

The background of the slide features a dark, semi-transparent financial chart with a white line graph showing an upward trend. The chart is overlaid with a large yellow circle that frames the main title. The title text is white and centered within the upper half of the circle.

PORTFOLIO OPTIMIZATION WITH PYTHON

USING EFFICIENT FRONTIER

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OVERVIEW OF THE OPTIMIZED INVESTMENT PORTFOLIO

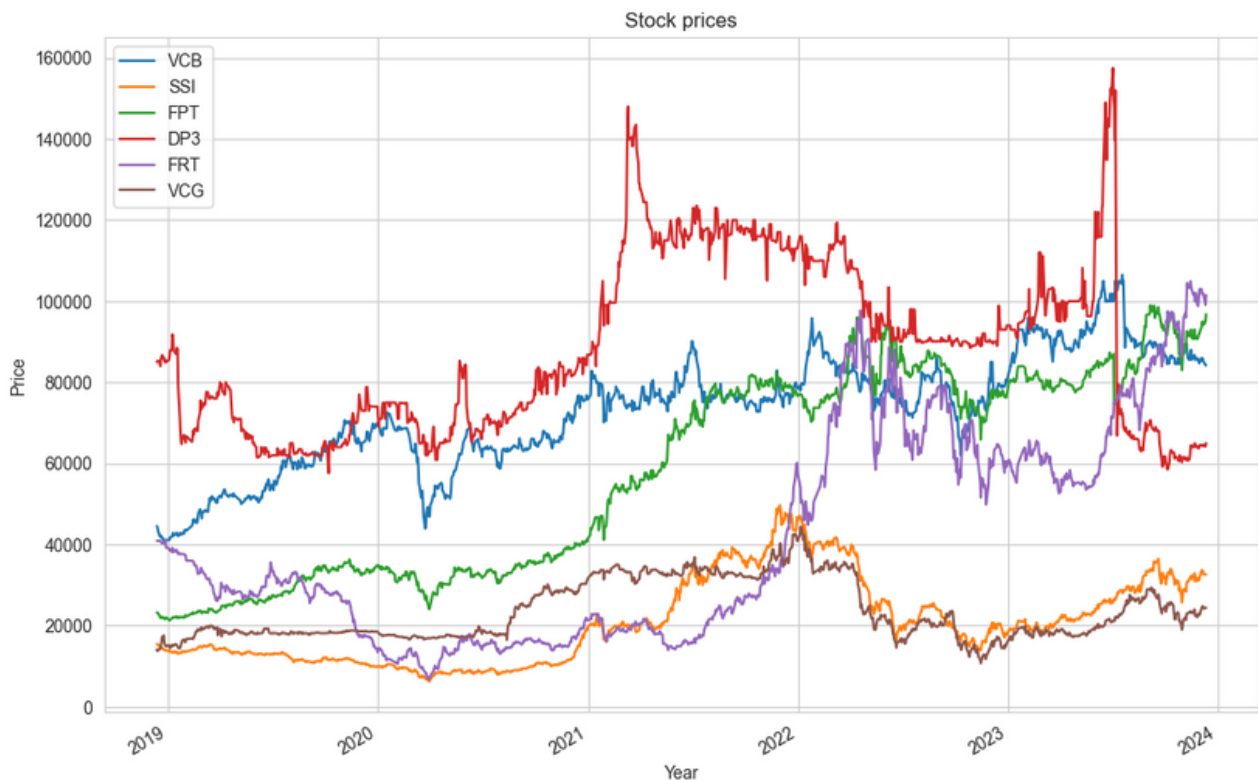
In the realm of equity markets, it's common practice to diversify investments across various stocks to optimize returns. Allocating funds effectively to each stock, aiming to minimize risk (standard deviation) and maximize returns, becomes a challenging task when dealing with multiple investments. Fortunately, employing Python and the portfolio optimization method can provide a solution to this challenge.

