

# Final Exam

## RM708/Bus386

Due Tuesday May 23 @ 6:30 pm

Instructions: Read the questions carefully. For some questions, you will have to refer to the relevant chapter in the Tsay textbook. For your answers, create a word document that includes your explanations along with the relevant Rstudio output and convert to a pdf file which you will send to me via email by the due date.

1. The data set q-ko-earn8309.txt contains the quarterly earnings per share of Coca-Cola Co. (KO) from the second quarter of 1983 to the third quarter of 2009. The earnings per share is in the third column.
  - (i) Build a time series model for the log earnings series. Perform model checking and write down the fitted model. [For simplicity, you may ignore the outliers, if any.]
  - (ii) Fit the following model to the log earnings series: `mm<-arima(xt,order=c(0,1,1),seasonal=list(order=c(0,0,1),period=4))` where xt denotes the log earnings series. Write down the fitted model.
  - (iii) Compare the two time series models. Which model is preferred in terms of fitting? Why?
  - (iv) Use the backtest procedure to compare the two models via 1-step ahead forecasts. You may use  $t = 75$  as the starting forecast origin. Which model is preferred? Why?
2. The data set d-nflx3dx0913.txt contains daily simple returns of Netflix (NFLX) stock from January 2, 2009 to December 31, 2013. Transform the simple returns (in the third column) to log returns.
  - (i) Is the expected log return zero? Why? Are there any serial correlations in the log returns? Why?
  - (ii) If there are serial correlations in the log return, build a mean equation for the log returns. Write down the fitted model. Is there ARCH effect in the log return series? Why?
  - (iii) Fit a Gaussian ARMA-GARCH model to the log return series. Obtain the normal QQ-plot of the standardized residuals, and write down the fitted model. Is the model adequate? Why?  
`garchFit( arma(p,q)+garch(m,n),data=data,trace=F)`
  - (iv) Build an ARMA-GARCH model with Student-t innovations for the log return series. Perform model checking and write down the fitted model.
  - (v) Obtain 1-step to 5-step ahead mean and volatility forecasts using the fitted ARMA-GARCH model with Student-t innovations.
3. Using the quantmod package download the adjusted closing prices Amazon (AMZN) . The sample period is from January 3, 2002 to May 16, 2017. The data can be downloaded from Yahoo. Use the adjusted closing prices to compute the daily log returns. For example, `getSymbols("AMZN",from="2002-01-03",to="2017-05-16")`. `mm<-diff(log(as.numeric(AMZN$AMZN.Adjusted)))` Assume that the tail probability of interest is 1% and that you hold a portfolio which consists of AMZN stock valued at \$1 million.
  - (i) Calculate the VaR of your position for the next trading day using the RiskMetrics method on May 16, 2017. You must estimate the corresponding IGARCH(1,1) model. What is the associated expected shortfall? Also, what is the VaR for the next 10 trading days?
  - (ii) Build a GARCH(1,1) model for the log return series with Gaussian innovations. What is the VaR based on the fitted model for the next trading day? What is the corresponding expected shortfall?
  - (iii) Build a GARCH(1,1) model with Student-t innovations for the log return series. What is the VaR for the next trading day based on the fitted model? What is the corresponding expected shortfall?