Assignment 2

DUE DATE: Tuesday 26^{th}, February 2019.

I pledge to the Honor Code and to obey all rules for taking and performing homework assignments as specified by the course instructor.

Full name _____ **Student ID.** _____

All data are downloadable from BE moodle

1.(30 points) Consider the growth rates of the U.S. real gross domestic product (GDP) from 1947.I to 2012.IV. The original data, from Federal Reserve Bank of St Louis, are in the file q-gdpmc1.txt (year, month, day, gnp), and the GDP are in millions of 2005 chained dollars. The growth rate is the first differenced series of the log(GDP).

(a) Build an AR model for the growth rate series. [Use the command ar with method mle to find the order.] Perform model checking to validate the fitted model. Write down the model.

(b) Does the model confirm the existence of business cycles? Why?

(c) Obtain 1-step to 8-step ahead point and 95 % interval forecasts for the U.S. quarterly GDP growth rate at the forecast origin October 1, 2012 (the last data point).

2.(40 points) Consider, again, the quarterly U.S. real GDP growth rates from 1947 to 2012 in Problem 1.

(a) Fit a simple AR(1) model to the series. Write down the model.

(b) Is the model adequate? Why?

(c) Compare the AR(1) model with the AR model built in Problem 2. In terms of in-sample fitting, which model is preferred? Why?

(d) Use **backtest** to compare the two AR models. You may use the data in 2008-2012 (inclusive) as the forecasting period. Which model is preferred? Why?

3.(50 points) (Commodity price). Consider the daily gold fixing price 10:30 am (London time) in London Bullion Market in U.S. dollars per Troy ounce from January 3, 1995 to March 30, 2017. The data can be obtained from FRED using the quantmod package. Since there are some missing values, we need to remove them before analysis. Let x_t = log(gold price). See instructions below.

Financial Toolbox

```
require(quantmod)
getSymbols('GOLDAMGBD228NLBM', src='FRED')
GOLD <- GOLDAMGBD228NLBM[6982:12784]
idx <- c(1:nrow(GOLD))[is.na(GOLD)]
GOLD <- GOLD[-idx]
xt <- log(as.numeric(GOLD))
rt <- 100*diff(xt)
```

(a)Obtain the time plots of xt and rt (in one page, using the command par(mfcol=c(2,1)).

(b) Let $r_t = 100*(x_t - x_{t-1})$ be the return series of the gold prices, in percentages. Consider the r_t series. Test $H_0 : \rho_1 = ... = \rho_{12} = 0$ versus $H_a : \rho_i \neq 0$ $\exists 1 \leqslant i \leqslant 12$. Draw the conclusion.

(c)Use the following command to specify the order of an AR model for rt.

```
ar(rt,method= "mle",order.max=20)
```

(d) Build an AR model for r_t, including model checking. Refine the model by excluding all estimates with t-ratio less than 1.645. Write down the fitted model.

(e) Use the fitted AR model to compute 1-step to 4-step ahead forecasts of rt at the forecast origin March 30, 2017. Also, compute the corresponding 95 % interval forecasts.