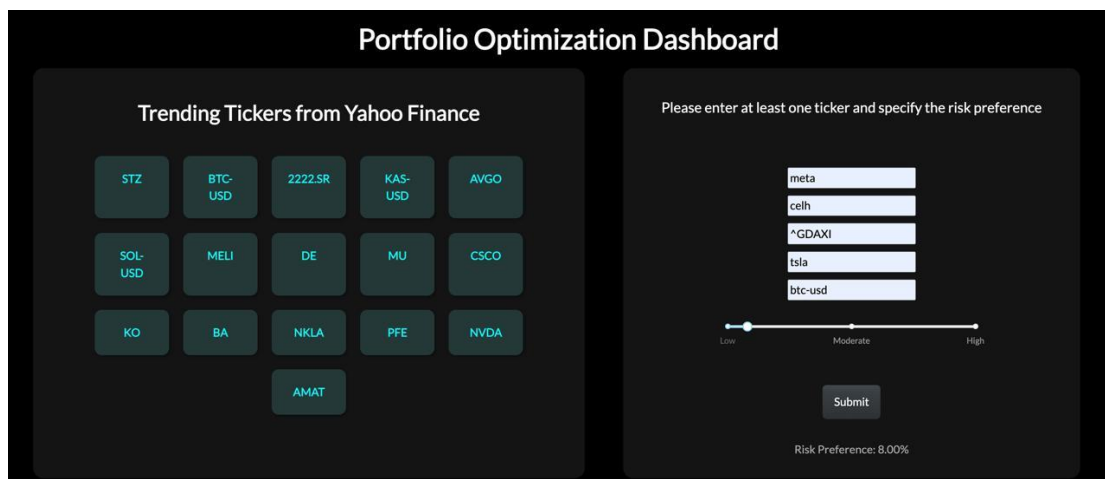# Dashboard overview:

This dashboard is tailored specifically for investors who may not have extensive investment experience but have already identified up to five stocks they are interested in. It simplifies the complex process of portfolio optimization, making it accessible and user-friendly.

Stocks input:

To begin, users can input the ticker symbols of up to five stocks they want to analyze. The dashboard also includes an intuitive slider that allows users to easily set their risk preference, whether they prefer a more conservative approach or are willing to take on higher risk for potentially greater returns.

After the tickers are entered, the dashboard automatically retrieves live data from Yahoo.finance and demonstrate key financial statistics, including Market Capitalization (Market Cap), Price-to-Earnings Ratio (P/E Ratio), Price/Earnings to Growth Ratio (PEG Ratio), Enterprise Value, and Enterprise Value to Revenue (EV/Revenue) . We selected these statistics because they are essential for informed investment decision-making by giving users a comprehensive overview of the financial health and valuation of their selected stocks. This process helps investors make informed decisions without needing deep financial expertise, as all the necessary data is readily accessible and easy to understand.

Key Statistics of Selected Tickers

Ticker	Market Cap	Trailing P/E	PEG Ratio	Price/Sales	Enterprise Value	EV/Revenue
meta	1278969118720	28.97816	0.86	8.961889	1258484269056	8.818
celh	13306594304	62.736263	1.62	9.412048	13253578752	9.375
^GDAXI	N/A	N/A	N/A	N/A	N/A	N/A
tsla	631078912000	50.73846	5.06	6.660815	614928154624	6.49
btc-usd	1214879236096	N/A	N/A	N/A	N/A	N/A

The dashboard first collects historical data from Yahoo Finance to predict future stock prices and generate an efficient frontier, which illustrates all possible portfolio combinations based on varying stock allocations. By visualizing the optimal portfolio weights in a pie chart and highlighting them as a red dot on the efficient frontier, the dashboard provides a clear and intuitive understanding of the best possible allocation for maximizing returns while minimizing risk.

