Lab 1

Start Assignment

Due Sunday by 11:59pm **Points** 12 **Submitting** a file upload **File Types** pdf

Instructions

1. This is a teamwork assignment - please check your assigned team on the course website.
2. All team members are expected to contribute to the assignment.
3. You are welcome to use any programming language or statistical software. Also, you are welcome to use any library/package unless stated otherwise.
4. You will need to download data on your own - unless provided otherwise.
5. The final report should be written using a special document editor, e.g. Word, Latex, Markdown, etc. **Any form of a document with handwriting will not be accepted**.
6. Please submit a pdf copy of your final report - include your codes in the appendix. Note that Canvas will not accept any other formats than pdf.
7. Please avoid taking pictures/snapshots. You should report your results in an organized table. The same applies to plots and other visualizations - do not paste any low resolution figures.
8. Please use a special equation editor to write any math, in case needed.
9. Last but not least, please utilize the length of your report carefully. **Any redundant results such as code warnings or printed tables will result in a one-point deduction**. Reporting along summary is key.

Task 1

Introduce yourself to your teammates and learn more about their program and their academic backgrounds. Provide a brief summary (1 point)

Task 2

What is your team's preferred programming language or statistical software? Rank from most to least preferred/familiar (1 point)

Task 3

It is common to use a scale of 252 days to compute annual expected returns using daily data. The same goes for volatility and, hence, the Sharpe ratio.

1. Using expectation and variance operations, **show analytically** that (1 point)
   $\mathbb{E}[R_A] = 252 \times \mathbb{E}[R_d]$
   $\sqrt{\mathbb{V}[R_A]} = \sqrt{252\mathbb{V}[R_d]}$
   $\text{with } R_A = \sum_{d=1}^{252} R_d$
2. Also, **what is the assumption behind this to hold true**? (1 point)

Task 4

Go to Yahoo Finance and download historical data for SPY and IEF ETFs, dating from 2004 to 2021. Compute the daily log returns using the adjusted close price column. This should result in two time series (two columns). Based on this, report the annual mean return and volatility for each ETF.

1. The first approach to answer this is to scale daily average returns and volatility (standard deviation) to reflect annual values - same as above (1 point)
2. The other approach is to compute annual rather than daily returns. Given the annual return time series compute the average and volatility (1 point)
3. How do both results compare? (1 point)

Note: Feel free to use the Shiny Yahoo app available **here (https://quantstats.shinyapps.io/yahoo/)** .

Task 5

Compute the correlation coefficient between the two ETFs and report the covariance matrix. (1 point)

Task 6

You are interested in allocating w to the SPY and $1 - w$ to the IEF. For a sequence of $w \in (0, 1)$, compute the portfolio mean return and volatility. As a final summary, plot the former (y-axis) versus the latter (x-axis). Given this frontier, highlight the Sharpe portfolio and address the following:

- What does the frontier tell us about holding the IEF alone versus a combination of the two? (1 point)
- Which point from the frontier would you choose? (1 point)

Task 7

Given the Sharpe portfolio, suppose that you have access to a risk-free asset. Your allocation problem now is denoted by a combination between the Sharpe portfolio and the risk-free asset. In particular, you allocate w to the Sharpe portfolio and $1 - w$ to the risk-free asset. For a sequence of $w \in (0, 2)$, compute the portfolio mean return and volatility. As a final summary, plot the former (y-axis) versus the latter (x-axis) and address the following:

- What does it tell us in terms of the security market line (SML)? (1 point)
- What does a negative (respectively positive) weight in the risk-free asset imply? Elaborate. (1 point)

Note: Assume that the annual risk-free rate is 2%