RTP Exercise Sheet

Series 7

Exercise 7.1

Similar to exercise 5.1, we start with some simulations. Thus, we would like to use this exercise to simulate several time series by means of an ARMA model. Please perform the same steps as in exercise 5.1 for the following models:

a) ARMA(1,2) model with coefficients $\alpha_1 = -0.75$, $\beta_1 = -0.3$ and $\beta_2 = 0.25$.

b) ARMA(2,1) model with coefficients $\alpha_1 = 0.5$, $\alpha_2 = -0.3$ and $\beta_1 = 0.25$.

The innovation E_t shall follow a standard normal distribution $\mathcal{N}(0;1)$ in every model.

Exercise 7.2

In this exercise, we look at the time series *sunspotarea*, which is available in the package *fpp*. It contains yearly data about the area of sunspots averaged over all days of the year (in units of millionths of a hemisphere). Sunspots are magnetic regions that appear as dark spots on the surface of the sun.

a) Plot the time series. Why does it make sense to log-transform the time series?

b) Choose a suitable AR-model only based on the first 100 observations (1875 - 1974) of the log-transformed series.

R-Hint: window()

Exercise 7.3

During their yearly spring melt, glaciers deposit layers of sand and mud. These annual sediments, known as varves, can be reconstructed in New England for the whole time between the beginning (about 12'600 years ago) till the end (6'000 years ago) of glacial retreat. From these varves, approximations of paleoclimatic parameters can be computed, such as temperature (a warmer year yields more sediment).

In the dataset *varve.dat*, you will find 350 annual sediment diameters (contained in lines 201 through 550) starting at 11'660 years ago. After loading these data, first construct a time series object from them:

```
t.url <- "http://stat.ethz.ch/Teaching/Datasets/WBL/varve.dat"
d.varve <- ts(scan(t.url)[201:550])
```

Comment: The procedure scan() is a more general data loading function than read.table(). We use it here to avoid putting the data into a data frame. Do not worry about the exact choice of procedure for reading data here: simply believe us when we say that scan() does what we need, or read the help file.

a) It is advisable to log-transform the time series. Why?

b) Is the log-transformed time series stationary? If not, how can you make this time series stationary?

Disclaimer: Parts of the exercises are adopted from 'Applied Time Series Analysis' course at ETHZ by Marcel Dettling.