

Introduction to Financial Risk Management (with R)

Exercise 13 – VaR and ES from GARCH bootstrap

Overview

The goal of this exercise is to use R to calculate the VaR and ES from a GARCH model by bootstrapping from the fitted ε (“standardized residuals”).

VaR and ES in GARCH bootstrap 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]
```

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 use the R function “ugarchboot” to simulate 1-day outcomes:

```
set.seed(123789)                                #set seed value
boot.garch <- ugarchboot(fit.garch,
                        method=c("Partial","Full")[1], # ignore parameter uncertainty
                        sampling="raw",                 # draw from standardized residuals
                        n.ahead=1,                     # 1-day ahead
                        n.bootpred=100000,             # number of simulated outcomes
                        solver="solnp")
```

The simulated outcomes are then saved in the vector “rvec”:

```
rvec <- boot.garch@fseries
```

The VaR and ES at the 95% confidence level are calculated as before:

```
VaR <- quantile(rvec,0.05)  
ES <- mean(rvec[rvec<VaR])
```

VaR and ES in GARCH bootstrap 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, estimate the same GARCH(1,1) – t model for Gold.

Set the seed value to 123789.

Then use the “ugarchboot” function to simulate 100,000 1-day outcomes.