Manul adjustment:

For investors looking to fine-tune their portfolio, the dashboard offers a feature that allows for manual adjustment of stock weights. After investors making the adjustment, a blue dot will be displayed on the efficient frontier, showing the updated risk and return profile of the adjusted portfolio. This interactive element is crucial because it empowers investors to experiment with different scenarios and see, in real-time, how changes in their portfolio allocation impact the overall risk and return.
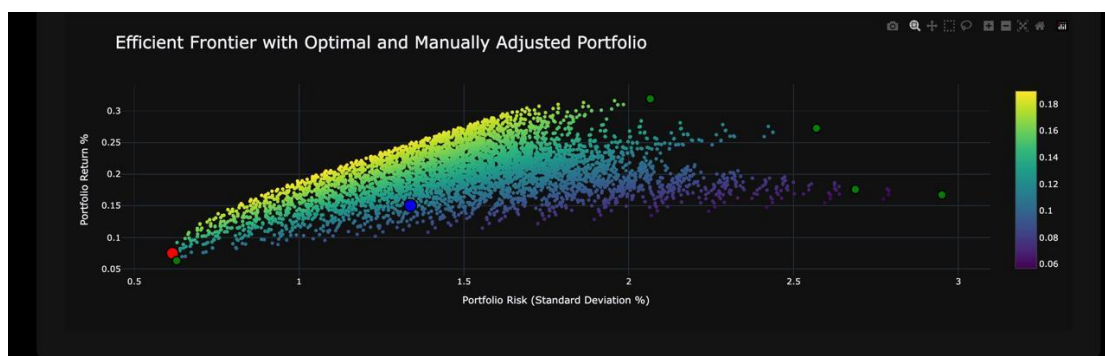
Results:

Finanly, a optimal portfolio weights pie chart will be showing. It indicated the optimal allocation of weights of each stock. We selected colors which drastically distinct from each other to show a clear picture of optimal weights. This function serves as a powerful tool for investors to visualize and understand the relationship between risk and return,

which is fundamental to making informed investment decisions. By offering both a data-driven optimal portfolio and the flexibility to manually adjust allocations, the dashboard caters to a wide range of investor preferences. This approach not only enhances the decision-making process but also builds investor confidence by providing clear, actionable insights.

The functionality of this dashboard offers investors critical insights into how they can optimally allocate their investments across a selection of stocks with varying proportions. By analyzing different allocation strategies, investors can better understand the potential impact on their portfolio's overall performance. Additionally, the tool provides a dynamic option for investors to manually adjust their portfolio composition, allowing them to experiment with different stock weightings. This interactive feature enables investors to observe how these adjustments influence the risk and return profile of their portfolio, empowering them to make more informed decisions that align with their individual risk tolerance and investment goals.

Methodology:

MVO:

MVO is used in the dashboard because it provides a rigorous, data-driven approach to portfolio optimization, balancing risk and return in a way that is both scientifically sound and practically useful. Its integration into the dashboard enhances the decision-

making process by offering investors a clear, customizable, and educational tool for managing their investments more effectively.

1. Quantitative Foundation: MVO is based on a quantitative framework that uses historical data to estimate the expected return (mean) and risk (variance) of individual assets. By applying this framework, the dashboard can analyze a large number of possible portfolio combinations and identify those that offer the best risk-return trade-off. This quantitative rigor provides a solid foundation for making informed investment decisions.

2. Efficient Portfolio Selection: The primary goal of MVO is to construct a portfolio that minimizes risk for a given level of expected return or maximizes return for a given level of risk. This aligns perfectly with the needs of investors who are looking to optimize their portfolios. The dashboard leverages MVO to generate the efficient frontier, which visually represents all possible combinations of portfolio allocations that meet these criteria. This allows investors to easily identify and select the most efficient portfolio based on their risk tolerance and return expectations.

3. Customizability and Flexibility: While MVO provides a data-driven approach to identifying the optimal portfolio, it also allows for customization. The dashboard enables investors to manually adjust the weights of individual assets in their portfolio. MVO recalculates the risk and return of these adjusted portfolios in real-time, helping investors see the impact of their changes. This flexibility ensures that investors can tailor their portfolios to meet specific goals or constraints while still benefiting from the insights provided by MVO.

