Financial Econometrics mid-term

Instructions:

A. Carefully read the questions in full. You will need to answer each section and submit a document with all the answers through BlackBoard. You may also submit your codes as support for your answers.

B. For simplicity, unless specifically specified, consider a 5% significance level for all questions.

C. For daily series, use ten (10) lags in all serial correlations or ARCH-effect tests. For monthly series, use twelve (12) lags.

D. You may use all materials for the mid-term.

E. Exam time: 150 minutes.

F. The exam is made up of 4 questions. You will be graded on the three best answers.

1. Provide a short description for the concepts addressed in the following questions:

(a.) Why study an asset return and not its price?

(b.) Let  denote the daily log return of an asset. Describe a procedure for testing the existence of serial correlations in .

(c.) What is a white noise process?

(d.) Describe a nice feature and a drawback of using ARCH model to modeling asset volatility.

(e.) What is a stationary time series? What is a non-stationary process?

(f.) Describe the different steps involved in performing a GARCH analysis.

2. Consider the return time series for the DJIA index.

(a.) Download the DJIA data from Yahoo! Finance using quantmod (the index ticker is ^DJI) from 1991-01-01 to 2018-12-31 and calculate the daily return time series.

(b.) Write down the AR model for the series. Remove insignificant coefficient estimates (based

on t-ratio in absolute value of 1.645). Provide model checking to confirm that the model is adequate.

(c.) Use the fitted model to obtain 1-step to 5-step ahead predictions series (forecast origin is the last data point). Also, compute the corresponding 95% interval forecasts.

(d.). Does the series exhibit GARCH effects? If yes, why?

(e.) Provide the volatility equation and perform model checking. Consider both a normal innovation and a Student-t innovation.

(f.) Write the full model for the series.

3. Considering the issue of volatility modelling, compare the volatility estimation using the VIX index and the volatility of the S&P500 index, using an econometric model.

(a.) What is the use of the Spearman correlation, compared to the Pearson correlation?

(b.) Consider the CBOE daily volatility index (VIX) from January 1, 1990 to December 31, 2018. The data are available from FRED via quantmod. Use the commands below:

getSymbols(“VIXCLS”,src=”FRED”)

vix <- VIXCLS['1990-01::2018-12']

n <- length(vix)

idx <- c(1:n)[is.na(vix)]

vix <- vix[-idx]

vix <- as.numeric(vix)

Find an AR model for the VIX series. Remove insignificant coefficient estimates (based on t-ratio 1.645). Provide model checking to confirm that the model is adequate. Write down the model.

(c.) Consider the S&P500 index from January 1, 1990 to December 31, 2018. The data is available using quantmod, and the symbol for the index is ^GSPC. Fit an ARMA model to the index return time series (calculate the returns using the adjusted closing prices), and a GARCH model for the index volatility.

(d.) Calculate the correlation between the VIX and the squared returns of the S&P500 index, and the fitted volatility using the GARCH model. Calculate the correlation over the entire time sample. Calculate the correlation on a year by year basis and plot the annual correlation.

(e.) Considering the correlation values, is the VIX a good representative of the volatility of the index? If not, why? Propose a way to test this in a quantitative way.

4. Consider the monthly U.S. unemployment rates from January 1, 1950 till December 31, 2018. Data are available from FRED and is listed as “UNRATE”. Let  be the unemployment at time t.

(a.) Fit the seasonal model as below

m1 <- arima(UNRATE,order=c(4,0,1),seasonal=list(order=c(1,0,1),period=12))

Perform model checking and write down the fitted model, including model checking.

(b.) Fit an AR(11) model to the time series.

(c.) Compare the two models. Which model is preferred? Why?

(d.) Use a GARCH(1,1) model for the volatility for the original time series, and the de-seasonalized series. Which one is better? Why?

(e.) Use the fitted model to obtain 1-step to 5-step ahead predictions series (forecast origin is the last data point). Also, compute the corresponding 95% interval forecasts. Perform the predictions separately for the return and volatility models, for both the original time series and the de-seasonalized time series.