Comprehensive Analysis of Stock Prices, Returns, and Portfolio Performance (01/01/2020 – 30/07/2025)

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Abstract—This study will involve an in-depth examination of the stock price, daily returns, volatility, and portfolio returns related to the chosen technology companies (**AAPL, MSFT, and GOOGL**) that experienced the period between **01/01/2020** and **30/07/2025**. The study uses quantitative approaches including a return distribution assessment, correlation analysis, Sharpe ratio, and a portfolio modelling in order to assess the risk-return dimension of individual assets and an invested portfolio. Results highlight the power of diversification, the diverse risk-adjusted returns profile of assets, and give information on decision-making when investing in uncertain conditions.

Key word: Stock Price Analysis; Daily Returns; Volatility; Risk–Return; Sharpe Ratio; Correlation Analysis; Portfolio Optimization; Diversification; Technology Stocks; AAPL; MSFT; GOOGL; Quantitative Finance; Investment Strategy.

1. Introduction

Technology has become a turning point in the financial markets of the world, and such companies like Apple (AAPL), Microsoft (MSFT), and Alphabet (GOOGL) have become the most powerful companies. Investors who want to base their diversified portfolios and handle uncertainty in a fast changing market setting cannot do without a detailed understanding of how they interact risk-wise and have a return. This analysis provides a research of stock prices, daily returns, volatility, and portfolio performance of these companies in the time frame between January 1 2020 and July 30 2025, thus covering such landmark events as the COVID-19 pandemic, the post-pandemic recovery, and the changes in the global monetary policy.

The quantitative framework used in the methodology is the combination of the analysis of return distributions, the measurement of correlations and the evaluation of Sharpe-ratio and the optimization of portfolios. These analytical applications make it easier to examine the behaviour of a particular stock, its performance adjusted by risk, and the overall utility that a diversification provides. The addition of correlation analysis and Sharpe-ratio calculation provides more information on how the stocks of technologies relate to each other as well as how risk can be managed in balance with anticipated returns.

Findings provide practical advice in investment strategy and current portfolio management and serve as an example on how diversification helps reduce volatility and improve risk-return performance. In addition to financial insights, the research shows the value of data-oriented analysis that is conducted using Python, pandas, and other financial libraries, hence evidence-based decision making, both to individual investors and professional portfolio managers. Related to careers in financial data analytics and investment-strategy development, this study also offers a background basis by connecting real market data and quantitative methods.

2. Data and Methodology

2.1 Data

The data set includes the daily adjusted price decrees of Apple (AAPL) and Microsoft (MSFT) and Alphabet (GOOGL) on 1 January 2020 to 30 July 2025 obtained by Yahoo Finance using the yfinance Python library. Adapted prices are use in consideration of stock splits and dividend payments, thus rendering the accuracy of return calculations.

The daily returns were computed as the percentage change in the adjusted closing prices and this method captures the market performance and volatility. The empirical framework of the Sharpe ratio and optimisation of the portfolio is put in place by the descriptive statistics such as mean, standard deviation and pair-wise correlation statistics of the three equities. The selected time frame envelops the major developments in the market, specifically the COVID-19 pandemic and consecutive changes in the monetary policy, both of which provide the in-depth background of the risk-reward analyses.

2.2 Methodology

In this paper, a quantitative analytical model is applied in examining risk-return relationships and portfolio performance.

- **Daily Returns and Volatility** - Daily returns are calculated as percentages of a change in adjusted closing prices. Volatility is measured by the standard deviation of the daily returns thus the market risk is captured.
- **Return Distribution and Correlation Analysis** - Descriptive statistics and return histograms are used to analyse the distributional features, a correlation matrix is used to measure the relationship between AAPL, MSFT, and GOOGL in the analysis of the potential of diversification.
- **Sharpe Ratio** - is the measure of risk-adjusted performance which compares excess returns to portfolio volatility at a risk-free rate.
- **Portfolio Optimization**- An efficient methodology of creating a portfolio under expected return and risk is mean- variance optimization.

The whole processing and visualisation are made in Python, with the use of packages like **pandas**, **NumPy**, **Matplotlib**, **seaborn** and **yfinance**, therefore, forming reproducibility and data dealings of the data.

3. Results and Discussion

3.1 Descriptive Statistics and Volatility

Table 1 summarizes the key descriptive statistics—mean, median, and standard deviation—of daily returns for Apple (AAPL), Alphabet (GOOGL), and Microsoft (MSFT) over the period **1 January 2020 to 30 July 2025**.

