Introduction to Financial Risk Management (with R)

Exercise 8 – Estimating VaR and ES via simulation

Overview

The goal of this exercise is to use R to estimate the VaR and ES of the daily log returns of Gold using two different methods of simulation.

Estimating the VaR and ES for daily log returns of the Wilshire 5000 index via simulation

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 discussed two simulation methods to estimate the VaR and ES.

Simulation method 1:

Assuming that daily log returns are normally distributed, we used the following R commands to estimate the two parameters of the normal distribution: mean and standard deviation.

```
mu <- mean(logret)
sig <- sd(logret)
```

Using these estimated parameters, we simulated from the normal distribution with mean mu and standard deviation sig for 100,000 outcomes, using the following R command:

```
set.seed(123789)
rvec <- rnorm(100000,mu,sig)
```

Note: we set the seed value here to allow us to reproduce the same result each time. In actual practice, we will not set the seed to a given number.

The VaR at the 95% confidence level is the 5% quantile of these 100,000 outcomes. We used the following R command to find VaR:

```
VaR <- quantile(rvec,0.05)
```

The ES as the 95% confidence level is the average of these 100,000 outcomes that are worse than the VaR. We used the following R command to find ES:

```
ES <- mean(rvec[rvec<VaR])
```

Simulation method 2:
The second simulation method does not assume that daily log returns are normally distributed. Instead, we draw 100,000 outcomes from the empirical distribution, with replacement, using the following R command:

```
set.seed(123789)
rvec <- sample(as.vector(logret),100000,replace=TRUE)
```

Note: again, we set the seed value here to allow us to reproduce the same result each time. In actual practice, we will not set the seed to a given number.

The VaR at the 95% confidence level is the 5% quantile of these 100,000 outcomes. We used the following R command to find VaR:

```
VaR <- quantile(rvec,0.05)
```

The ES as the 95% confidence level is the average of these 100,000 outcomes that are worse than the VaR. We used the following R command to find ES:

```
ES <- mean(rvec[rvec<VaR])
```

Estimating the VaR and ES for daily log returns of Gold via simulation

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 Exercise 5, you estimated its mean and standard deviation for this sample.

In this exercise, you will perform the same two simulations as in the lectures to estimate the VaR and ES for gold at the 95% confidence level.