477/577 In-class Assignment 2 : Fitting AR(p) to Temp Data

(due Tue 2/27/2020)

Submit your code file (.R or .txt extension).

- You must submit the code file (.R or .txt extension) on Brightspace, then also submit **printout** of the file in class.
- (1point) The file name must be

TS-A2-FirstLastname.R (or .txt)

- (1point) The code file must have title, and visible separator for questions. You can use the template posted on the website.
- (1point) When you print out the file, make sure all of your comments are on the page. If the word wrap is turned off, long sentences will be cut off.
- Each block of the code must have brief comment of what it's doing.
- You are encouraged to collaborate with your classmate, but your submission must be your own work.

Here is the code to load the data from the web.

```
D  <- read.csv("https://nmimoto.github.io/datasets/gtemp.csv")
D1 <- ts(D, start=c(1), freq=1)    # turn D into time series object
D2 <- diff(D1)                        # Take monthly difference

plot(D1)
plot(D2)
```

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

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

2. Use auto.arima() function in forecast package to fit AR(p) model using AICc as a best fit criteria (auto.arima() uses AICc as default criteria. AICc is a slightly improved version of AIC). What is the suggested model?

3. From AR(p) model suggested in part 2, investigate AR(p-1) and AR(p+1). Remove any parameters that has non-significant parameter estimate. What is your final AR model?

4. In your final AR model, what is the estimate for the standard deviation of the error term? What is the estimate of unconditional standard deviation?

5. Perform the residual analysis using Randomness.tests() provided on the class web site. Is model fit adequate? Comment on the quality of your residuals.

6. There are 129 observations in D2. Perform 1-month rolling forecast of the data with model found in part 3. Use window size of 100, and predict the last 29 observation 1-month at a time in retrospective. What is the prediction root mean square? Is the prediction satisfactory? Is the prediction rMSE (from the last 29 out-of-sample comparison) close to what it was suggested by your model (this is what #7 is asking)?

7. If you perform 1-month prediction on the future observation (obs 130). What is the estimate of the theoretical prediction rMSE? What is the 95% CI for 1-month prediction for the next monthly difference (obs 130)?

8. Using all 129 observations, perform 12-month forecast. Plot the graph. What is the line that h-step forecast is approaching?

9. Write down mathematical formula for your final AR model. Don’t forget parameters for your error term.