	Mean	**Median**	**Std Dev**
Ticker			
AAPL	0.000971	0.001157	0.020422
GOOGL	0.000967	0.001616	0.020565
MSFT	0.001045	0.001115	0.019042

Table 1: Descriptive Statistics of Daily Returns

All three stocks had a favourable positive average daily return of around 0.1 %, with standard deviations of about 2 %. Of them, **MSFT exhibited the highest mean and the lowest volatility**, implying a more attractive individual risk–return profile.

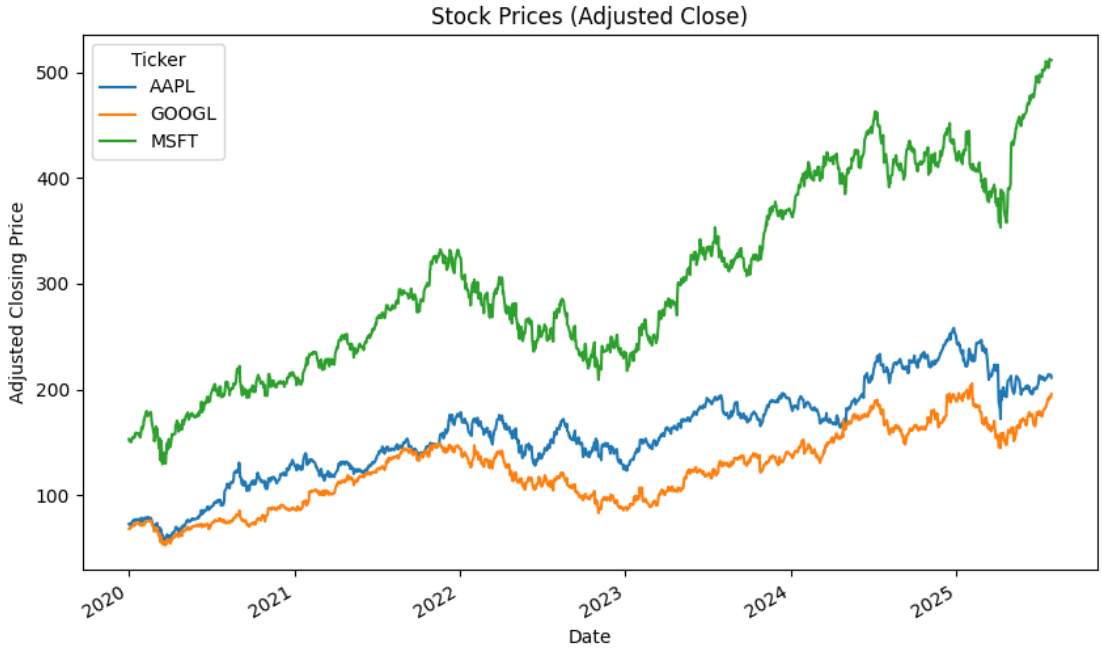

Figure 1: Stock Prices (Adjusted Close) show steady long-term growth for all three companies despite temporary drawdowns.

Analysis: The chart reveals persistent upward trends interrupted by episodes of market stress such as the early-2020 pandemic shock and later monetary policy adjustments. Microsoft's higher price trajectory reflects stronger fundamental growth and market confidence, consistent with its superior mean return in Table 1.