I will develop a portfolio optimization code using Python. We will examine six different stocks, including **VCB**, **SSI**, **FPT**, **DP3**, **FRT**, **VCG**. The stock data will be analyzed from December 12, 2018, to December 12, 2023, sourced from *Investing.com*. My aim is to strike a balance between risk and reward, and increase the likelihood of achieving long-term financial success. Additionally, stocks chosen from various industries help us mitigate losses more effectively



RESULTS ANALYSIS

Over the past 5 years, stocks have experienced significant price volatility, especially during the Covid-19 period



- **VCB (Vietcombank - Joint Stock Commercial Bank for Foreign Trade of Vietnam)**

In the context of the recent economic landscape, Vietcombank's profits have increased rapidly, enhancing the value of VCB shares circulating in the market. It can be observed that VCB stock prices have been on an upward trend from late 2018 to the end of 2019. However, in the first quarter of 2020, the stock prices experienced the deepest decline, dropping by over 40,000 Vietnamese dong due to the impact of the COVID-19 pandemic. After the pandemic, VCB stock prices recovered and began to rise again. Despite fluctuations over the years, it is evident that VCB stock prices show a long-term growth trend in the future.

- **FPT (FPT Corporation):**

Since late 2018, the stock prices only saw slight increases until 2020, then surged to peak in 2021-2023. Particularly in 2022, despite many stocks experiencing a decline in value, FPT moved in the opposite direction. Overall, FPT is one of the stocks with sustainable growth over many years, accompanied by a consistent dividend policy.

- **SSI (SSI Securities Corporation):**

This stock exhibits significant volatility from 2018 to 2023, experiencing notable periods of both price increases and declines. In early 2020, due to the impact of the pandemic, SSI stock prices saw a sharp decrease. Subsequently, the stock prices began to recover and gradually grow in each phase. By the end of 2021, at times, SSI stock prices reached a peak of 51,000 Vietnamese dong per share. However, after reaching the highest point, SSI stock prices experienced a substantial decline. By 2023, the prices showed an upward trend due to a series of corporate bond markets and real estate markets benefiting from interest rate reductions through government support measures.

- **DP3 (Central Pharmaceutical Company 3 - Joint Stock Company):**

In general, DP3 stock prices have experienced the most intense fluctuations compared to the stocks our group has examined. In the period from late 2018 to 2021, DP3 stock prices showed a strong upward trend, reaching their peak in the first quarter of 2021. However, after that, the stock prices experienced a significant and sharp decline. By 2023, due to the issuance of bonus shares, DP3 stock prices reached another peak, approaching 160,000 Vietnamese dong per share. However, after reaching this peak, the stock prices declined more deeply than the peak in 2021.

- **FRT (FPT Digital Retail Joint Stock Company):**

The chart indicates that FRT has a decreasing trend from late 2018 to Q1/2020. Subsequently, there are signs of a price increase, and by Q4/2021, FRT stock prices began to rise significantly, reaching their peak in the first half of 2022. In the latter half of 2023, FRT stock prices continued to rise. FRT is expected to maintain an upward stock price trend in the future due to the development of the Long Chau stores, as well as the stability and recovery of FPT shops, driven by the resurgence of non-essential shopping.

- **VCG (Vietnam National Export-Import and Construction Joint Stock Corporation):**

The chart shows that VCG stock prices remained stable with minimal fluctuation from 2018 to 2021. However, in early 2022, the stock market of VCG experienced a sharp decline due to the impact of rising construction material prices, causing a slowdown in the real estate and construction markets. In 2023, VCG stock prices gradually increased and regained momentum. This was attributed to VCG being announced as the contractor for several sections of the North-South highway Phase 2 and its membership in the Vietur consortium, which is the contractor for the construction of Terminal 1 at Long Thanh International Airport. These projects are expected to ensure a continuous revenue stream for VCG in the future.

