

## Problem Set 1

You can work in groups of up to four people. Hand in all codes (data, functions, main script) as well as an accompanying PDF with your answers and graphs in a single .zip folder whose name contains the last names of all group members and the number of the problem set.

From FRED data base download the series GDPC1 (quarterly US real GDP). Transform the series in growth rates. Suppose that real GDP growth rates follow an AR(1)

$$y_t = c + \phi y_{t-1} + \epsilon_t \quad \epsilon_t \sim iid(0, \sigma^2)$$

1. Plot the series.
2. Estimate the parameters  $c$ ,  $\sigma^2$  and  $\phi$  with OLS.
3. Estimate and plot the first 10 autocorrelations.
4. Obtain and plot the coefficients of the Wold representation of  $y_t$ .

Now suppose that GDP admits an AR(2) representation

$$y_t = c + \phi_1 y_{t-1} + \phi_2 y_{t-2} + \epsilon_t \quad \epsilon_t \sim iid(0, \sigma^2)$$

5. Estimate the parameters  $c$ ,  $\phi_1$ ,  $\phi_2$ , and  $\sigma^2$  with OLS.
6. Compute the roots of the AR polynomial.
7. State the conditions under which the process is causal and stationary.
8. Obtain and plot the coefficients of the Wold representation of  $y_t$ .

(Analytical) Consider the following MA

$$y_t = c + \epsilon_t + 1.2\epsilon_{t-1} + 2\epsilon_{t-2}$$

9. Show that the process is stationary.
10. Find the roots of the MA polynomial. Is the process invertible?