Introduction to Financial Risk Management (with R)

Exercise 12 – Serial Correlation, Volatility Clustering, GARCH

Overview

The goal of this exercise is to use R to graph (i) the autocorrelation function of log returns to check for evidence of serial correlation, and (i) the autocorrelation function of |log returns|, to check for evidence of volatility clustering.

ACF for log returns and |log returns| / GARCH for the Wilshire 5000 index

In the lectures, we ran the following R script to create a data series called "wilsh":

```
library(quantmod)
getSymbols("WILL5000IND",src="FRED")
wilsh <- na.omit(WILL5000IND)
wilsh <- wilsh["1979-12-31/2017-12-31"]
names(wilsh) <- "TR"
```

Next, we calculated its daily log returns:

```
logret <- diff(log(wilsh))[-1]
```

In the lectures, we graphed the autocorrelation function of log returns using the R command:

```
acf(logret)
```

Next we graphed the autocorrelation function of |log returns| using the R command:

```
acf( abs(logret) )
```

To estimate the GARCH(1,1) –t model, we use the "rugarch" package in R:

```
library(rugarch)
uspec <- ugarchspec(  variance.model = list(model = "sGARCH",garchOrder = c(1,1)),
                      mean.model = list(armaOrder = c(0,0), include.mean = TRUE),
                      distribution.model = "std")
fit.garch <- ugarchfit(spec = uspec, data = logret[,1])
```

The estimated parameters are in
fit.garch@fit$coef

The output of the estimation are then saved:

```
save1 <- cbind( logret[,1], fit.garch@fit$sigma, fit.garch@fit$z )
names(save1) <- c( "logret", "s", "z" )
```

We then examine the acf of the "z" column to check if the GARCH model has captured volatility clustering in the data.

```
acf(save1$z)
acf(abs(save1$z))
```

ACF for log returns and |log returns| / GARCH for Gold

In Exercise 2, you retrieved the price of gold in the London Bullion Market at 3pm from FRED: "GOLDPMGBD228NLBM"
You calculated its daily log returns from 1979-12-31 to 2017-12-31.

In this exercise, graph the acf of log returns to check for serial correlation, and graph the acf of |log returns| to check for volatility clustering.