HEAT MAP

Next, to visualize the correlation between different stocks in the investment portfolio, the team decides to use a Heat Map. Imperfect correlation is the reason we can diversify risks among different types of assets. The team has utilized the seaborn library's Heat Map function to clearly illustrate the strength of this relationship.

Based on the "**Heat Map of Stock Price Correlation**" above, we observe that lower values indicate less similarity between stocks; this can support risk management.



STOCKS WITH POSITIVE CORRELATION

Stocks VCB and FPT: The result shows a correlation coefficient of 0.85 between the two stocks.

Stocks SSI and FPT: The result shows a correlation coefficient of 0.78 between the two stocks.

Stocks FRT and FPT: The result shows a correlation coefficient of 0.77 between the two stocks.

If two stocks have a **high positive correlation**, it means they tend to move in the same direction. When one stock rises, the other stock also tends to rise, and vice versa. This positive correlation may not help investors avoid risks through diversification because the movements of the two stocks are linked. If the market experiences a downturn, both stocks are likely to decrease simultaneously.

**STOCKS WITH
NEGATIVE
CORRELATION**

- **Stocks FRT and VCG:** The result shows a correlation coefficient of -0.07 between the two stocks.

This means that when one stock increases in price, the other stock tends to decrease, and vice versa. Therefore, holding a mix of assets with negative correlation can reduce the overall volatility of the investment portfolio, thus diversifying risk across different assets.

**STOCKS WITH LOW OR
NO CORRELATION**

- **Stocks FRT and DP3:**

The result shows a correlation coefficient of 0.05 between the two stocks.

The movement of FRT stock does not predict the movement of DP3 stock.

THE EFFICIENT FRONTIER

The efficient frontier is a chart plotting:

- **'Returns'** on the **Y-axis**
- **'Volatility'** on the **X-axis**

=> It illustrates the highest achievable return for a given level of volatility or, conversely, the level of volatility one must accept for a specific level of returns.

1

- **Running a loop**

During each iteration, the loop evaluates various weights assigned to assets and computes the return and volatility associated with that specific portfolio combination.



2

- **The Sharpe Ratio**

The optimal risky portfolio is the one with the highest Sharpe ratio. Additionally, I define the risk-free rate to be 1% or 0.01.



3

- **Optimal Risky Portfolio**

The red star denotes the most efficient portfolio with minimum volatility.

The green star represents the optimal risky portfolio.

A portfolio with **the highest Sharpe ratio** can be regarded as an **optimal risky portfolio**.

VOLATILITY & RETURNS

	RETURNS	VOLATILITY
VCB	0.177520	0.278458
SSI	0.454611	0.434517
FPT	0.376330	0.278296
DP3	-0.026250	0.538070
FRT	0.473575	0.492001
VCG	0.236495	0.408555

- **VCB**

Returns: 0.177520

Volatility: 0.278458

VCB has a positive return of 0.177520, indicating its increase and volatility level at 0.278458. The positive return rate suggests that, overall, investing in VCB is expected to generate profit. The relatively moderate volatility indicates that VCB's operations have not experienced significant anomalies.
- **SSI**

Returns: 0.454611

Volatility: 0.434517

SSI has a higher return rate of 0.454611, indicating better operational efficiency compared to VCB. However, the higher volatility at 0.434517 suggests that SSI's profit has more fluctuations, indicating a higher level of risk.

VOLATILITY & RETURNS

- **FPT**

Returns: 0.376330

Volatility: 0.278296

FPT has a positive return rate of 0.376330, similar to SSI but with lower volatility at 0.278296. This combination indicates a favorable risk-profit profile compared to SSI.

- **DP3**

Returns: -0.026250

Volatility: 0.538070

DP3 has a negative return of -0.026250, indicating an average loss. Additionally, it has the highest volatility in the set (0.538070), signifying a higher level of risk. DP3 appears to be a riskier investment with negative profit.

- **FRT**

Returns: 0.473575

Volatility: 0.492001

FRT has the highest return in this set at 0.473575. This implies that, on average, FRT has delivered the highest return among the listed assets. However, it also has a relatively high volatility of 0.492001, indicating higher risk associated with these profits.

