Recall from our call I have used daily SP500 data for the years 2016 and 2017 to illustrate the development of multifactor models for the stock market using Principal Component Analysis. Recall that the models have been developed for stock ***prices*** rather than stock ***returns***.

The objectives of this project are as follows:

1. 1)  Extend the daily price multifactor models to a much ***longer time span***: 2010-01-01 until the present.
2. 2)  Evaluate the ***stability*** of the two-year multifactor model over the period 2010-01-01 until the present.
3. 3)  Develop and evaluate the multifactor models for stock price ***returns*** and study their stability in comparison with the ***price*** models.
4. 4)  Compare the ***daily*** return models with the ***weekly*** ones.
5. 5)  Develop a ***volatility model*** for the major daily eigen portfolio using GARCH and compare it with the volatility of the SP500 market index.
6. 6)  Specialize the multifactor analysis to specific ***sectors*** of the stock market, recall our call information technology.

To achieve the above objectives, I will provide the following files:

1. SP500 data from 2010-01-01 until 2023-03-11.
2. Python code for SP500 data generation using the Yahoo Finance interface.
3. SP500 and the ticker symbols for information technology sector.
4. Jupyter notebook for the PCA analysis.
5. Jupyter notebook for the GARCH volatility model.

**Project Tasks:**

**Task 1:** Use the uploaded SP500 data to carry out the PCA analysis of the PCA notebook for the years 2010 to the present. Your main challenge here is that you need to generate the corresponding SP500 price index yourself. You may use either *Yahoo Finance* as per the Python code or *FRED* as per the GARCH notebook.

**Task2:** Repeat Task 2 for daily stock ***returns*** rather than stock ***prices***. Compare the eigen portfolios of prices and returns.

**Task 3:** To study the stability of the two-year eigen portfolios, conduct a rolling two-year PCA analysis from 2010 until the present. Do so for both daily stock prices and daily stock returns. For analysis consistency, use a one-year overlap between successive periods. Plot the maximum eigenvalues of the two-year covariance matrices year to year. Comment on the stability of the maximum eigenvalues. Comment on the stability of the number of components needed to explain 95% of asset variances.

**Task 4:** Repeat Task 3, for *weekly* stock prices and returns. What are your observations in comparison to the daily eigen portfolios?

**Task 5:** According to the market sector you have been assigned, extract market data for your stock tickers from 2010-01-01 until 2023-03-11. Conduct a two-year rolling PCA analysis on your market sector, comparing the stability of daily and weekly eigen portfolios for both prices and returns.

**Task 6:** Select a ***favorite stock*** from your sector and develop a ***daily volatility*** model for its log return using two-year data. Use a GARCH model of the ***same order*** as in the GARCH notebook. Study the stability of your stock return GARCH model year-to-year and compare it with the volatility of the SP500 index.

**Task 7:** Repeat Task 6 for the ***major eigen portfolio*** in your market sector.  
**Task 8 :** Repeat Tasks 6 and 7 for weekly log returns and compare the daily and weekly volatility models.

**Project Deliverable:** Jupyter Notebook showing all the work.