QUANTITATIVE PORTFOLIO MANAGEMENT

TP PYTHON

Portfolio VaR Computation

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Introduction

The objective is to compute the $\boldsymbol{VaR_{99\%}}$ for a portfolio with two methods. VaR calculation should be made using 12 months data, which is the methodology imposed by Basel III[1]. It is assumed that the 12 months period begins on **January 1, 2017** and ends on **December 31, 2017**. Note that, in the future, this risk measure may be replaced by a 10 business days 97,5% expected shortfall[2] calibrated on the most recent 12 months data.

The investment portfolio π considered here consists of **five** stocks of the DAX index:

- Deutsche Post AG,
- Allianz SE,
- Bayerische Motoren Werke Aktiengesellschaft,
- BASF SE,
- Fresenius Medical Care AG & Co. KGaA

Stock	Yahoo Ticker
Deutsche Post AG	DPW.DE
Allianz SE	ALV.DE
Bayerische Motoren Werke Aktiengesellschaft	BMW.DE
BASF SE	BAS.DE
Fresenius Medical Care AG & Co. KGaA	FME.DE

Let us consider that those five stocks are represented with an equal weight in π at inception.

[1] Basel III is an international regulatory accord that introduced a set of reforms designed to improve the regulation, supervision and risk management within the banking sector.

[2] $ES_\alpha = \mathbb{E}[X|X \leq VaR_\alpha(X)]$.
Expected shortfall is a risk measure sensitive to the shape of the tail of the distribution of returns on a portfolio, unlike the more commonly used value-at-risk (VAR). Expected shortfall is calculated by averaging all of the returns in the distribution that are worse than the VAR of the portfolio at a given level of confidence. In other words, it is the average of the losses suffered during a shock that appears only in the α% worst case(s).

Part 1: Gaussian framework parametric method

Compute the daily $VaR_{99\%}$ of π using the Gaussian framework parametric method

Instructions:

1) The code should be commented.
2) Test the normality hypothesis of the portfolio's daily returns using Jarque Bera test.
3) Display the histogram of the portfolio's daily returns fitting with a normal curve.
4) Print the daily $\boldsymbol{VaR_{99\%}}$ in percentage, rounded to three decimal points, in a dedicated sentence.

HELP

Steps of the VaR estimation are as follows:

1) Import the following packages: numpy, pandas, stats from SciPy, matplotlib.pyplot
2) Using the function DataReader of the module *pandas_datareader.data*, import the daily prices for the five stocks on 2017.
3) Compute portfolio daily returns.

Remark: The vectors of return obtained correspond to the empirical law of distribution for the daily returns of the five stocks, based on the historic considered here.

4) Estimate the mean and the standard deviation of the portfolio daily returns.
5) Compute the gaussian $VaR_{99\%}$ of the portfolio in percentage (rounded to two decimal points).

Part 2: Bootstrap Historical Simulation method

Compute the 10 business days $VaR_{99\%}$ of π using the *Bootstrap Historical Simulation* method

Instructions:

1) The code should be commented.
2) The method should use **10 000** bootstrap simulations.
3) Print the 10 business days $\boldsymbol{VaR_{99\%}}$ in percentage, rounded to three decimal points, in a dedicated sentence.

HELP

Steps are as follows:

1) Import the following packages: numpy, pandas, pandas_datareader.data, matplotlib.pyplot
2) Using the function DataReader of the module pandas_datareader.data, import the daily prices for the five stocks on 2017.
3) Compute daily returns of the 5 stocks.

Remark: The vectors of return obtained correspond to the empirical law of distribution for the daily returns of the five stocks, based on the historic considered here.

4) Using 10 000 bootstrap simulations, simulate 10 000 returns over 10 business days.
5) Compute the $VaR_{99\%}$ of the portfolio in percentage (rounded to three decimal points).