- **VCG**

Returns: 0.236495

Volatility: 0.408555

VCG has a positive return rate of 0.236495, at a moderate level. Its volatility of 0.408555 suggests a moderate level of risk. The risk-profit profile of VCG lies between SSI and FPT.

RUNNING THIS LOOP A 10000 TIMES

Returns ÷	Volatility ÷	VCB weight ÷	SSI weight ÷	FPT weight ÷	DP3 weight ÷	FRT weight ÷	VCG weight ÷
0.292875	0.256546	0.126196	0.320330	0.246635	0.201710	0.052568	0.052
0.263914	0.271092	0.018016	0.268670	0.186453	0.219629	0.006385	0.300
0.257303	0.230542	0.371791	0.094836	0.081208	0.081913	0.135882	0.234
0.309732	0.234777	0.202503	0.136533	0.286847	0.065397	0.136962	0.171
0.304968	0.271491	0.175816	0.302687	0.076975	0.198238	0.228377	0.017

num_portfolios = 10000

=> Observing various portfolios with distinct weights, returns, and volatility, plotting the returns and volatility data from this dataframe will generate the efficient frontier for our portfolio.

PORTFOLIO WITH MINIMUM VOLATILITY

RETURNS	0.231159
VOLATILITY	0.209955
VCB weight	0.410174
SSI weight	0.008294
FPT weight	0.291336
DP3 weight	0.105407
FRT weight	0.016874
VCG weight	0.167914

- **Returns: 0.231159**

The expected returns of the investment portfolio with minimum volatility are 0.231159. This reflects the average profit that investors can anticipate from the investment portfolio based on the assigned weights for each asset.

- **Volatility: 0.209955**

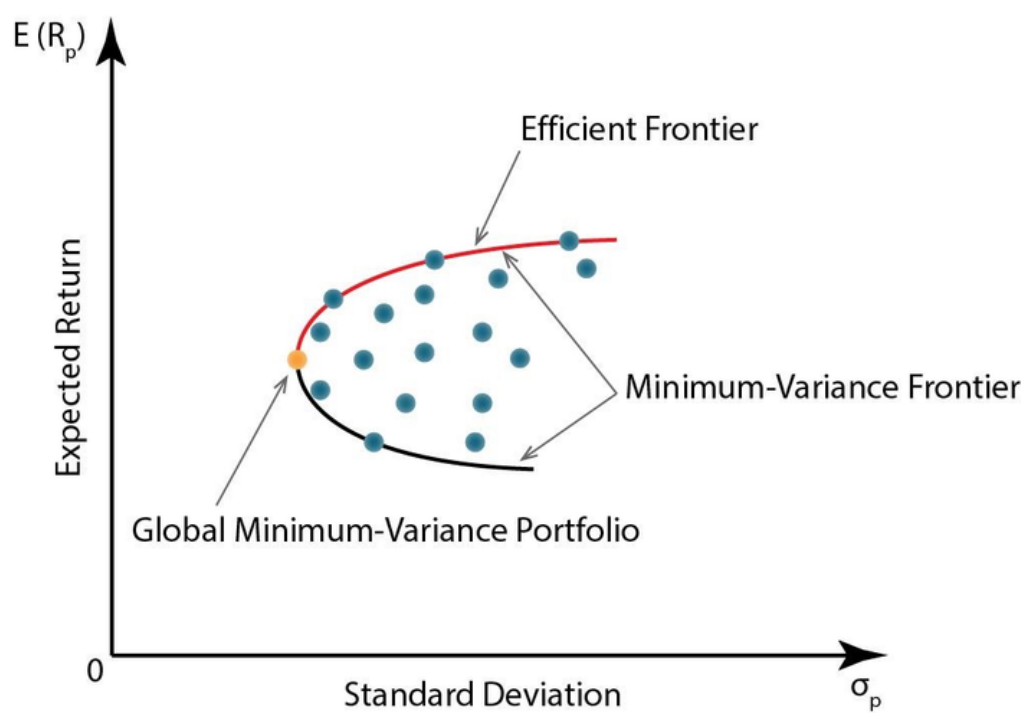
The volatility of the investment portfolio with minimum volatility is 0.209955. This value represents the standard deviation of the portfolio's returns and serves as a measure of the portfolio's risk. In this context, the investment portfolio with minimum volatility has the lowest risk among the simulated portfolios.

