Data Driven Business Analytics
MGT-302

Homework 3: Financial Risk Management
Due June 13th, 2023 at 15:00

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The topic of this homework is the computation of a bootstrapped distribution of Value at Risk (VaR) and Expected Shortfall (ES) given historical financial market data.

You can find a dataset of historical stock prices (Nestle, Roche, and Novartis) and currency exchange rates (EURUSD and CHFUSD) on Moodle. First, using this data, compute daily simple returns (i.e., percentage changes) of each of the five financial assets. Then, write a function that given a (univariate) data sample $x_1, \dots, x_n$ (e.g., historical stock or currency returns) and a significance level α computes $\widehat{\mathrm{VaR}}_\alpha(X)$ and $\widehat{\mathrm{ES}}_\alpha(X)$ with the historical simulation method.[1]

Now, apply the non-parametric bootstrap (i.e., sampling with replacement) of the daily simple returns and write a function that computes the bootstrapped distributions of estimators $\widehat{\mathrm{VaR}}_\alpha(X)$ and $\widehat{\mathrm{ES}}_\alpha(X)$ from above.[2]

- Run the computation for the three stocks (Nestle, Roche, and Novartis) and two currency exchange rates (EURUSD and CHFUSD). Use the last two years of the data sample provided to you, $N = 1000$ bootstrap replications, and a significance level $\alpha = 0.05$. Do you observe any differences between the bootstrapped distributions of VaR and ES estimators between equities and currencies? Moreover, compute the (approximate) standard deviations of the bootstrapped estimators $\widehat{\mathrm{VaR}}_\alpha(X)$ and $\widehat{\mathrm{ES}}_\alpha(X)$.
- Repeat the computation using $\alpha = 0.01$. What do you notice?

This is a *mandatory* homework. The assignment can be solved individually or in groups of two students. You should mention the name of your partner in your report file. Note that both of the students in a group will receive the same grade.

All computations and programs are to be done in Python. Your code is to be excellently documented, and demonstrated to work. Upload a single zip file on Moodle containing your report and code. The homework is due at 15:00 on June 13th.

[1] Note that, until here, you can completely re-use the code presented in the lecture and available on Moodle.

[2] Note that you can re-use a part of the code that calculates the bootstrapped distributions of VaR and ES as computed by the Monte Carlo estimation method presented in the lecture and available on Moodle.