Financial Econometrics T2 2021

Tutorial 8

1. (Miscellaneous questions)

(a) Why do we care about the conditional variance matrix of a vector of returns? What are required for a matrix to be a "variance matrix"?

(b) What is the daily realised variance of an asset return? What does it estimate?

2. (Realised volatility, data source: http://realized.oxford-man.ox.ac.uk/data)

This exercise is based on on the data in **sp500rv-tut11.xls**. The time series are related to the S&P500 index. There are 3 columns in the file: **Date**, **RV** (daily realised variance of the index, 5-minute intervals), **Close** (daily close price of the index), spanning from 2000-01-03 to 2012-10-05 with a total of 3181 observations. The goal of this exercise is to examine the empirical characteristics of the realised variance.

(a) Compute the daily return R

Compute the daily log realised variance LRV

Compute the daily realised standard deviation RSD by typing

and the standardised return SR=R/RSD

Make the time series plots of R, LRV and SR and comment. Find the descriptive statistics and histograms of R, LRV and SR and comment. Here, "comment" means "describe the features of the associated objects".

(b) Find the correlograms of R and LRV and comment.

(c) Is there a unit-root in LRV? If you are to fit an ARMA(p, q) model to LRV, what would be the p and q? Estimate your ARMA model, check the residual for autocorrelation and comment. Also is the residual normally distributed?

(d) Define the residual from the model in part (c) as E, and the fitted (or predicted) value as F = LRV−E. The conditional variance of R can be approximated by CV = A × exp(F) where A is the sample mean of exp(E). Then, the conditional standard deviation CSD is computed as the square root of CV. Make a scatter plot of RSD agains CSD and comment.

(e) Estimate an AR(1)-EGARCH(2,1) model for the return R, which only relies on the return series. Define the conditional standard deviation from the EGARCH(2,1) as EGSD. Make time series plots EGSD and CSD, as well as a scatter plot of EGSD against CSD. Compute the cross correlation of EGSD and CSD and comment.

(f) Re-estimate the AR(1)-EGARCH(2,1) model for R, including LRV(-1) in the variance equation, ie,

$$\ln(\sigma_t^2) = \alpha_0 + \alpha_1|v_{t-1}| + \gamma v_{t-1} + \alpha_2|v_{t-2}| + \beta_1 \ln(\sigma_{t-1}^2) + \psi \mathrm{LRV}_{t-1}.$$

Compare the estimation results to those in part (e) and comment.