

**Group Number: 6B Group Members:**

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Location (Country) | Email Address | Non- Contributing Member (X) |
| Quyen Ho | Singapore | thquyen11@hotmail.com |  |
| Wei Hao Lew | Singapore | lewweihao93@hotmail.com |  |
| Hai Ninh | Vietnam | haininhhoang94@gmail.com |  |
| Indira Djambaeva | Kyrgyz Republic | idjamboeva@mail.ru |  |

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# Introduction

This submission’s goal is to select an ideal or optimal portfolio from group of the SPDR family of funds on the calculation and analysis of efficient frontier.

The efficient frontier (portfolio frontier), is a set of ideal or optimal portfolios that are expected to give the highest return for a minimal level of return.  This efficient frontier is formed by plotting the [expected return](https://www.wallstreetmojo.com/expected-return-formula/) on the y-axis and the [standard deviation](https://www.wallstreetmojo.com/standard-deviation-in-excel/) as a measure of risk on the x-axis. It demonstrate the risk-and return trade-off of a portfolio. There are three factors from which we can build frontier, such as e**xpected return, variance or standard deviation** (a measure of the variability of returns) also known as risk and [**covariance**](https://www.wallstreetmojo.com/covariance-formula/) of one asset’s return to that of another asset. This model was established by the American Economist [Harry Markowitz](https://en.wikipedia.org/wiki/Harry_Markowitz) in 1952. He spent a few years on the research about this phenomenon which let him to win the Nobel Prize in 1990.

The content of this group work assignment is structured as follows. Section 1 presents initial data and submission requirements. Section 2 provides a calculation code, a scatter plot graph of the efficient frontier, a chosen portfolio on the efficient frontier. Calculation part also is introduced in separate file in .ipynb format.

# Submission requirements

The S&P 500 index is comprised of 500 large U.S. public companies traded on an eligible U.S. stock exchange. Its objective is to measure the performance of the large- cap U.S. equity market. These 500 companies are classified into 11 sectors:

* Energy
* Materials
* Industrials
* Consumer discretionary
* Consumer staples
* Health care
* Financials
* Information technology
* Communication services
* Utilities
* Real estate

State Street Global Advisors and Merrill Lynch created and manage 11 exchange-traded funds (ETFs) that are indexed to these 11 sectors of the S&P 500.

This group of 11 ETFs are known as the SPDR (pronounced “spider”) family of funds. The following table provides the ticker symbol on the NYSE Arca for each of these 11 ETFs. S&P Sector.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
| |  |  |  | | --- | --- | --- | | **S&P Sector** | **SPDR ETF Ticker** | **S&P Sector** | | |  | | --- | | **SPDR ETF Ticker** | | |  | | --- | | **S&P Sector** | | |  | | --- | | **SPDR ETF Ticker** | |  |
| Energy | XLE | Health care | XLV |  |
| Materials | XLB | Financials | XLF |  |
| Industrials | XLI | Information technology | XLK |  |
| Consumer discretionary | XLY | Communication services | XLC |  |
| Consumer staples | XLP | Utilities | XLU |  |
|  | | Real estate | XLRE |  |

The performance of the S&P 500 index in a period will be equal to the weighted-average of each sector’s performance.

Using the data that you calculated in Submission 1, compete the following tasks (use the data in the “**GWP\_PTAP\_Data.xlsx**” spreadsheet provided in the course room):

a) Calculate and draw a scatter plot graph of the efficient frontier based on 11 combinations of XLE and XLI:

* Portfolio 1 = 100% XLE + 0% XLI
* Portfolio 2 = 90% XLE + 10% XLI
* ..
* ..
* ..
* Portfolio 11 = 0% XLE + 100% XLI

b) Select a portfolio from portfolios 1-11 on the efficient frontier that satisfies the following constraints:

* The return is greater than 9.43%
* The volatility is not greater than 16.8%

c) Comment on how the portfolio selected in Submission 2(b) is expected to perform relative to the S&P 500 in terms of the following:

* Return
* Risk
* Risk-adjusted return, including the Sharpe Ratio

d) Comment on the appropriateness of the S&P 500 as a benchmark for the portfolio.

**Explain the calculations required to accomplish each task.**

Make sure to use the feedback your group received for your previous submission.

