

PO 7005: Assignment 2

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NOTE: Always justify your answer. Show **R** code when relevant. Late submissions will not be accepted.

Question A (20%)

Carefully read the following statements. Are they *true* or *false*? Explain. 5% each.

1. A regression of the OLS residual upon the regressors included in the model by construction yields an R^2 of zero.
2. The hypothesis that the OLS estimator is equal to zero can be tested by means of a t -test.
3. If the absolute t -value of a coefficient is smaller than 1.96, we accept the null hypothesis that the coefficient is zero, with 95% confidence.
4. If a variable in a model is significant at the 10% level, it is also significant at the 5% level.

Question B (3%)

1. Show that $\text{Var}[b - \beta] = \text{Var}[b]$

Question C (45%)

Let $y = \begin{pmatrix} 2 \\ 4 \\ 5 \end{pmatrix}$ and $x = \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix}$. You want to estimate the following model:

$$y = \beta_0 + \beta_1 x + \varepsilon$$

For each of the following questions, unless otherwise stated, calculate your results BY HAND. You may check your results using R, but you should show your manual calculations (but no

need to show every step in excruciating detail. i.e., I don't need to see how you multiply each term...). You may submit handwritten work (ideally scanned and uploaded onto Turnitin). Each question is worth 5%

1. How many degrees of freedoms are there?
2. Calculate b_0 and b_1 , the estimates of β_0 and β_1 . You may use a software to calculate the inverse of a matrix (though you are welcome to do it manually—it's easy here).
3. Calculate the standard error of b_1 and b_2 . You may use a statistics table or software to obtain the relevant critical value.
4. Calculate the 95% confidence interval of these coefficients.
5. Find the t- and p-values associated with these coefficients (use a software or a table for the p-value)
6. Calculate R^2
7. Suppose you collect a new observation, $x^0 = 0$. What do you predict the corresponding y , \hat{y}^0 , will be?
8. Calculate confidence and prediction intervals around y^0 .
9. Calculate the regression's F-statistic comparing this model to an alternative model $y = \beta_0 + \varepsilon$ and find the corresponding p-value (p-value may be found in a statistics table or using a software).

Question D (32%)

Perform the same operations as in Question C 2–9, but this time using R. Do not use canned functions such as `lm`. Show your code. Each question is worth 4%