Stat 463, Lab 5

October 12, 2007

1 In Class

1. Load the mortality data from chaper 2 of Shumway and Stoffer (`cmort.txt`). Recall that this data is not stationary because there are both stationary and overall trends. We may remove the trend using smoothing. Then, we should have a stationary time series. Now, generate the ACF and PACF plots. This can be done using the following commands

```
x=scan("cmort.txt")
plot.ts(x)
t=1:length(x)
lines(ksmooth(t,x,"normal", bandwidth=5))
resx=x-ksmooth(t,x,"normal", bandwidth=5)$y
plot.ts(resx)
acf(resx)
pacf(resx)
```

2. Enter the data from the file `grain.txt`. In this file are the annual grain yield on Broadbalk field at Rothamsted, UK from 1852 to 1925. Generate the ACF and PACF plots.

2 Homework

1. For a polynomial $ax^2+bx+c = 0$, the R command `polyroot(c(c,b,a))` will return the roots of a polynomial. Since some of these might be complex numbers, we can obtain the moduli of the roots using the command `Mod(polyroot(c(c,b,a)))`. Using these R commands determine whether the following models are causal and/or invertible.

Also, say if there are any parameter redundancies. (If there are redundancies then you don't need to say whether it is causal and/or invertible.

(a) $x_t = -\frac{1}{6}x_{t-1} + \frac{1}{3}x_{t-2} + w_t - \frac{5}{2}w_{t-1} + w_{t-2}$

(b) $x_t = \frac{8}{3}x_{t-1} + x_{t-2} + w_t + \frac{7}{6}w_{t-1} + \frac{1}{3}w_{t-2}$

(c) $x_t = \frac{2}{3}x_{t-1} + w_t + \frac{5}{2}w_{t-1} + w_{t-2}$

2. Create a function in R to simulate and $ARMA(p,q)$ time series. This function should take four arguments, a vector of length p, a vector of length q, the variance of the white noise process (σ^2), and the length of the simulation T.

   Explore the behavior of the ACF and PACF. Simulate a single path of 10,000 observations for each of the following models:

   (a) $x_t = 0.6x_{t-1} - 0.8x_{t-2} + w_t$

   (b) $x_t = w_t + 0.8w_{t-1} + 1.1w_{t-2}$

   (c) $x_t = 0.8x_{t-1} + w_t + 0.8w_{t-1}$

   Plot the ACF and PACF (use the command `pacf()`) for each path. Discuss what you see in the plots and if it is what you would expect.

3. Load the Berkeley and Santa Barbara temperature data using the following commands

```
berk=scan("berkeley.dat", what=list(double(0),double(0),double(0)))
time=berk[[1]]
berkeley=berk[[2]]
stbarb=berk[[3]]
```

   Create ACF and PACF plots for `berkeley` and `stbarb`. Repeat this for the differenced data. Do you have an opinion on possible models based only on these plots?

4. Load the global average temperature using the command

```
temperature=scan("globtemp.dat")
```

   Create ACF and PACF plots for `temperature` and the differenced data. Do you have an opinion on possible models based on these plots?

5. Verify example 3.4 from the book. Simulate the two MA models of length 10,000 using your newly created function and the two sets of parameters in this example. Now, fit those two MA models using the command `arima(x,c(0,0,1))` where `x` is the name of your time series. (We'll talk more about this command later; just trust the output for now.) Also, make ACF plots of your two simulated series. Does this confirm what was shown in theory?