SIMULTAN

$$H_0: \beta_1 = \beta_1 = \cdots = \beta_k = 0$$

$$H_1: \beta_j \neq 0 \quad \text{for at least one } j$$

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F_0
Regression	SS_R	k	MS_R	MS_R/MS_{Res}
Residual	SS_{Res}	$n-k-1$	MS_{Res}	
Total	SS_T	$n-1$		

$$SS_R = \hat{\boldsymbol{\beta}}'\mathbf{X}'\mathbf{y} - \frac{\left(\sum_{i=1}^{n} y_i\right)^2}{n}$$

$$SS_{Res} = \mathbf{y}'\mathbf{y} - \frac{\left(\sum_{i=1}^{n} y_i\right)^2}{n} - \left[\hat{\boldsymbol{\beta}}'\mathbf{X}'\mathbf{y} - \frac{\left(\sum_{i=1}^{n} y_i\right)^2}{n}\right]$$

$$SS_T = \sum_{i=1}^{n} y_i^2 - \frac{\left(\sum_{i=1}^{n} y_i\right)^2}{n} = \mathbf{y}'\mathbf{y} - \frac{\left(\sum_{i=1}^{n} y_i\right)^2}{n}$$

$$SS_T = SS_R + SS_{Res}$$

$$\hat{\sigma}^2 = MS_{Res}$$

Therefore, to test the hypothesis $H_0: \beta_1 = \beta_2 = \ldots = \beta_k = 0$, compute the test statistic F_0 and reject H_0 if $F_0 > F_{\alpha,k,n-k-1}$

PARTIAL

The hypotheses for testing the significance of any individual regression coefficient, such as β_j, are

$$H_0: \beta_j = 0, \quad H_1: \beta_j \neq 0 \tag{3.28}$$

If $H_0: \beta_j = 0$ is not rejected, then this indicates that the regressor x_j can be deleted from the model. The **test statistic** for this hypothesis is

$$t_0 = \frac{\hat{\beta}_j}{\sqrt{\hat{\sigma}^2 C_{jj}}} = \frac{\hat{\beta}_j}{\mathrm{se}\left(\hat{\beta}_j\right)} \tag{3.29}$$

where C_{jj} is the diagonal element of $(\mathbf{X}'\mathbf{X})^{-1}$ corresponding to $\hat{\beta}_j$. The null hypothesis $H_0: \beta_j = 0$ is rejected if $|t_0| > t_{\alpha/2, n-k-1}$. Note that this is really a **partial** or **marginal test** because the regression coefficient $\hat{\beta}_j$ depends on all of the other regressor variables $x_i (i \neq j)$ that are in the model. Thus, this is a test of the **contribution** of x_j **given the other regressors in the model**.