Tuesday, September 20, 2016 9:45 AM

ESS = Explained Sum of Squares = $\sum(\hat{Y}_i - \bar{Y})^2$ = Regression Sum of Squares = RSS

RSS = Residual Sum of Squares = $\sum \hat{u}_i^2 = \sum (Y_i - \hat{Y}_i)^2$ = Error Sum of Squares = ESS

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$$Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + \cdots + \beta_k X_{ki} + u_i \qquad i = 1, 2, \ldots, n$$

$$\begin{aligned}
i=1 \quad & Y_1 = \beta_1 + \beta_2 X_{21} + \beta_3 X_{31} + \cdots + \beta_k X_{k1} + u_1 \\
i=2 \quad & Y_2 = \beta_1 + \beta_2 X_{22} + \beta_3 X_{32} + \cdots + \beta_k X_{k2} + u_2 \\
& \vdots \\
i=n \quad & Y_n = \beta_1 + \beta_2 X_{2n} + \beta_3 X_{3n} + \cdots + \beta_k X_{kn} + u_n
\end{aligned}$$

$$\begin{bmatrix} Y_1 \\ Y_2 \\ \vdots \\ Y_n \end{bmatrix} = \begin{bmatrix} 1 & X_{21} & X_{31} & \cdots & X_{k1} \\ 1 & X_{22} & X_{32} & \cdots & X_{k2} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 1 & X_{2n} & X_{3n} & \cdots & X_{kn} \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_k \end{bmatrix} + \begin{bmatrix} u_1 \\ u_2 \\ \vdots \\ u_n \end{bmatrix}$$

$$Y = X\beta + u$$

$$\hat{\beta} = \begin{bmatrix} \hat{\beta}_1 \\ \vdots \\ \hat{\beta}_k \end{bmatrix} = (X'X)^{-1} X'Y$$

$$\hat{\beta} = \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_k \end{bmatrix} = (X'X)\,X'Y$$

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✓① $Y_i = \beta_1 + \beta_2 X_{2i} + u_i$

② $Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + u_i$

Nested Models.

$R^2_{②} \geq R^2_{①}$

✓③ $Y_i = \beta_1 + \beta_3 X_{3i} + \beta_4 X_{4i} + u_i$

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④ $Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + u_i$

⑤ $Y_i = \beta_1 + \beta_2 X_{2i} + \beta_4 X_{4i} + \beta_5 X_{5i} + u_i$

⑥ $Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + u_i$

$R^2_{⑥} \geq R^2_{④}$

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① $Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + u_i$ ← Variation

① $Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + u_i$ ← Variation in $Y_i$

② $\ln Y_i = \beta_1 + \beta_2 X_{2i} + \beta_4 X_{4i} + \beta_5 X_{5i} + u_i$

↓ Variation in $\ln Y_i$

③ $Y_i = \beta_1 + \beta_2 X_{2i} + \beta_4 X_{4i} + u_i$