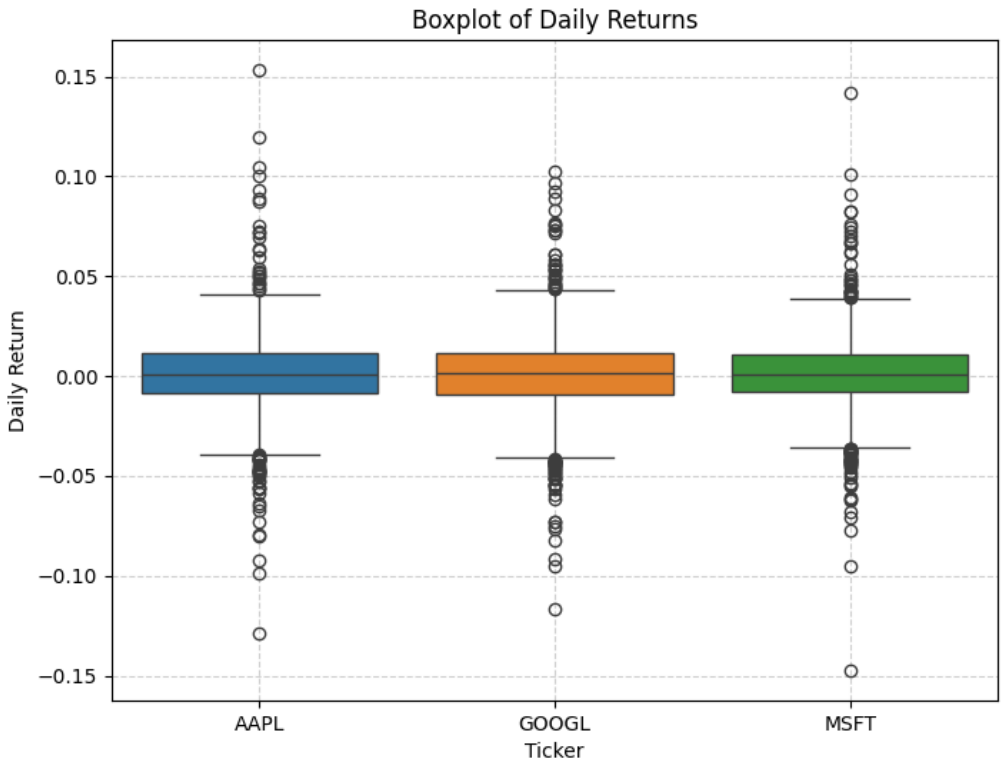

Figure 2: Boxplot of Daily Returns compares return distributions

Analysis: Median daily returns cluster near zero across all stocks, but AAPL exhibits a slightly wider interquartile range and more extreme outliers. This indicates greater day-to-day variability and aligns with its marginally higher standard deviation.

3.2 Volatility Dynamics

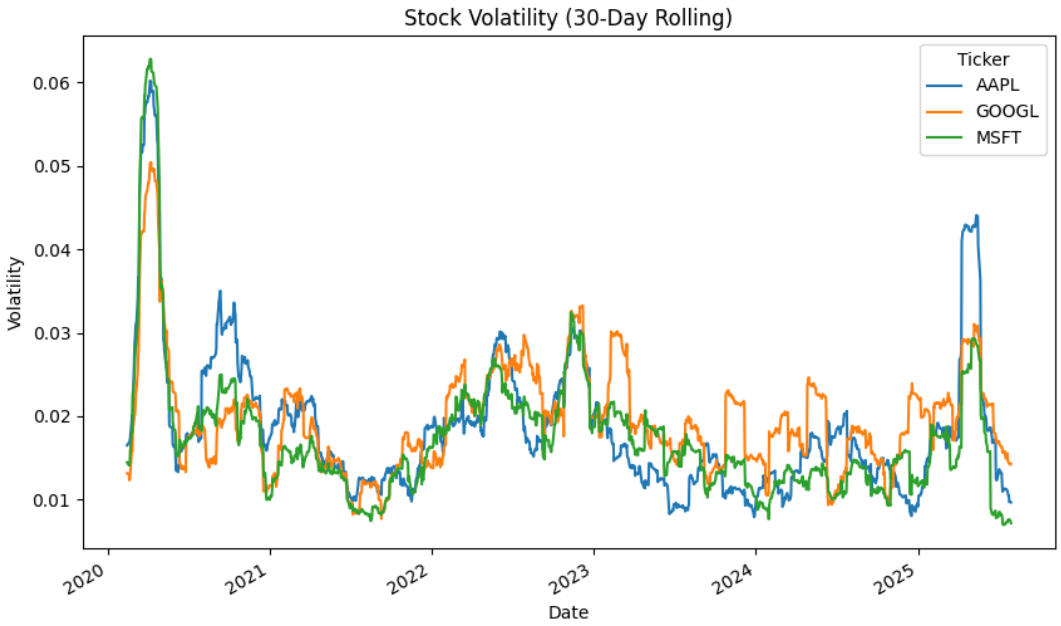

Figure 3. Stock Volatility (30-Day Rolling) depicts time-varying risk.

Analysis: All three stocks show pronounced volatility spikes during major macroeconomic events, notably the COVID-19 outbreak and subsequent tightening cycles. Over time, volatility trends downward, with MSFT consistently maintaining the lowest rolling standard deviation. This supports the view of MSFT as the most stable component of the sample.

