

# 1 Simple regression

Formula for  $\hat{\beta}_1$

$$\hat{\beta}_1 = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^n (x_i - \bar{x})^2}$$

Sum of squares

$$SST = \sum_{i=1}^n (y_i - \bar{y})^2$$

$$SSE = \sum_{i=1}^n (\hat{y}_i - \bar{y})^2$$

$$SSR = \sum_{i=1}^n \hat{u}_i^2$$

Standard error of  $\hat{\beta}_1$

$$se(\hat{\beta}_1) = \frac{\hat{\sigma}}{\sqrt{SST_x}}$$

where

$$\hat{\sigma}^2 = SSR/(n-2)$$

## 2 Multiple regression

Standard error of slopes

$$se(\hat{\beta}_j) = \frac{\hat{\sigma}}{\sqrt{SST_j(1 - R_j^2)}}, j = 1, 2, \dots, k$$

where

$$\hat{\sigma}^2 = (n - k - 1)^{-1} \sum_{i=1}^n \hat{u}_i^2$$

$t$  statistic

$$\frac{\hat{\beta}_j - \beta_j}{se(\hat{\beta}_j)} \sim t_{n-k-1} = t_{df}$$

F statistic

$$F = \frac{(SSR_r - SSR_{ur})/q}{SSR_{ur}/(n - k - 1)}$$

or

$$F = \frac{(R_{ur}^2 - R_r^2)/q}{(1 - R_{ur}^2)/(n - k - 1)}$$