

# Regression Analysis: Basic Concepts

Allin Cottrell

## OLS

The basic technique for determining the coefficients  $\hat{\beta}_0$  and  $\hat{\beta}_1$  is *Ordinary Least Squares* (OLS).

Values for the coefficients are chosen to minimize the sum of the squared estimated errors or *residual sum of squares* (SSR). The estimated error associated with each pair of data-values  $(x_i, y_i)$  is defined as

$$\hat{u}_i = y_i - \hat{y}_i = y_i - \hat{\beta}_0 - \hat{\beta}_1 x_i$$

We use a different symbol for this *estimated error* ( $\hat{u}_i$ ) as opposed to the "true" disturbance or error term, ( $u_i$ ). These two coincide only if  $\hat{\beta}_0$  and  $\hat{\beta}_1$  happen to be exact estimates of the regression parameters  $\alpha$  and  $\beta$ . The estimated errors are also known as *residuals*.

The SSR may be written as

$$SSR = \sum \hat{u}_i^2 = \sum (y_i - \hat{y}_i)^2 = \sum (y_i - \hat{\beta}_0 - \hat{\beta}_1 x_i)^2$$

## The simple linear model

Represents the dependent variable,  $y_i$ , as a linear function of one independent variable,  $x_i$ , subject to a random "disturbance" or "error",  $u_i$ .

$$y_i = \beta_0 + \beta_1 x_i + u_i$$

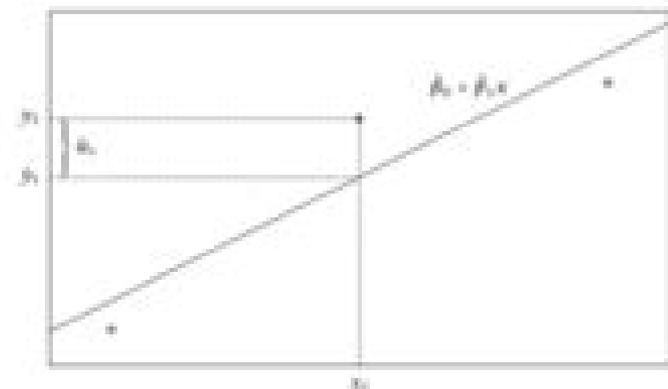
The error term  $u_i$  is assumed to have a mean value of zero, a constant variance, and to be uncorrelated with its own past values (i.e., it is "white noise").

The task of estimation is to determine regression coefficients  $\hat{\beta}_0$  and  $\hat{\beta}_1$ , estimates of the unknown parameters  $\beta_0$  and  $\beta_1$  respectively.

The estimated equation will have the form

$$\hat{y}_i = \hat{\beta}_0 + \hat{\beta}_1 x_i$$

## Picturing the residuals



The residual,  $\hat{u}_i$ , is the vertical distance between the actual value of the dependent variable,  $y_i$ , and the fitted value,  $\hat{y}_i = \hat{\beta}_0 + \hat{\beta}_1 x_i$ .

# Regression Analysis Basic Concepts

**Kathleen Armour**



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