MITx: 14.310x Data Analysis for Social Scientists

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The Multivariate Linear Model Continued... - Quiz

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Question 1

1/1 point (graded)

True or False: Suppose you are running a regression, and are worried that two of your variables might be perfectly collinear. You start by looking at the correlation coefficients, and find that they are highly correlated $p = 0.9$. This means that they are perfectly collinear.

- a. True
- b. False ✔

Explanation

A high correlation coefficient implies your variables are strongly related to each other, however it doesn't imply that your variables are perfectly collinear, because they maybe related by some.

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✔ Correct (1/1 point)

Question 2

1/1 point (graded)

Suppose you are estimating a model $Y = \alpha + \beta X + \epsilon$, where $\epsilon = \begin{bmatrix} \epsilon_1 \\ \vdots \\ \epsilon_n \end{bmatrix}$ Which of the following would imply that $E[\epsilon\epsilon^T] \neq \sigma^2 I$?

- a. $\mathrm{Cov}[\epsilon_i \epsilon_j] \neq 0$ for some $i, j \in (1, \ldots, n),\ i \neq j$
- b. $\mathrm{Cov}[\epsilon_i \epsilon_j] \neq 0$ for all $i, j \in (1, \ldots, n),\ i \neq j$
- c. $\mathrm{Cov}(\epsilon) \neq \sigma^2 I$
- d. Your errors are correlated across observations
- e. All of the above ✔

Explanation

First, recall that $E[\epsilon\epsilon^T]$ is sometimes denoted as $\mathrm{Cov}(\epsilon)$ (the variance-covariance matrix of ϵ). So C is equivalent to $E[\epsilon\epsilon^T] \neq \sigma^2 I$. As Prof. Ellison showed in class, the off-diagonal elements of the n x n matrix $E[\epsilon\epsilon^T]$ are given by $\mathrm{Var}(\epsilon_i)$ for all $i, j \in\ (1, \ldots, n), i \neq j$. Whereas the elements on the diagonal are $\mathrm{Var}(\epsilon_i)$ for all $i \in (1, \ldots, n)$. So, in order for $E[\epsilon\epsilon^T] = \sigma^2 I$, all the off-diagonal elements must be equal to 0, i.e. $\mathrm{Cov}(\epsilon_i \epsilon_j) = 0$ for all $i, j \in (1, \ldots, n),\ i \neq j$, or in words: the errors must be uncorrelated across observations.

So if this fails to hold for any pair (i.e your errors are correlated across some observations), then $E[\epsilon\epsilon^T] \neq \sigma^2 I$, which implies that A and D are both correct. Since the equality fails to hold if the errors are correlated across any pair, it will fail to hold if the errors are correlated across all pairs of observations. So all the answers imply that $E[\epsilon\epsilon^T] \neq \sigma^2 I$, so the correct answer is E.

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