ECON 457 - A01
Computational Economics*
UVIC - Department of Economics
Spring Term 2023/24

Assignment 2
Due on Brightspace before ***11.59pm February 27th*** *2024*
Please create and submit a pdf file, making sure that it's readable and unlocked.
The file name has to follow this template: 457_PS2_Surname_Name_StudentNumber.pdf

You can cooperate with other students, but no group submissions will be accepted
If you do cooperate, please list the other students' names in the cover page
No "photocopy answers"will be accepted
No late submissions will be accepted

NOTE: YOU MUST INCLUDE THE ASSIGNMENT COVER PAGE
(Failure to do so will entail a 5-point deduction from the grade received)

Remarks: Your answers have to be submitted in a "report" format. Relying on Jupyter is the easiest option. The codes you developed have to be included as well in the pdf file. Devote some time to give the graphs, plots and tables a format easy to understand. Also the way you present your answers matters for the final grade. Even if a question is mainly technical, ***briefly*** *explain what you are doing, stressing the economic meaning of the various steps whenever possible. Being able to convey your thoughts effectively is an asset also in real life.*

Question 1: Estimating consumption and investment functions (50 Marks)

The text file *US_data.txt* contains data for the U.S. economy on aggregate consumption (C_t), income (Y_t), gross private investment (I_t), and the interest rate (r_t). The variable names in the dataset are PCEC (C_t), GDP (Y_t), IR (r_t), and GDPI (I_t). All variables are nominal, quarterly, and span the period 1960Q1-2023Q2. The Excel file *US_data_clean.xls* provides additional information on the data.

Write Python codes to do the following:

(a) Import the data using Pandas (abbreviated as pd). The following command does work (on my office computers):

filename = 'US_data.txt'
df = pd.read_csv(filename, delim_whitespace=True)

Do check that the data were imported correctly in your notebook with the command print(df).

(b) Plot the four series. Comment.

(c) Compute the OLS (point) estimates of the following linear regression models:*

$$C_t = \alpha_0 + \alpha_1 Y_t + \alpha_2 r_t + \varepsilon_t^C$$

$$I_t = \beta_0 + \beta_1 r_t + \varepsilon_t^I$$

Report in a table the parameter estimates of the two models. Comment on your findings.

(d) Compute the residuals of the two regressions in part (c), and plot them in two separate graphs. Comment.

(e) Since the dependent variables are growing over time, it is reasonable to estimate (with OLS) an extension of the two econometric models considered above. In the set of regressors, we add a linear time trend (*time*):

$$C_t = \gamma_0 + \gamma_1 Y_t + \gamma_2 r_t + \gamma_3 time + \varepsilon_t^C$$

$$I_t = \phi_0 + \phi_1 r_t + \phi_2 time + \varepsilon_t^I$$

Compute the OLS (point) estimates for the two models and obtain the residuals of the investment regression. Report in a table the parameter estimates of the two models. Comment on your findings.

(f) As a final specification for investment, in the set of regressors, we now also add GDP:

$$I_t = \mu_0 + \mu_1 r_t + \mu_2 Y_t + \mu_3 time + \varepsilon_t^I$$

Compute the OLS (point) estimates for this model and report them in a table. Do you trust these estimates more than the corresponding ones obtained in part (e)? Compute the residuals of the regression, and plot them in a graph together with the residuals of the investment regression considered in part (e). Comment.

*For all parts in this question, you can use the estimation commands in popular libraries, such as SciPy/NumPy or statsmodels. For background, you can find the relevant OLS formulas here: `https://en.wikipedia.org/wiki/Simple_linear_regression`

Question 2: An IS-LM-FE Model (50 Marks)

We consider a simple extension to the basic IS-LM model for a closed economy that we discussed in class. You may want to modify the Python notebook I provided (1_IS-LM_closed.ipynb).

In particular, the consumption function now depends also on the interest rate r (and s is a negative parameter):

$$C = \overline{C} + c * (Y - \overline{T}) + s * r$$

The investment function is as in the benchmark model (b is a negative parameter):

$$I = \overline{I} + b * r$$

(a) For the parameters c, s, and b, use the values you obtained in part (e) of Question 1. For the other parameters, use the following values: $k = 0.6, h = 2700, \overline{C} = 55, \overline{I} = 200, \overline{G} = 150, \overline{T} = 150, \overline{M} = 200, \overline{P} = 1$.

Write a Python code to solve this version of the model. In a Table, report the values of GDP, Consumption, Investment and the interest rate. Comment.

(b) Now we analyze the role of fiscal and monetary policies by considering two cases. In one case, there is a fiscal stimulus policy with $\overline{G}^{new} = 160$ (taxes do not change), while in the other one there is an increase in the money supply with $\overline{M}^{new} = 210$. In two separate figures, plot the IS and LM curves before and after the policy changes. In a Table, report the values of GDP, Consumption, Investment and the interest rate. Do you think that the changes in the aggregate variables predicted by the model are reasonable? Why or why not? Comment.

(c) For this part, we consider a more general investment function (b is a negative parameter, and q is a positive parameter):

$$I = \overline{I} + b * r + q * Y$$

For the parameters c, s, and b, use the values you obtained in part (e) of Question 1. For the parameter q, use the values you obtained in part (f) of Question 1. For the other parameters, use the following values: $k = 0.6, h = 2700, \overline{C} = 55, \overline{G} = 150, \overline{T} = 150, \overline{M} = 200, \overline{P} = 1$.

Find numerically the value of $\overline{I}$ that delivers an Investment/GDP ratio equal to 20%. A sensible way to achieve this is by setting up the problem as the solution to a non-linear equation (e.g., with the bisection method). Explain your implementation and, in a Table, report the values of GDP, Consumption, Investment and the interest rate. Comment.