# Calculations and explanations

In this assignment, it is required to use the previous Submission 1 results, so we use the following Correlation, Annualized Return Standard Deviation, and Expected Return as below:

# Calculating and drawing a scatter plot graph of the efficient frontier

1. **Calculating and drawing a scatter plot graph of the efficient frontier based on 11 combinations of XLE and XLI**

Based on Module 1, Portfolio Theory and Asset Pricing, the Efficient Frontier consist of the Volatility of the Portfolio as the horizontal axis, and the Expected Return of the Portfolio as the vertical axis.

In order to draw the Efficient Frontier, we calculate the Return and Volatility of the Portfolio by using the following equation:

Expected Return of a Portfolio:

where:

: Expected Return of the Portfolio

: Expected Return of the Asset

: Weight of the Asset in the Portfolio

Volatility of a Portfolio (consist of two assets, can be called Two-asset Portfolio):

where:

: Volatility of the Two-asset Portfolio

: Weight of asset 1 and 2 in the Portfolio respectively

: Volatility of asset 1 and 2 in Portfolio respectively

: Correlation between asset 1 and assets 2 returns

If the Portfolio consists of more than two assets, the General Equation of Volatility of the Portfolio should be:

Apply the Correlation, Annualized Standard Deviation, Annualized Expected Return of XLE and XLI from the above we create the following result table:

**![A screenshot of a cell phone

Description automatically generated]()**

From this data table, we create the Efficient Frontier graph as below:

A close up of a map

Description automatically generated

# Selecting a portfolio on the efficient frontier

1. **Selecting a portfolio on the efficient frontier that satisfies the following constraints:**

* The return is greater than 9.43%
* The volatility is not greater than 16.8%

From the 11 Portfolios above we will choose a Portfolio with:

The result is shown below:

**![A screenshot of a cell phone

Description automatically generated]()**

Portfolio 7 is made of 40% XLE and 60% XLE, with the Expected Return of 0.094 and Volatility of 0.167.

# Portfolio selecting on the S&P 500

**c) Comment on how the portfolio selected in Submission 2(b) is expected to perform relative to the S&P 500 in terms of the following:**

* Return
* Risk
* Risk-adjusted return, including the Sharpe Ratio

Given that both XLI and XLE have positive beta, combining them in any proportions into a portfolio will definitely result in an expected return which is higher than S&P 500, which is taken to be the market, and has an expected return of 9%.(As given in previous assignment). In fact, the expected return of this portfolio can be calcuated by the weighted average of the expected return of each of the individual assets.

The volatility of this portfolio is 16.66%, as compared to the S&P 500 volatility of 15%. (Market volatility) Hence, this portfolio has a higher risk than S&P500.

The Sharpe ratio is given by

Hence, the S&P500 still has a higher sharpe ratio than the portfolio.

# Appropriateness of the S&P 500 as a benchmark for the portfolio

**d) Comment on the appropriateness of the S&P 500 as a benchmark for the portfolio**

The S&P 500 is appropriate to some extent as the XLE and XLI indices are both created out of taking some assets from the S&P500 index. However, the XLE only tracks the energy sector of the S&P500 while the XLI only tracks the industrial sector of the S&P 500. Hence, using S&P500 as a benchmark for this portfolio has its limitations as the S&P500 index contains other sectors that are not being represented by the portfolio, like healthcare and technology. This results in inconsistencies as other irrelevant sectors will impact the benchmark performance without impacting the portfolio. Hence, using another benchmark index that focuses primarily on the energy sector and industrial sector would be more reliable.

# Conclusion

To sum up, the efficient frontier displays a combination of assets that has the optimal level of expected return for a given level of risk. It is dependent on the past and it keeps changing every year there is new data. After all, the figures of the past need not necessarily continue in the future.  
All the portfolios on the line are ‘efficient’ and the assets which fall outside the line are not optimal because either they offer a lower return for the same risk or they are riskier for the same level of return. From the benchmark model the S&P 500 is appropriate to some extent as the XLE and XLI indices are both created out of taking some assets from the S&P500 index. However, the XLE only tracks the energy sector of the S&P500 while the XLI only tracks the industrial sector of the S&P 500. This results in inconsistencies as other irrelevant sectors will impact the benchmark performance without impacting the portfolio. Hence, using another benchmark index that focuses primarily on the energy sector and industrial sector might be more reliable.

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