PORTFOLIO WITH MINIMUM VOLATILITY

RETURNS	0.231159
VOLATILITY	0.209955
VCB weight	0.410174
SSI weight	0.008294
FPT weight	0.291336
DP3 weight	0.105407
FRT weight	0.016874
VCG weight	0.167914

These weights indicate the proportion of the total investment portfolio allocated to each asset to achieve minimum volatility.

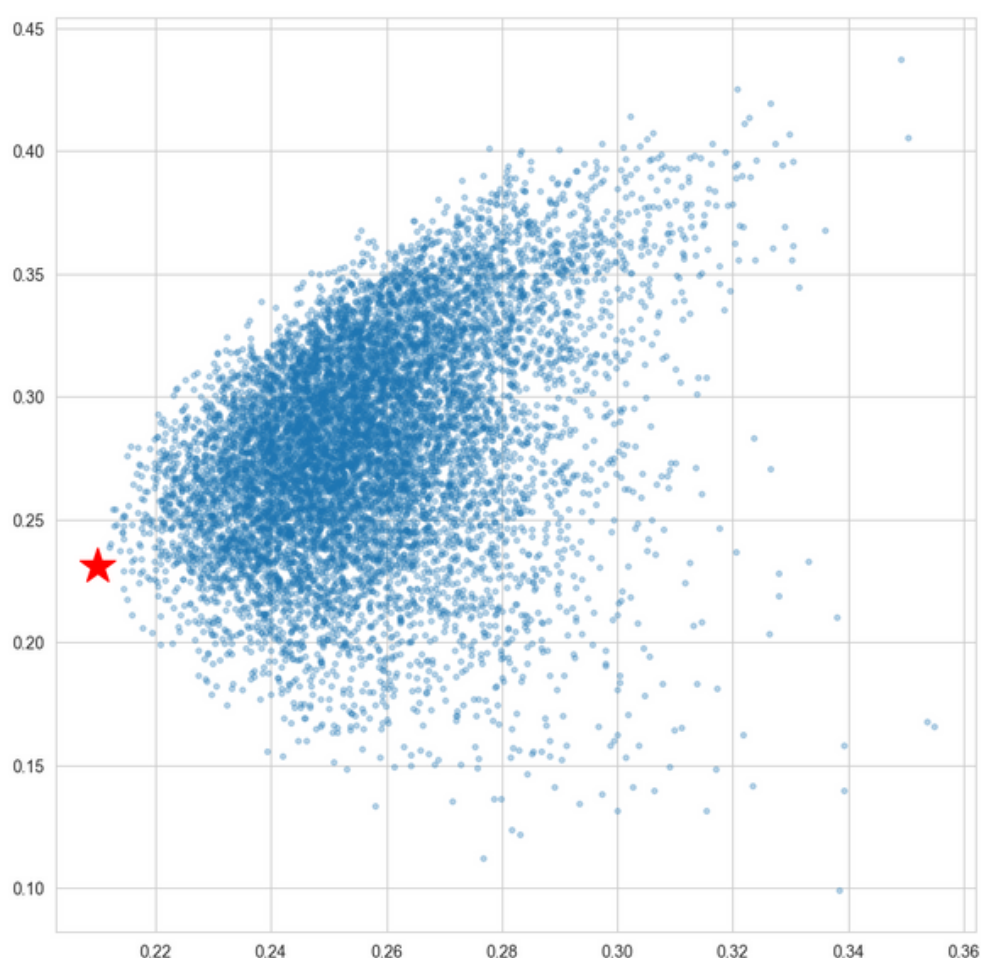
In this specific portfolio, the highest weight is allocated to **VCB** (Bank) at **41.02%**, followed by **FPT** (Leading Technology company in Vietnam) at **29.13%**. Other assets, including SSI, DP3, FRT, and VCG, have smaller weights in the portfolio.



