Assignment 3 Spring 2018

DUE DATE: Tuesday 2^{nd}, April 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.** _____

There are four questions.

Question1.

Consider the daily log returns of Caterpillar stock (CAT) from January 3, 2006 to March 15, 2019.You may download the data using quantmod. Let r_t be the log returns, which can be obtained via

```
rt <- diff(log(as.numeric(CAT[,6])))
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(a) Are there any serial correlations in the log return series r_t ? Why?

(b) Are there any ARCH effects in the log return series r_t (the linear depedence of squared returns)? Why?

(c) Fit a Gaussian ARMA(1,0)-ARCH(1) model to the r_t series. Perform model checking, including showing the normal QQ-plot of the standardized residuals. Is the model adequate? Write down the fitted model.

(d) Build a ARMA(1,0)-ARCH(1) model with standardized Student-t innovations for the r_t series. Perform model checking, including the QQ-plot. Is the model adequate? Why?

(e) Write down the fitted model.

(f) Obtain 1-step to 5-step ahead mean and volatility forecasts using the fitted ARMA(1,0)-ARCH(1) model with standardized Student-t innovations.

(g) Compute the 95 % 1-step to 5-step interval predictions of the log return series using standardized student-t innovations.

Question2.

Consider the monthly returns log returns of the CRSP decile 9 portfolio from January 1951 to December 2010. The simple returns are in the file m-deciles.txt under the name CAP9RET.

(a) Is the expected value of the CRSP decile 9 portfolio log return zero? Why? Is there any serial correlation in the log returns? Why? If necessary, find an ARMA model to remove the serial correlations.

(b) Is there any ARCH effect in the log returns? Why?

(c) Build a AR(1)-ARCH(1) model with Gaussian innovations for the log return series. Perform model checking and write down the fitted model.

(d) Fit a AR(1)-ARCH(1) model with Standardized Student-t innovations to the log return series. Perform model checking and write down the fitted model.

(e) Build a ARCH(1) model with Gaussian innovations for the log return series. Perform model checking and write down the fitted model.

(f) Fit a ARCH(1) model with Standardized Student-t innovations to the log return series. Perform model checking and write down the fitted model.

(g) Compare the model (c)-(f) which model you select.

Question3.

(Seasonal model). Consider the monthly U.S. unemployment rates U.S. (total civilian, 16 and older) from January 1948 to December, 2018. Data are available from FRED and is entitled UNRATE. Let rt be the unemployment at time t.

(a) Fit the seasonal model as below

m1 <- arima(unrate,order=c(3,0,1),seasonal=list(order=c(1,0,1),period=12))

Perform model checking and write down the fitted model.

(b) Fit an AR(11) model and remove insignificant coefficient estimates (based on t-ratio 1.645).

(c) Use backtest at the forecast origin t=770 and horizon h= 1 to compare the two models. Which model is preferred? Why?

Question4.

Consider the monthly new one family houses sold in the U.S. from January 1963 to December 2018. The data are available from FRED and are entitled HSN1FNSA.

(a) Build an Airline model for the house-sold data. You should perform model checking. Write down the fitted model.

(b) Denote the series by hsold. Fit the following model

m2 <- arima(hsold, order=c(0,1,1),seasonal=list(order=c(1,1,1),period=12))

Are all coefficient estimates significant at the 5 % level? If not, use the subcommand fixed to remove insignificant estimates. Write down the fitted model.

(c) Compare the models in parts (1) and (2). Which model is preferred in the in- sample comparison? Why?

(d) Use the backtest to compare the two models with forecast origin t = 600. Which model do you prefer? Why?