

**Problem Set 8**  
**Advanced Macroeconomics**  
**Winter 2025/26**

## Stochastic Processes, Time Series, and Filtering

1. Describe what is meant by a stochastic process and a time series with its components.
2. Explain the idea of the Hodrick-Prescott filter and the role of  $\lambda$ .
3. Download the following time series data from the [Eurostat database](#) for a country of your choice:

table	variable	unit	adjustment	periods
namq_10_gdp	B1GQ	CP_MEUR	SCA	2005–Q1 - latest
namq_10_gdp	B1GQ	PD10_EUR	SCA	2005–Q1 - latest
namq_10_gdp	P3_S13	CP_MEUR	SCA	2005–Q1 - latest
namq_10_gdp	P3_S13	PD10_EUR	SCA	2005–Q1 - latest

*Hint:* If you download the data with R you can use the package eurostat.

4. Given these data on nominal gross domestic product  $GDP_{nom}$  and nominal government spending  $GOV_{nom}$  and their respective price indices:
  - a) Calculate real gross domestic product  $GDP_{real}$  and government spending  $GOV_{real}$ .
  - b) Apply the HP filter from the lecture to compute the cyclical components  $GDP_{real}^{cycle}$  and  $GOV_{real}^{cycle}$  of the variables in real terms.
  - c) Compute the correlation coefficient between  $GDP_{real}^{cycle}$  and  $GOV_{real}^{cycle}$ . Display it in the command window.
  - d) Calculate the public consumption to GDP ratio  $GOV/GDP$  and its average value in percent. Display the latter in the command window.
  - e) Change the unit of time series  $GDP_{real}$  and  $GOV_{real}$  to index 2010 = 100.
5. Plot the indexed time series of real GDP and government spending for all quarterly observations as well as the public consumption to GDP ratio and its average in percent. Furthermore, show the cyclical components and a scatter plot of  $GDP_{real}^{cycle}$  and  $GOV_{real}^{cycle}$ .
6. Given these plots, describe the development and relationship of the presented variables referring to special events in the past.