PORTFOLIO WITH MINIMUM VOLATILITY

Every point along the line's left edge signifies an optimal stock portfolio that maximizes returns for a specific level of risk.

Portfolios located within the interior are considered sub-optimal for a given risk level. For each interior point, there exists another point that provides higher returns for an equivalent level of risk.



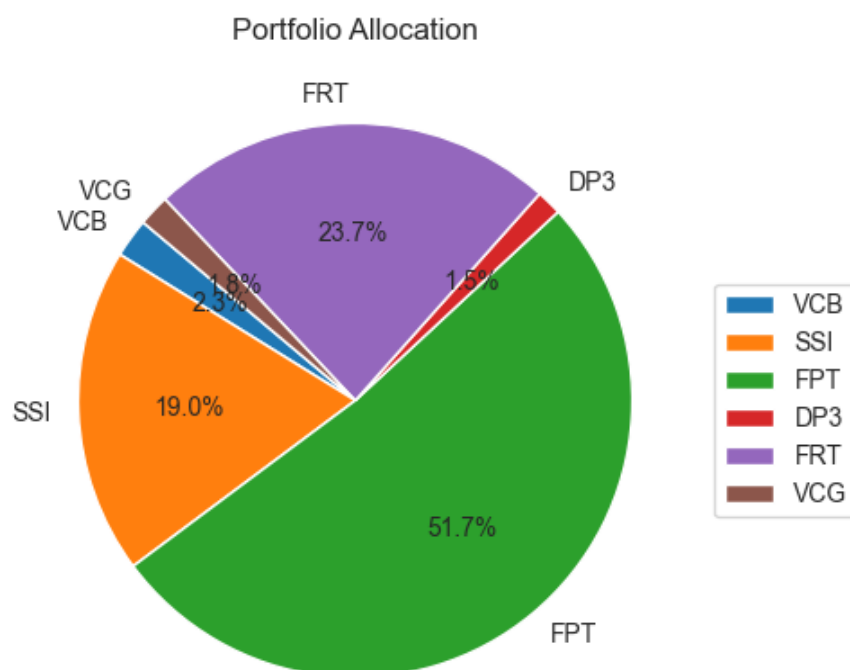
The red star represents the most efficient portfolio with minimal volatility.

While we identified the portfolio with the least volatility, it's evident that the return on this portfolio is relatively low. Any prudent investor aims to maximize their return, even if it involves accepting a certain level of risk.

The question then arises: How do we discover this optimal risky portfolio and ultimately optimize our portfolio to its fullest potential?

OPTIMAL RISKY PORTFOLIO

In addressing the question posed earlier, I will utilize a parameter known as the **Sharpe Ratio**. This metric is valuable for assessing the risk-adjusted performance of an investment portfolio, considering both its returns and volatility.



- **FPT (FPT Corporation): 51.7%**

FPT Corporation is the highest-ranked in the portfolio, indicating that, based on the optimization model, this company is expected to contribute the most to the overall profit of the investment portfolio and risk-adjusted performance.

- **FRT (FPT Digital Retail Joint Stock Company): 23.7%**

FRT's securities represent the second-largest allocation in the investment portfolio, making a significant portion of the investment. The model suggests that SSI has favorable characteristics to be included in the portfolio.

OPTIMAL RISKY PORTFOLIO

- **SSI (SSI Securities Corporation): 19.0%**

SSI holds a moderate weight in the investment portfolio. Although not the highest, it still plays a meaningful role in diversifying and enhancing the overall efficiency of the investment portfolio.