4. Risk Management: MVO is particularly valuable for risk management. By considering both the expected returns and the covariances between assets (how they move in relation to one another), MVO helps in constructing diversified portfolios that can reduce overall portfolio risk. The dashboard uses MVO to guide investors toward portfolios that achieve a balance between maximizing returns and minimizing unnecessary risk, thereby enhancing the robustness of

their investment strategies.

5. Educational Value: For many investors, understanding the relationship between risk and return is crucial for making informed decisions. MVO, when integrated into the dashboard, serves not only as a practical tool but also as an educational resource. It helps investors visualize how different asset allocations affect their portfolio's performance, deepening their understanding of investment principles. The use of MVO thus empowers investors with the knowledge they need to navigate complex financial markets.

6. Real-Time Decision Support: The real-time application of MVO in the dashboard means that investors can see immediate feedback on how their portfolio adjustments impact risk and return. This dynamic interaction between MVO and the dashboard's user interface provides a seamless experience for investors, making it easier for them to make quick and informed decisions in response to market conditions or personal changes in investment strategy.

ARIMA (Autoregressive Integrated Moving Average):

ARIMA is a powerful statistical method commonly used for time series forecasting. In the context of the dashboard, ARIMA plays a critical role in predicting future stock prices and trends, which are essential for making informed investment decisions. Here's why ARIMA is chosen for the dashboard:

1. **Robust Time Series Forecasting**: ARIMA is one of the most reliable models for analyzing and forecasting time series data, which is data that is indexed in time order, such as historical stock prices. By using ARIMA, the dashboard can effectively model the temporal dependencies in stock price data, providing accurate predictions of future prices. These predictions form the basis for constructing the efficient frontier and optimizing portfolios.

2. **Capturing Complex Market Dynamics**: Stock prices are influenced by a variety of factors, including trends, cycles, and random fluctuations. ARIMA is well-suited to capture these complexities because it combines three components:

- **Autoregressive (AR)**: Captures the relationship between an observation and a number of lagged observations.

- **Integrated (I)**: Applies differencing to make the time series stationary, removing trends and seasonality.

- **Moving Average (MA)**: Models the relationship between an observation and the residual errors from a moving average model applied to lagged observations.

This combination allows ARIMA to model and forecast stock prices with a high degree of accuracy, accounting for both long-term trends and short-term variations.

3. **Enhancing Portfolio Optimization**: The primary goal of the dashboard is to help investors build and manage optimized portfolios. By predicting future stock prices, ARIMA helps estimate expected returns more accurately. These expected returns are crucial inputs for the Mean-Variance Optimization (MVO) process, which the dashboard uses to construct the efficient frontier. With more accurate return estimates, investors can make better-informed decisions about how to allocate their assets to achieve their desired balance of risk and return.

4. **Flexibility and Customization**: ARIMA is highly adaptable and can be fine-tuned to suit different types of time series data. This flexibility is important for the dashboard, as it allows the model to be customized to the specific characteristics of the stocks being analyzed. Whether the data exhibits strong trends, seasonality, or volatility, ARIMA can be adjusted to provide the best possible forecasts.

5. **Real-Time Forecasting**: The integration of ARIMA into the dashboard allows for real-time forecasting of stock prices. As new data becomes available, the model can be updated, providing investors with the most current predictions. This real-time capability ensures that the efficient frontier and other portfolio optimization tools reflect the latest market conditions, making them more relevant and actionable for investors.

6. **Educational Value for Users**: Beyond its practical applications, the use of

ARIMA in the dashboard also has educational value. By seeing how time series forecasting works in practice, investors gain a deeper understanding of market dynamics and the importance of data-driven decision-making. This understanding can help them become more sophisticated investors, better able to interpret market signals and adjust their strategies accordingly.

