

Financial Econometrics I

Final Project

January 7, 2019

1. You want to fit an ARIMA model to the daily close “price” (index) X_t of NASDAQ in January 1, 2013-December 31, 2015.
 - (a) How many observations you have in this period? Draw the time series plot, the ACF plot, and the PACF plot for X_t and $\nabla X_t = X_t - X_{t-1}$. Comment on your findings.
 - (b) Apply the ADF test to both X_t and ∇X_t . Briefly interpret your test results.
 - (c) Use EACF and AIC to select an ARIMA model for X_t .
 - (d) Estimate the model you select in Part (c) and report your estimation results.
 - (e) Conduct residual analysis (time series plot, ACF, Ljung-Box test, QQ plot, etc.) for the model you estimated in Part (d). Do you think this model is adequate? Interpret your answer briefly.
 - (f) To gain some appreciation of the prediction power of your model estimated in Part (d), perform the out-sample prediction of the daily NASDAQ index in January, 2016. More precisely, you will need to calculate the one-step ahead predicted indices and their 95% confidence intervals, and compare the predicted values with the realized (true) indices (see Figure 2.10 and the related discussion for an example).
2. Your textbook shows empirical applications of the GARCH model in its Section 3.2.3. Reproduce the analysis using the Ford data, i.e., you will need to replicate the results presented in Figure 3.7-3.10 (the 3rd panel) and Table 3.1-3.2 (the 3rd row).
3. Now you have the data of daily close “price” (index) Z_t of S&P 500 along with the NASDAQ in the same period as in Question 1. Denote $\mathbf{Y}_t = (X_t, Z_t)$.
 - (a) Denote $r_t^{(X)} = \log(X_t/X_{t-1})$ and $r_t^{(Z)} = \log(Z_t/Z_{t-1})$ as the log returns of X_t and Z_t , respectively. Compute the sample cross-correlation matrices $\hat{R}(k)$ of $r_t = (r_t^{(X)}, r_t^{(Z)})$ for $1 \leq k \leq 10$.
 - (b) Fit a VAR(p) model to the r_t data with order p selected by AIC. Report and interpret your estimation results.
 - (c) Conduct model diagnostics by performing the portmanteau test and computing sample cross-correlations of the residuals resulting from your fitted VAR model in Part (b). Comment on your findings.
 - (d) Test the Granger causality and instantaneous causality between the two components of r_t . Briefly interpret the test results.
 - (e) Apply the ADF test to Z_t . Briefly interpret your test results. Do you think \mathbf{Y}_t is cointegrated with order $(1, 1)$?
 - (f) Provided that you can establish the cointegration between X_t and Z_t , suggest a proper method to estimate the dynamics between these two time series.