

Computer Exercise

This exercise is optional. It can be done either in R or Python. The Python version will be explained in the tutorial session.

Exercise 1 (ARMA modelling of GDP data)

We consider the analysis of quarterly US GDP data ranging from 1950/1 to 2000/4, $n = 201$ observations. The CSV file containing the data can be found on the moodle site.

- (a) Load the dataset *US_GDP.csv* into your working environment. Plot the data and their first differences as well as the corresponding sample ACFs. Do you think the series is stationary? Perform the Augmented-Dickey-Fuller test.
- (b) Most of the time the fundamental data itself is not of interest but rather their (percentage) change. Construct the continuous growth rate i.e.

$$growth_t = \frac{GDP_t - GDP_{t-1}}{GDP_{t-1}}$$

- (c) Use the sample ACF and PACF of $growth_t$ to suggest an appropriate ARMA(p,q) model, that is, search for AR and MA signatures. Their properties are summarized in the following table.

	AR(p)	MA(q)	ARMA(p,q)
ACF	Tails off	Cuts off after lag q	Tails off
PACF	Cuts off after lag p	Tails off	Tails off

Once the lags are determined, fit the suggested model(s) on the growth data using the ML method, and interpret the output.

- (d) Determine the "best" model according to the AIC and BIC criteria.
- (e) What can you do in order to judge the quality of the fit(s)? Implement your suggestions, visualize and interpret your results. Hint: Plot the residuals. What do they have to resemble?
- (f) Forecast the series for one periods into the future. Furthermore, split the data into a training and a test set and evaluate the accuracy of your forecast.