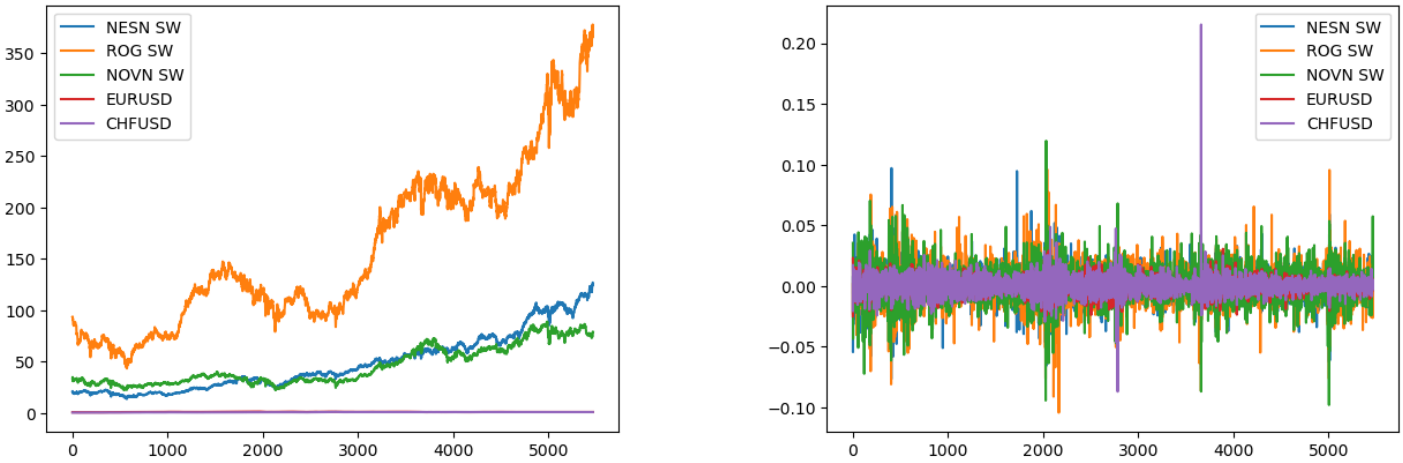
Homework 3: Financial Risk Management

Eduardo Neville, Janson Åke

1 Computation of a bootstrapped distribution of Value at Risk (VaR) and Expected Shortfall (ES) given historical financial market data

This document will explain what is done in the Jupyter notebook.

First, the daily simple returns were computed for each of the five financial assets. The resulting plot is shown in figure 1b.



(a) (b)

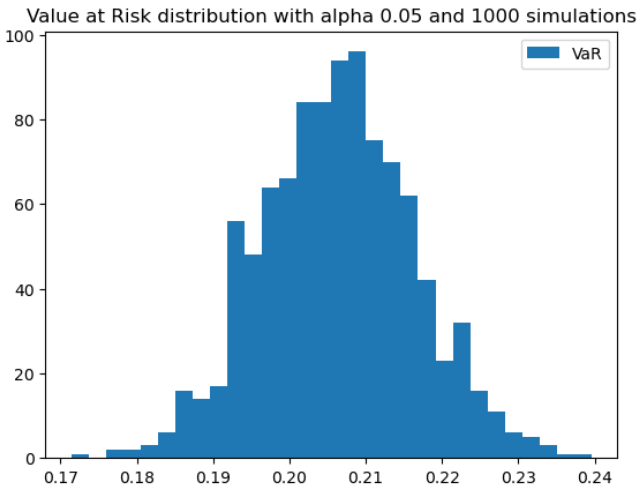
Figure 1: (a) Plot of the stock prices and exchange rates.
(b) Plot of the daily returns for each of the stock prices and exchange rates.

Then a function that calculates $\widehat{\mathbf{VaR}}_\alpha(\mathbf{X})$ and $\widehat{\mathbf{ES}}_\alpha(\mathbf{X})$ from a univariate sample $x_1, ..., x_n$ and a significance value α.

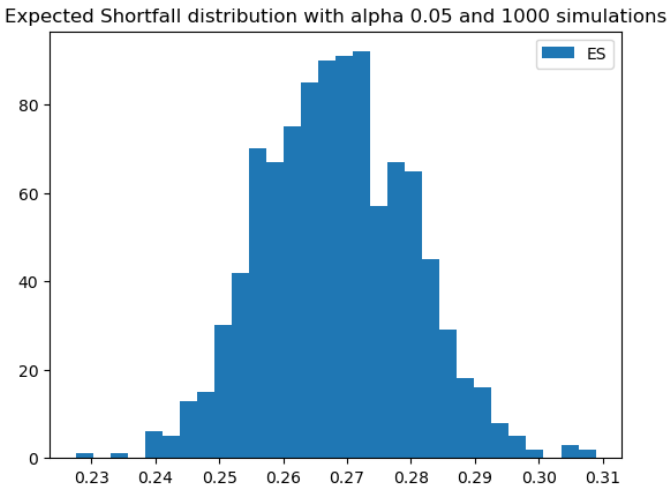
We then use the Monte Carlo estimation method to calculate the bootstrapped distributions of $\widehat{\mathbf{VaR}}_\alpha(\mathbf{X})$ and $\widehat{\mathbf{ES}}_\alpha(\mathbf{X})$. In figures 2 we see the bootstrapped distributions of the estimator VaR and ES.

After Running the computation for the three stocks (Nestle, Roche, and Novartis) and two currency exchange rates (EURUSD and CHFUSD). Using the last two years of the data sample provided, N = 1000 bootstrap replications, and a significance level α= 0.05. We observe that the VaR is always higher for the stocks than the currencies by a factor close to 2. This is also the case for the ES. By calculating the approximate standard deviation of the bootstrapped estimators, $\widehat{\mathbf{VaR}}_\alpha$ and $\widehat{\mathbf{ES}}_\alpha$, we find that the standard deviation is also much smaller for the currencies than for the stocks.

Now if we change α from 0.05 to 0.01, we find that the value at risk and expected shortfall both increases for the stocks and the currencies but that the standard deviation remains the same.



(a)



(b)

Figure 2: (a)Value at risk distribution with $\alpha = 0.05$ and 1000 simulations. (b).Estimated shortfall distribution with $\alpha = 0.05$ and 1000 simulations.