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ECONOMETRICS - 15-01-2020

INSTRUCTIONS

1. Save this file to your local computer, fill it in as appropriate and save the edited version *under a different file name*: the name you should use for saving should be your "matricola" number and of course pdf extension. So for instance a student whose matricola is S1071010 should save the filled-in version of this document as `S1071010.pdf`.

   Note: you may experience problems in some software environments. I have tried to test the file under as many platforms as I could.

   - Under Linux, both evince and okular work OK for opening, editing and saving the file, xpdf does not.
   - The same goes for the internal pdf reader under OSX; on a Mac, you can also use Acrobat Reader, but I am told that in some cases you will have to jump a few hurdles.
   - If you use Windows, your best bet seems to be a recent version of Acrobat Reader.
   - As for Android, I've briefly tried xodo, that seems to get the work done, but I haven't tested it very thoroughly.
   - Under iOS, I think the internal pdf reader should work, but I have no first-hand experience.

   However, keep in mind that **no browser will let you fill in the form and save it**; so, whatever your operating system, be sure to download it first and open it with a proper pdf application (not Chrome, Firefox, Edge or any other browser).

2. For the "True/False/Not Necessarily" questions, say if the statements are unambiguously true (True), unambiguously false (False) or impossible to classify the way they are stated (Not necessarily). Give one answer only and write the motivations to your answers in the text box provided. **Answers with no motivations will be considered wrong.**

3. For the "Test" questions, the fields are meant to be filled in as follows:

   Test type refers to the type of the test (eg Wald, LR, t, F, etc.)

   Distribution refers to the density the test statistic should have under the null (eg Normal, χ^2_2, ...)

   Test statistic is the actual numerical value of the test

   and after that you should select one of the two tick boxes ACCEPT and REJECT. For example:

   Test type: `Wald` Distribution: `chi^2(3)` Test statistic: `12.43`
   Decision: Accept ☐ Reject ☑

4. To enter matrices into a text box, use "," to separate columns and ";" to separate rows. For example, the matrix $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ should be entered as `[1, 2; 3, 4]`.

EXERCISES

1. (a) The matrix $\begin{bmatrix} 1 & -x \\ x & 1 \end{bmatrix}$, where x is a positive number, is singular.

True ☐ False ☐ Not necessarily ☐

(b) Consider the statistic $\hat{\theta}$ as an estimator of the parameter θ_0. Given a sample of size n, if its distribution is

$$\hat{\theta} = \begin{cases} \theta_0 + 1/n & \text{con prob. } 0.5 \\ \theta_0 - 1/n & \text{con prob. } 0.5, \end{cases}$$

then $\hat{\theta} \xrightarrow{\text{p}} \theta$.

True ☐ False ☐ Not necessarily ☐

(c) If you add an irrelevant regressor to a linear model, the R^2 index cannot increase.

True ☐ False ☐ Not necessarily ☐

(d) In a linear model marginal effects are always constant.

True ☐ False ☐ Not necessarily ☐

(e) In an ADL model, the long-run multiplier can never be 0.

True ☐ False ☐ Not necessarily ☐

2. Imagine you have a dataset with three variables: y_i, x_i and w_i, and consider the following table:

	1	y_i	x_i	w_i
1	200	100	50	75
y_i	100	300	100	75
x_i	50	100	350	50
w_i	75	75	50	350

to be read as: each element is the cross-product of the variables in the row and column headings. For example, $\sum_{i=1}^{n} x_i y_i = 100$ and $\sum_{i=1}^{n} w_i = 75$. Consider the model:

$$y_i = \beta_0 + \beta_1 x_i + \varepsilon_i$$

(a) Compute the sample size: $n =$

(b) Compute the OLS statistic: $\hat{\beta}_0 =$ $\hat{\beta}_1 =$

(c) Compute the sum of squared residuals and the variance estimator:

$\mathbf{e}'\mathbf{e} =$ $\hat{\sigma}^2 =$

(d) Test the hypothesis $H_0 : \beta_1 = 0$

Test type: Distribution: Test statistic:

Decision: Accept Reject

3. The dataset `villages.gdt` contains data on 708 villages in Central Italy (municipalities may contain more than one village). The variables it contains are:

Symbol	**varname**	**description**
$n51_i$	`pop51`	Population at the 1951 census
$n71_i$	`pop71`	Population at the 1951 census
a_i	`alt`	Altitude (in thousand metres)
c_i	`cap`	Dummy, 1 if belongs to a local capital municipality

(a) Calculate the variable $y_i = \log \frac{n71_i}{n51_i}$ (symmetric relative change in population between 1951 and 1971) and report its sample mean and variance:

$m =$ $v =$

(b) Estimate by OLS the model

$$y_i = \beta_1 + \beta_2 \log(n51_i) + \beta_3 a_i + \beta_4 c_i + \varepsilon_t \tag{1}$$

and report the estimated coefficients and standard error. **If necessary, use robust standard errors.**

Coeff.	**Estimate**	**std. err.**
β_1		
β_2		
β_3		
β_4		

(c) Comment on the result obtained above: give an interpretation of the sign of the coefficients and their statistical significance

(d) Perform a RESET test and e comment on its results:

(e) Independently of the RESET test, estimate an augmented version of the model:

$$y_i = \beta_1 + \beta_2 \log(n51_i) + \beta_3 a_i + \beta_4 c_i + \beta_5 \log(n51_i)^2 + \beta_6 a_i^2 + \varepsilon_t \tag{2}$$

and briefly comment on the differences with (1).