# 477/577 In-class Exercise 2 : Fitting AR(p)

(due Fri 2/10/2017)

Name: Sample Solution

Use this file as a template for your report. Submit your code and comments together with (selected) output from R console.

- Your comments must be Arial font, and **BOLD FACED**.
- Your code must be Lucida Console font.

You must submit PRINTOUT of this file.

First, copy and paste below command in R console.

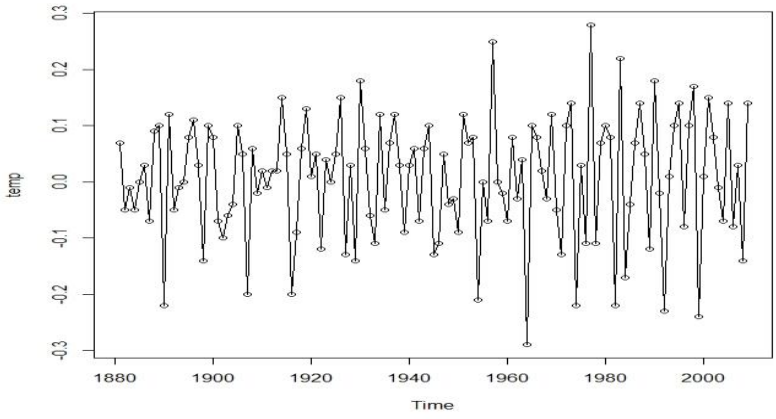
```
D  <- read.csv("http://gozips.uakron.edu/~nmimoto/pages/datasets/gtemp.txt")
D1 <- ts(D, start=c(1880), freq=1)
D2 <- diff(D1)

plot(D2)
```

Now your "D2" in R contains monthly difference in global temperature.

1. Plot the time series "D2". Does it look (weakly) stationary? Briefly explain what you see in the plot of "D2" regarding the stationarity.

   ```
   plot(D2, type="o")
   ```

   **Seems to have constant mean and constant variance. There's nothing that suggests non-stationarity.**



2. How many observation does “D2” have? What is the overall mean and variance of D2?

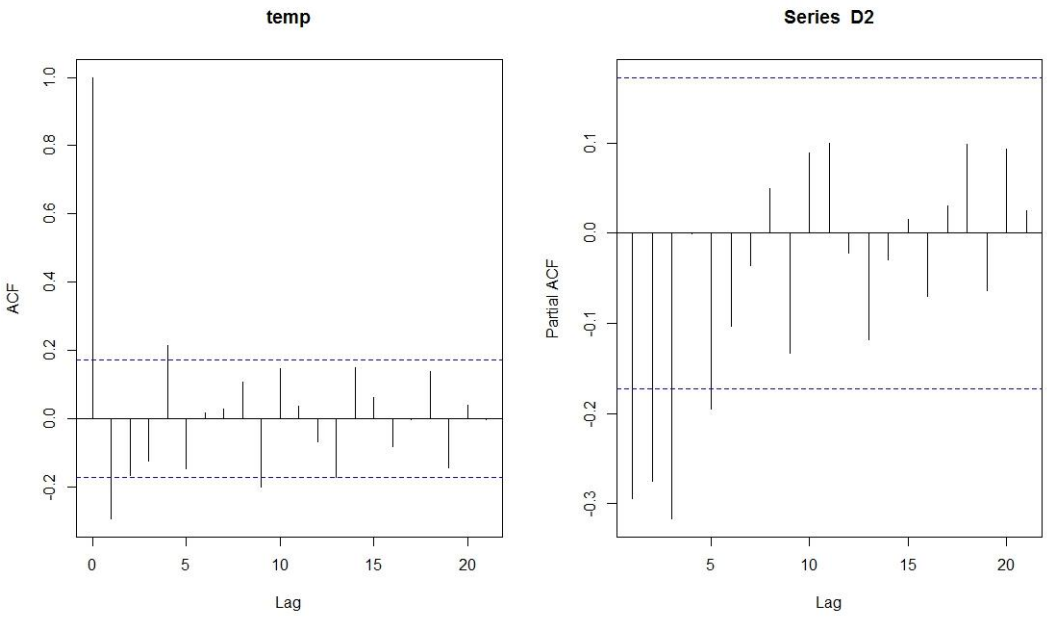
```
length(D2)
mean(D2)
var(D2)
```

**129 observations**

3. Does “D2” look like White Noise?, Or does it look like AR(p)? Examine plot of ACF and PACF and explain your thought briefly.

```
acf(D2)
pacf(D2)
```

**(PACF of D2 seems to be cutting off either at lag 3 or lag 5. This suggests AR(3) and AR(5) to be candidates for the model. Question is whether PACF at lag 5 is significant or not. We do not have to decide now, and look for more indications from other tools.**



4. Use ar() function to fit AR(p) model to D2. Keeping default of demean=TRUE and aic=TRUE, select the best value of p based on Minimum AIC.

```
Fit1 <- ar(D2)
```

**From the function AR(5) has the minimum AIC.**

5. Now compare p you got from (4) with plots of ACF and PACF from (3). Are they consistent, or are they conflicting? Briefly explain.

**Since AR(5) is one of the candidate from plots of ACF and PACF, this does not conflict with #3.**

6. Test Yule-Walker estimate of the AR parameter from (4) for significance. Quote the 95% CI result in $0.00 \pm 0.000$ format for each parameter, and clearly state test conclusion.

```
Fit1$ar
1.96*sqrt(diag(Fit1$asy))
```

```
Phi1: -0.462 +- 0.173
Phi2: -0.456 +- 0.191
Phi3: -0.394 +- 0.195
Phi4: -0.091 +- 0.191
Phi5: -0.195 +- 0.173
```

**All parameter estimates except Phi4 are significantly different from 0. (95% CI does not include 0.) While Phi4 may be zero, Phi5 is significant. We could look into AR(3) and see what happens (See R-Code file).**

7. Plot the residuals resulting from AR(p) fitting in (4). Does the residual looks like WN? Include ACF and PACF plot of residuals to support your conclusion. (hint: use acf() function, include "na.action=na.pass" so that they will ignore NA values.)

```
layout(matrix(c(1,1,2,3),2,2,byrow=TRUE))
plot(Fit1$resid)
acf(Fit1$resid, na.action=na.pass)
pacf(Fit1$resid, na.action=na.pass)
```

**ACF and PACF plot of residuals suggest that the residuals are white noise, and thus AR(5) is an adequate model for D2.**