3.3 Correlation and Diversification

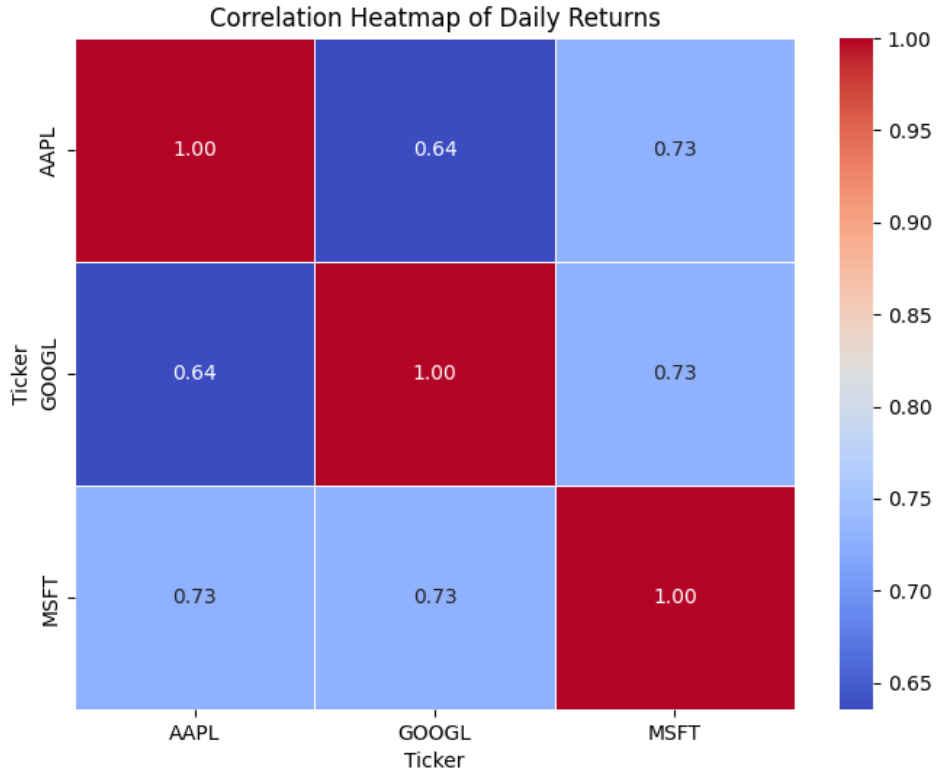

Figure 4. Correlation Heatmap of Daily Returns

Analysis: Pairwise correlations range from **0.64 to 0.73**, indicating moderate positive relationships. Such less-than-perfect co-movement allows diversification benefits: combining these assets can reduce total portfolio variance while retaining expected return. This property provides the foundation for improved portfolio performance documented below.

3.4 Portfolio Optimization

Risk-adjusted returns are evaluated using the Sharpe ratio.

Ticker	**Sharpe Ratio**
AAPL	0.043680
GOOGL	0.043179
MSFT	0.050734
Portfolio	0.051217

Table 2. Sharpe Ratios (Individual Stocks and Portfolio)

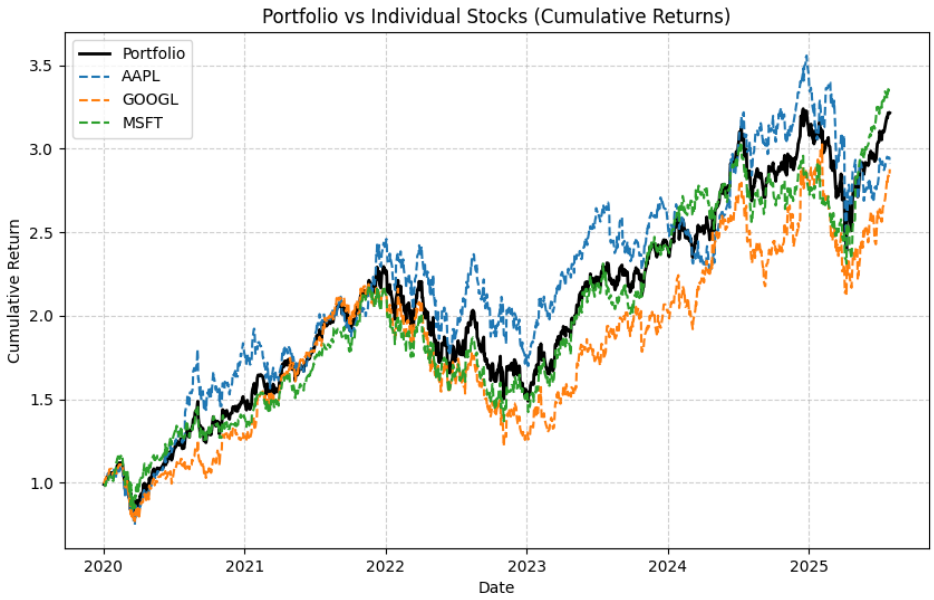

Figure 5. Sharpe Ratios: Stocks vs Portfolio

Analysis: MSFT achieves the highest individual Sharpe ratio, confirming the best single-stock balance of risk and return. Notably, the optimized three-asset portfolio slightly surpasses MSFT (0.0512 vs. 0.0507), proving that diversification yields a measurable gain in risk-adjusted performance even among correlated technology equities.

