RTP Exercise Sheet

Series 1

Exercise 1.1

What is the expected period (time period of repetition) and the time step for the following timeseries:

a) Sunshine duration per month in Basel from 1990 to 2000.

b) Number of newborn babies in the city of Zurich per year from 2000 to 2011.

c) Number of reservations in a restaurant for every night during 4 weeks.

d) Water runoff of a river. The data has been collected every day for 4 years.

Exercise 1.2

Using the data **hstart.dat**[1], we illustrate various methods for descriptive decomposition and elimination of trends. The data contains monthly data on the start of residential construction in the USA within the time frame of January 1966 to December 1974. The data have undergone some transformation unknown to us (perhaps an index over some baseline value has been calculated, or perhaps the data are to be read as $x \cdot 10^?$ construction permits).

R-hint: (Reading data)

```
hstart <- read.table("hstart.dat")
```

Make a time series plot. Is this a stationary time series? If not, what kind of non-stationarity is evident?

Exercise 1.3

Simulate timeseries according to the following models:

a) Y1: $Y_t = E_t - 0.5 \cdot E_{t-1}$, where $E_t \sim N(0,1)$ i.i.d. $E_0 = 0$

b) Y2: $Y_t = Y_{t-1} + E_t$, where $E_t \sim N(0,1)$ i.i.d. $Y_0 = 0$

c) Y3: $Y_t = 0.5 \cdot Y_{t-1} + E_t$, where $E_t \sim N(0,1)$ i.i.d. $Y_0 = 0$

d) Y4: $Y_t = Y_{t-1} \cdot E_t$, where $E_t \sim U(0.95, 1.05)$ i.i.d. $Y_0 = 1$

[1] http://stat.ethz.ch/Teaching/Datasets/WBL/hstart.dat

Use a time series plot to decide whether or not these processes are stationary.

R-hint: (Simulating the time series $X_t = E_t$)

```
set.seed(1)
Et <- ts(rnorm(101, 0, 1))
Et[1] <- 0
y1 <- 0  #delete later
for (i in 2:length(Et)) {
    y1[i] <- Et[i]
}
y1 = y1[2:length(y1)]
ts.y1 = ts(y1)
```

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