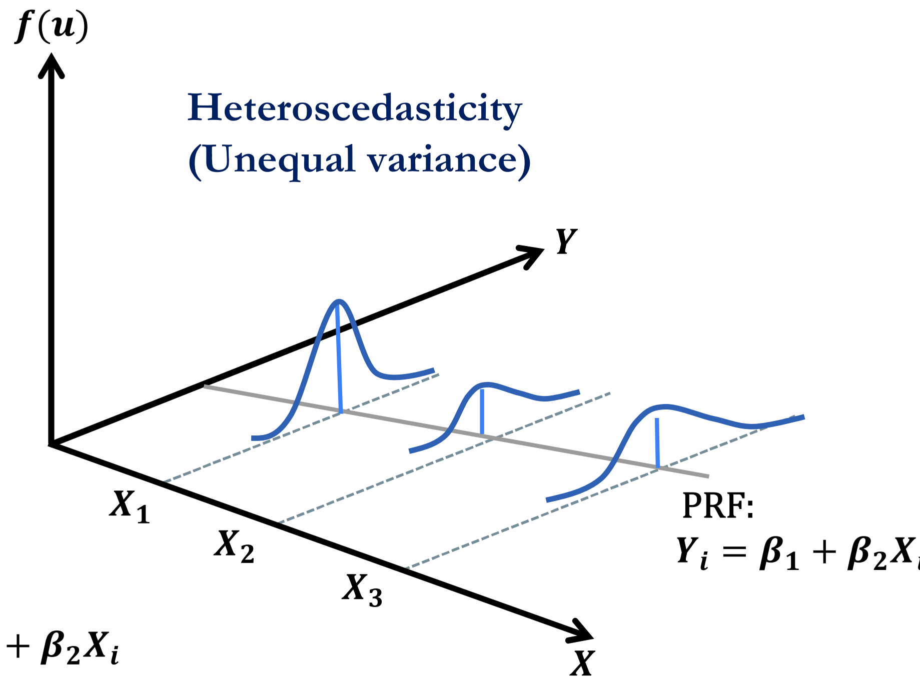
$$var(u_i) = E\left(u_i^2 \middle| X_i\right) = \sigma^2$$

$$var(u_i) = E\left(u_i^2\right) = \sigma^2 \quad \text{(if } X \text{ is non-stochastic)}$$

Assumptions of Classical Linear Regression Model (CLRM)

Assumption 4: Homoscedasticity or Constant Variance of u_i





Assumptions of Classical Linear Regression Model (CLRM)

Assumption 5: No Autocorrelation between the Disturbances

- Given any two X values, X_i and $X_j (i \neq j)$, the correlation between any two u_i and $u_j (i \neq j)$ is zero. Simply put, the observations are sampled independently.

$$cov(u_i, u_j | X_i, X_j) = 0$$

$$cov(u_i, u_j) = 0$$ (if X is non-stochastic)

Assumptions of Classical Linear Regression Model (CLRM)

Assumption 5: No Autocorrelation between the Disturbances

Diagram 1

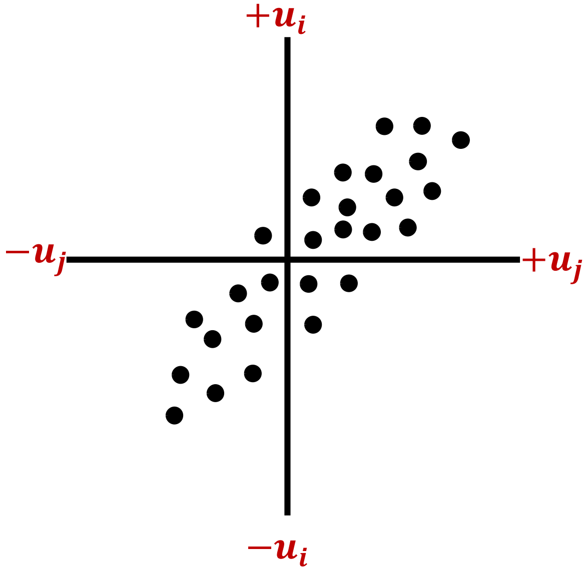


Diagram 2

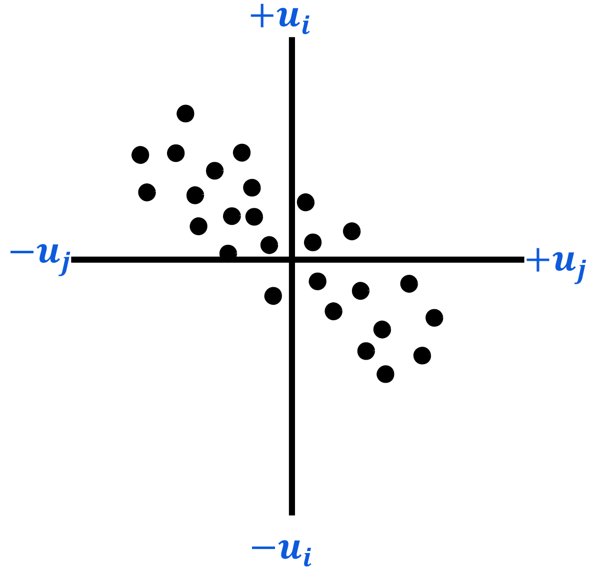
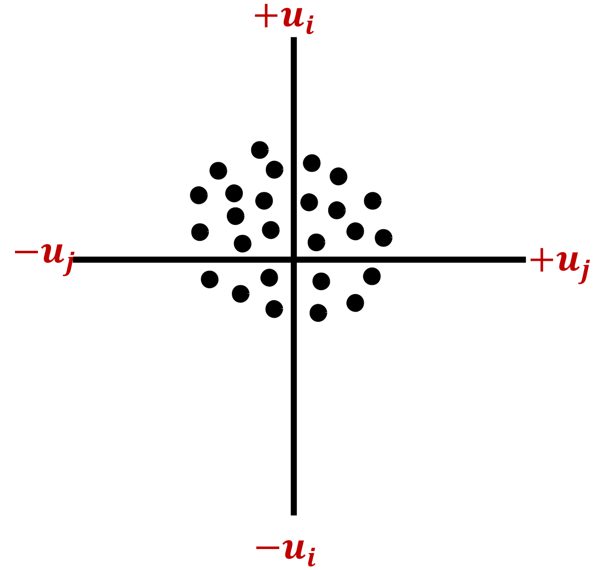


Diagram 3



Assumptions of Classical Linear Regression Model (CLRM)

Assumption 6: The Number of Observations (n) Must Be Greater than the Number of Parameters to Be Estimated

- The number of observations must be greater than the number of explanatory variables.

Assumptions of Classical Linear Regression Model (CLRM)

Assumption 7: The Nature of *X* Variables

- The X values in a given sample must not all be the same.
- Also, there can be no outliers in the values of the *X* variable.

Assumptions of Classical Linear Regression Model (CLRM)

Violations of Assumptions of CLRM

- Multicollinearity
- Heteroscedasticity
- Autocorrelation
- Model Misspecification or Specification Bias

THANK YOU!

Next Lesson: Precision or Standard Errors of OLS Estimates