Introduction to Financial Risk Management (with R)

Exercise 11 – Estimate VaR and ES at 10-day horizon

Overview

The goal of this exercise is to use R to estimate the VaR and ES at the 10-day.

VaR and ES at 10-day horizon 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 used 3 simulation methods to find the VaR and ES at the 95% confidence level for a 10-day horizon.

Simulation Method 1:

used the "moments" package in R to estimate the parameters of the scaled student-t distribution:

```
library(MASS)
rvec <- as.vector(logret)
t.fit <- fitdistr(rvec, "t")
round(t.fit$estimate,6)
```

To estimate the VaR and ES at the 95% confidence interval for a 10-day horizon, we simulated ten 1-day outcomes and add them up. Repeat 100,000 times. Then calculate the VaR and ES for these 100,000 outcomes.

```
alpha <- 0.05
set.seed(123789)
rvec <- rep(0,100000)
for (i in 1:10) {
  rvec <-  rvec+rt.scaled(100000,mean=t.fit$estimate[1],sd=t.fit$estimate[2],df=t.fit$estimate[3])
}
VaR <- quantile(rvec,alpha)
ES <- mean(rvec[rvec<VaR])
```

Simulation Method 2:
Instead of simulating from the scaled student-t distribution, the second simulation method randomly samples ten 1-day observations from the empirical distribution and add them up. Repeat 100,000 times. Then calculate the VaR and ES for these 100,000 outcomes.

```
alpha <- 0.05
set.seed(123789)
rvec <- rep(0,100000)
for (i in 1:10) {
  rvec <- rvec+ sample(as.vector(logret),100000,replace=TRUE)
}
VaR <- quantile(rvec,alpha)
ES <- mean(rvec[rvec<VaR])
```

Simulation Method 3:
The third simulation method also samples from the empirical distribution, but draws blocks of ten consecutive 1-day outcomes and add them up. Repeat 100,000 times. Then calculate the VaR and ES for these 100,000 outcomes.

```
alpha <- 0.05
set.seed(123789)
rdat <- as.vector(logret)
rvec <- rep(0,100000)
posn <- seq(from=1,to=length(rdat)-9,by=1)
rpos <- sample(posn,100000,replace=TRUE)
for (i in 1:10) {
  rvec <- rvec+ rdat[rpos]
  rpos <- rpos+1
}
VaR <- quantile(rvec,alpha)
ES <- mean(rvec[rvec<VaR])
```

VaR and ES at 10-day horizon 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, you will calculate the VaR and ES at the 95% confidence level for a 10-day horizon in gold, using the above 3 simulation methods.