- **VCB (Bank): 2.3%**

VCB has a smaller weight compared to FPT and SSI, indicating that, according to the optimization model, VCB contributes less to the expected profit and risk-adjusted efficiency of the investment portfolio.

- **VCG (Vietnam Export Import and Construction Corporation): 1.8%**

VCG has the second-smallest weight in the investment portfolio, showing that its impact on the overall investment portfolio is relatively small. This may be due to its characteristics, such as volatility or historical returns, compared to other assets in the investment portfolio.

- **DP3 (Central Pharmaceutical Joint Stock Company 3): 1.5%**

DP3 has the smallest weight in the investment portfolio, indicating that, according to the model, it is expected to contribute the least to the profit of the investment portfolio and risk-adjusted efficiency.



OPTIMAL RISKY PORTFOLIO

RETURNS	0.401158
VOLATILITY	0.277816
VCB weight	0.022782
SSI weight	0.190306
FPT weight	0.517197
DP3 weight	0.014873
FRT weight	0.236560
VCG weight	0.018281

- **Returns**

Minimum Volatility Portfolio: 0.231159

Optimal Risk Portfolio: 0.401158

- **Volatility**

Minimum Volatility Portfolio: 0.209955

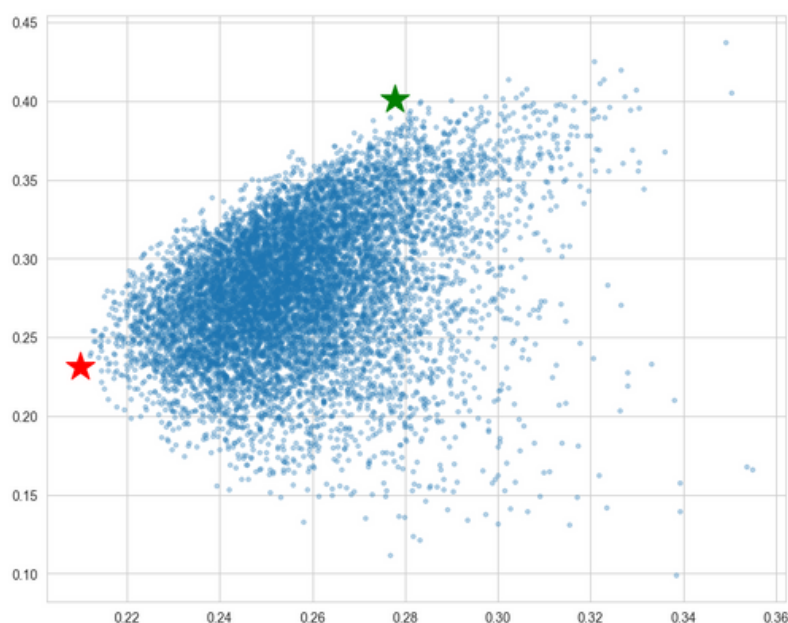
Optimal Risk Portfolio: 0.277816

=> You may notice that although the risk difference between the minimum volatility investment portfolio and the optimal risk investment portfolio is only 7%, the difference in returns reaches up to 17%.

We can plot this point too on **the graph of efficient frontier**:

The red star denotes the most efficient portfolio with minimum volatility.

The green star represents the optimal risky portfolio.



CONCLUSION

To determine the expected profit level corresponding to the risk I am willing to accept, I strive to maximize the Sharpe ratio of the investment portfolio. The Sharpe ratio is a metric used to evaluate returns adjusted for the risk of an investment or investment portfolio.

After analysis, the results recommend that:

- A significant portion of the investment portfolio be allocated to **FPT**, indicating high expectations for risk-adjusted returns from this company.
- **SSI** and **FRT** also play crucial roles in the investment portfolio, contributing to diversification and overall operational efficiency.
- The smaller weights assigned to **VCB**, **VCG**, and **DP3** suggest a lesser impact on the portfolio according to the optimization model.

