Financial Econometrics
FINN/ECON 6219, Fall 2023

Problem Set 3
Due November 8 at the beginning of class

<u>You may work in a group of 2 or 3 students</u>
(submit a single set of solutions that includes the names of all group members)

<u>Attach a copy of your Stata code at the end of your solutions</u>

Question 1.

Download the “PS3data.xlsx” file that is posted with the problem set. The file contains monthly data on the consumer price index (CPI) and the USD/Euro exchange rate for Jan 1999 to Sep 2018. Load the data into Stata and analyse it as follows.

a. Let y_{1t} and y_{2t} denote the CPI and exchange rate for month t. Conduct ADF tests to assess whether y_{1t} and y_{2t} have a unit root. The alternative for the CPI test should be a trend-stationary AR(3) model. The alternative for the exchange rate test should be a stationary AR(3). Use the `regress` option for `dfuller` to display the regression table. Copy and paste the two regression tables into your solutions. Can you reject a unit root at the 10% significant level for either variable?
b. Use the `arima` command to fit ARIMA(1,1,0), ARIMA(2,1,0), ARIMA(3,1,0), and ARIMA(1,1,1) models to y_{1t}. Store the estimates produced by each model and use `estimates stats` to display the AIC and BIC for the models in a single table (i.e., use this command after fitting all four models). Make sure that you fit each model using exactly the same number of observations. Copy and paste the AIC/BIC table into your solutions. Which model is selected by AIC? By BIC?
c. Repeat the analysis of part (b) for y_{2t}.
d. Now consider VAR(p) models for $\Delta y_{1t} = y_{1t} - y_{1t-1}$ and $\Delta y_{2t} = y_{2t} - y_{2t-1}$. Use the `varsoc` command with a `maxlag` of 6 to display the AIC and BIC for the models. Copy and paste the AIC/BIC table into your solutions. Which model is selected by AIC?
e. Fit the VAR model selected by the AIC criterion in part (d) using the first 201 observations. Use the `predict` command to generate static one-month-ahead forecasts of Δy_{1t}. Use the estimated standard deviation of the residuals to construct interval forecasts (assume the residuals are normally distributed). Plot the interval forecasts along with $\Delta y_{1t}$for observations 202 to 237. Label the axes appropriately and paste the plot into your solutions. Note: the VAR postestimation `predict` command does not have the `stdf` option. Hence, you will have to compute the standard deviation of the residuals manually in order to construct interval forecasts.
f. Use the `vargranger` command to conduct pairwise Granger causality tests for the model in part (e). Copy and paste the output table into your solutions. Interpret the results of the tests.
g. Using the VAR model of part (e), construct the <u>orthogonalized</u> impulse response functions for both possible orderings of Δy_{1t} and Δy_{2t}. Does the order (choice of exclusion

restriction) have a meaningful impact on the IRFs? If so, which order do you think makes the most sense from an economic standpoint?

Question 2.

Download the "industry.xlsx" file that is posted with the problem set. The file contains monthly percentage stock returns for three industry portfolios (pharmaceuticals, utilities, and banks) for Jul 1963 to Sep 2018. Load the data into Stata and analyse it as follows.

a. Fit a GARCH(1,1) model to the returns for each industry portfolio. Use the `predict` command after fitting each model to obtain the estimated conditional variances for each portfolio. Use the `tsline` command to plot the time series of estimated conditional <u>volatilities</u> (not variances) for the three portfolios on a single graph. Label the axes, add a title to the graph, and paste it into your solutions.
b. Stata will also fit multivariate GARCH models. For example, the command `mgarch dcc (drug util bank), arch(1) garch(1)` fits a dynamic conditional correlation (DCC) model to the returns on the three portfolios. Under a DCC model, the variance of each variable is modelled as a GARCH(1,1) process and the correlation matrix follows something similar to a GARCH(1,1) process (see the Stata documentation for more details). Fit the DCC model to the portfolio returns. Copy and paste the output (the table with the parameter estimates and associated information) into your solutions.
c. Use the `predict` command to obtain the estimated conditional correlations for the DCC model. The syntax is `predict rho*, correlation`, where `rho*` indicates that the variables that contain the correlations start with rho (e.g., rho_util_drug). Use the `tsline` command to plot the time series of estimated conditional correlations on a single graph (3 pairwise correlations in total). Label the axes, add a title to the graph, and paste it into your solutions.
d. Use the `predict` command to obtain the estimated conditional means, conditional variances, and conditional covariances for the DCC model. The syntax is `predict m*, xb` for the means (3 in total) and `predict s*, variance` for the variances and covariances (6 in total). Use the estimated means to compute the estimated mean of an equally weighted portfolio of the three industry portfolios. Use the estimated conditional variances and covariances to compute the estimated conditional variance of an equally weighted portfolio of the three industry portfolios (use the standard portfolio formulas for these computations). Finally, assume that the standardized shocks for the equally-weighted portfolio are normally distributed and compute the one-day VaRs at the 95% confidence level for the portfolio. Use the `tsline` command to plot the time series of VaRs. Label the axes, add a title to the graph, and paste it into your solutions. Note: portfolio VaR = mHat – 1.645 vHat. where mHat is the estimated conditional mean of the portfolio return and vHat is the estimated conditional volatility of the portfolio return.
e. A simpler way to compute VaRs for an equally-weighted portfolio would be to assume that the portfolio returns follows a GARCH(1,1) process. Fit a GARCH(1,1) model to the returns on the equally-weighted portfolio. Use the `predict` command after fitting the model to obtain the estimated conditional variances for the portfolio. Assume that the standardized shock for the portfolio are normally distributed and compute the one-day VaRs at the 95% confidence level. Subtract the VaRs obtained using this approach from the VaRs obtained from the DCC model in part (d). Call this the VaR spread. Use the `tsline` command to plot the VaR spread. Label the axes and add a title to the graph. Use the `graph combine` command to combine the graph from part (d) with this graph (e.g., `graph combine g1 g2, row(2) col(1)`). Copy and paste the combined graph into your solutions. Do you see any systematic pattern to the spread between the VaRs? If so, then explain.
f. Conduct unconditional coverage tests for the VaRs obtained part (d) and in part (e). Report the results of the tests (violation rates, test statistics, and p-values). Does one approach appear to perform better than the other? Explain.