# Econometrics – Assessment

**Exercise 1**

Consider the following regression equation:

$$E\left[\ln C_i \mid X_i, D_i\right] = \beta_0 + \beta_1 \ln X_i + \beta_2 \left(D_i \times \ln X_i\right) + \beta_3 D_i$$

where $C$ is household's consumption, $X$ is its income, both <u>in thousands of euro</u>, and $D$ is a dummy variable equal to one if the head of the household is unemployed and 0 otherwise. The available sample has 750 independent observations and is representative of the entire population. The (OLS) estimated function is:

$$\hat{E}\left[\ln C_i \mid X_i, D_i\right] = 0.13 + 0.70 \ln X_i + 0.15\left(D_i \times \ln X_i\right) - 0.4 D_i$$

with estimated variance-covariance matrix:

$$\hat{V}\left(\hat{\beta}\right) = \begin{bmatrix} 0.81 & 0.1 & -0.3 & 0.7 \\ 0.1 & 0.2 & -0.01 & 0.02 \\ -0.3 & -0.01 & 0.04 & 0.01 \\ 0.7 & 0.02 & 0.01 & 1.4 \end{bmatrix}$$

1. Consider a household whose head is employed, provide an estimate of the percentage variation of its consumption when its income increases by 1%. Test if is such variation is significantly different from zero.
2. Do the estimation results support the following statement? “The consumption elasticity to income of the household whose head is unemployed is higher than the corresponding elasticity when the head of the household is employed”. Use a proper test to answer.
3. Compute the predicted value and its confidence interval of the logarithm of consumption for a household whose head is employed and its income is euro 1000.
4. Test the hypotheses that the predicted value at 3. is equal to *ln(1.1)* and that the consumption elasticity to income equals 1 when the head of the household is employed

   NB: Remind that: $\begin{bmatrix} a & b \\ c & d \end{bmatrix}^{-1} = \dfrac{1}{ad-bc}\begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$.

**Exercise 2**

Describe the probit model. For what type of dependent variables is this model suitable? What are the distributive assumptions on the stochastic component of the model? What is the typical estimation principle adopted to estimate the parameters? Do the parameters have a direct interpretation in terms of marginal effects?

**Exercise 3**

Define the concept of stationarity and discuss why the stationarity assumption is essential for the estimation and use of models in the time series framework.

**Exercise 4**

Consider the equation

$$y_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + u_i \qquad (1)$$

and a sample with 200 observations. Given that $x_1$ is endogenous, the equation has been estimated with 2SLS. The results of the first and second stage are shown in the following table, where $z_1$, $z_2$ and $z_3$ are the three instrumental variables used in the estimation.

| | Col. (1) | | Col. (2) | | Col (3) | |
|---|---|---|---|---|---|---|
| Estimation method → | 2SLS | | OLS | | OLS | |
| Dep. Var. → | $Y$ | | $x_1$ | | $\hat{u}$ | |
| | Coeff. | Std.err. | Coeff. | Std.err. | Coeff. | Std.err. |
| $x_1$ | -0.07 | 0.04 | | | | |
| $x_2$ | -0.30 | 0.27 | 0.5 | 0.1 | 0.1 | 0.8 |
| $z_1$ | | | 0.6 | 0.5 | 3.5 | 2.0 |
| $z_2$ | | | 0.2 | 0.4 | 0.7 | 0.7 |
| $z_3$ | | | 1.2 | 0.3 | 0.9 | 0.8 |
| *Constant* | -2.71 | 0.47 | -0.3 | 0.2 | 0.6 | 0.2 |
| *F statistics* | | | 12.0 | | 1.5 | |

The last row of columns (2) and (3) shows the F statistics necessary to test for the relevance of the instruments and the validity of the overidentifying conditions.

1. Say if this is a case of exact or overidentification, and in the latter case specify the order of the overidentification
2. Which are the hypotheses considered to test for the relevance/weakness of the instruments? (Write the hypotheses explicitly and declare which column you refer to). Are the instrumental variables weak?
3. Which are the hypotheses considered to test for the validity of the overidentifying restrictions? (Write the hypotheses explicitly and declare which column you refer to). Are the overidentification conditions valid?
4. Given the results at points 2. and 3., are the 2SLS estimates consistent?

$\chi^2$ distribution

| | Significance level | | |
|---|---|---|---|
| **Degree of freedom** | **10%** | **5%** | **1%** |
| **1** | 2.706 | 3.841 | 6.635 |
| **2** | 4.605 | 5.991 | 9.21 |
| **3** | 6.251 | 7.815 | 11.345 |
| **4** | 7.779 | 9.488 | 13.277 |
| **5** | 9.236 | 11.07 | 15.086 |