Quiz 7

Due: Thursday November 5, 2020 6:30 PM (EST)

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Help

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Q1 (5 points)

Assume the usual linear multiple regression model. Label the following statement True (meaning always true) or False (meaning not always true), and show your work or explain: $\widehat{\boldsymbol{\epsilon}}' \, \widehat{\boldsymbol{\epsilon}} = \boldsymbol{\epsilon}' \, \widehat{\boldsymbol{\epsilon}}$.

Q2 (5 points)

For the usual multiple regression model with normal error terms, we seek to test whether *all* the β_j parameters are equal to zero -- including β_0, if the model has an intercept. A suggested test statistic is $G^* = \frac{\sum_{i=1}^n \widehat{y}_i^2}{(k+1)MSE}$. Show how this statistic arises from the general linear test of $H_0 : \mathbf{C}\boldsymbol{\beta} = \mathbf{t}$. What is the distribution of G^* under the null hypothesis?

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① TRUE

$$\hat{\varepsilon}'\hat{\varepsilon} = (y - \hat{y})'\hat{\varepsilon} = y'\hat{\varepsilon} - \hat{y}'\hat{\varepsilon}$$

$$= (X\beta + \varepsilon)'\hat{\varepsilon} + (X\hat{\beta})'\hat{\varepsilon}$$

$$= (X\beta)'\hat{\varepsilon} + \varepsilon'\hat{\varepsilon} + \hat{\beta}'\underbrace{X'\hat{\varepsilon}}_{0}$$

$$= \beta'\underbrace{X'\hat{\varepsilon}}_{0} + \varepsilon'\hat{\varepsilon} \qquad = \varepsilon'\hat{\varepsilon}$$

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② For $H_0 : I\beta = 0$, $F^* = \dfrac{(I\hat{\beta} - 0)'(I(X'X)^{-1}I')^{-1}(I\hat{\beta} - 0)}{(k+1)\, MSE}$

$$= \frac{\hat{\beta}'((X'X)^{-1})^{-1}\hat{\beta}}{(k+1)\, MSE} \qquad = \frac{\hat{\beta}'X'X\hat{\beta}}{(k+1)\, MSE}$$

$$= \frac{(X\hat{\beta})'(X\hat{\beta})}{(k+1)\, MSE} \qquad = \frac{\hat{y}'\hat{y}}{(k+1)\, MSE}$$

$$= \frac{\sum_{i=1}^{n} \hat{y}_i^2}{(k+1)\, MSE} = G^* \overset{H_0}{\sim} F(k+1, n-k-1)$$