Efficient Frontier:

The efficient frontier is a key concept in modern portfolio theory and plays a central role in this dashboard. It represents a set of optimal portfolios that offer the highest expected return for a given level of risk or the lowest risk for a given level of return. In other words, any portfolio on the efficient frontier is considered "efficient" because no other portfolio provides a better return without increasing risk.

1. **Data Collection and Analysis**: The dashboard first collects historical stock price data from Yahoo Finance. This historical data is used to calculate the expected returns, variances, and covariances of the selected stocks. These calculations are essential for understanding how each stock might perform in the future and how they interact with one another in a portfolio.

2. **Generating the Efficient Frontier**: Using the calculated statistics, the dashboard simulates a large number of possible portfolio combinations by varying the allocation of each stock. For each combination, the dashboard computes the portfolio's expected return and its risk (measured by the portfolio's standard deviation). These portfolios are then plotted on a graph, with risk on the x-axis and return on the y-axis. The resulting curve is the efficient frontier, and it visually represents the boundary of the optimal portfolios.

3. **Identifying the Optimal Portfolio**: Among all the portfolios on the efficient frontier, there is one that is considered the "optimal" portfolio, depending on the investor's risk tolerance. This portfolio offers the best possible balance between risk and return and is highlighted as a red dot on the efficient frontier graph.

This optimal portfolio's allocation is also shown in a pie chart for easy visualization.

4. **Manual Adjustments and Visualization**: The dashboard also allows investors to manually adjust the weights of the stocks in their portfolio. As they make these adjustments, the dashboard recalculates the portfolio's expected return and risk and plots this new portfolio as a blue dot on the efficient frontier. This feature is particularly useful for investors who want to tailor their portfolio according to their personal preferences or constraints. By comparing the position of the blue dot with the efficient frontier, investors can see how close or far their custom portfolio is from the optimal efficiency.

5. **Decision-Making Support**: By using the efficient frontier, investors can make more informed decisions about their portfolio allocation. They can visually assess whether their current or proposed portfolio is efficient or if they might benefit from adjustments. The dashboard simplifies this complex process by providing real-time feedback on how different allocations affect the risk and return of the portfolio.

Project Setup:

To get the project setup and running, follow these steps to set up a virtual environment, install dependencies, and run the code.

1. Navigate to the Project Directory First, open your terminal and navigate to the directory where your project is located. Replace /path/to/your/project with the actual path to your project: cd /path/to/your/project

2. Create a Virtual Environment Create a virtual environment to manage project-specific dependencies. This ensures that your project's packages don't interfere with system-wide packages or other projects: python3 -m venv myenv

3. Activate the Virtual Environment Activate the virtual environment. This step may vary depending on your operating system: On macOS/Linux: source myenv/bin/activate On Windows: myenv\Scripts\activate After activation, your

terminal prompt should change to indicate that the virtual environment is active.

4. Install Dependencies With the virtual environment activated, install the necessary packages listed in requirements.txt. This file contains all the dependencies required for the project: pip3 install -r requirements.txt

5. Run the Code Now that all dependencies are installed, you can run the code. Replace your_script.py with the name of the Python file you want to execute: python3 Static Portfolio Optimisation Dashboard.py

6. Deactivate the Virtual Environment After you're done working, you can deactivate the virtual environment: deactivate

Resources:

-MVO:

https://smartasset.com/financial-advisor/mean-variance-optimization

https://medium.com/@phindulo60/portfolio-optimization-with-python-mean-variance-optimization-mvo-and-markowitzs-efficient-64acb3b61ef6

-Generative AI and AI-assisted technologies in the writing process:

During the preparation of this work the authors used OpenAI. (2024). ChatGPT [Large language model]. https://chatgpt.com/c/0241f3d1-891b-43e0-be37-b451b1f329e in order to draft, edit, and refine the code and documentation contents, including adding docstrings structing and proofreading.