

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 λ .
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.