3.5 Investment Insights

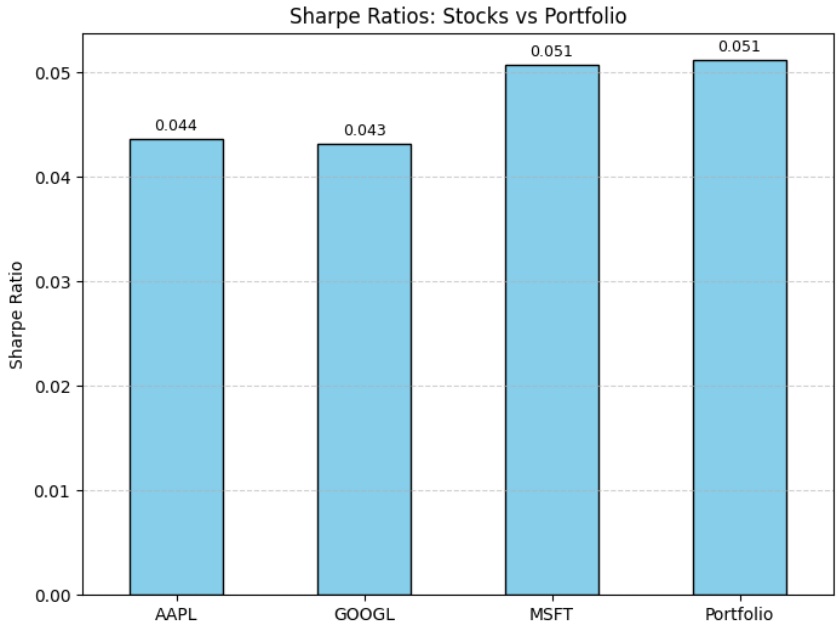

Figure 6. Portfolio vs Individual Stocks (Cumulative Returns)

Analysis: The portfolio's cumulative return curve is smoother and less volatile than those of the individual stocks while sustaining comparable or higher long-term growth. This demonstrates that a diversified, mean-variance-optimized combination of AAPL, GOOGL, and MSFT **enhances stability without sacrificing return potential**.

3.6 Key Insights

1. **Microsoft leads individually** with the highest mean daily return, lowest volatility, and strongest Sharpe ratio.
2. **Diversification adds clear value**: the optimized portfolio delivers the best risk-adjusted return, validating modern portfolio theory.
3. **Resilience to macro shocks**: the diversified portfolio maintained upward momentum through market crises such as the COVID-19 pandemic and policy-driven volatility spikes.

Overall, the combination of descriptive statistics, dynamic volatility models, correlation models, Sharpe ratio calculations and portfolio optimization models results into a holistic, empirically based, assessment of risk and returns. The findings suggest that carefully constructed technology -stock portfolio may **outperform individual** holdings on a risk-adjusted basis, which supports the evidence-based investment strategies in dynamic financial markets.

4. Conclusion and Recommendations

This paper explores the risk-return features of the Apple Inc. (AAPL), Alphabet Inc. (GOOGL), and Microsoft Corporation (MSFT) between 1 January 2020 and 30 July 2025 by using various quantitative methods, such as descriptive statistics, rolling-volatility analysis, correlation measure, the evaluation of Sharpe ratio, and mean-variance portfolio optimization.

Key Findings

- All three stocks generated **positive average daily returns of around 0.1 %**, with MSFT exhibiting the **highest mean and lowest volatility**, confirming the most attractive individual risk–return profile.
- Correlations among the stocks (0.64–0.73) were **positive but moderate**, creating scope for **diversification** to reduce portfolio volatility.

- The **optimized portfolio achieved a Sharpe ratio of 0.0512**, slightly exceeding MSFT's 0.0507, demonstrating that a well-constructed three-stock portfolio **outperforms any single constituent on a risk-adjusted basis**.
- Cumulative return analysis showed that the diversified portfolio produced **smoother and more stable growth**, maintaining upward momentum through market shocks such as the COVID-19 crisis and subsequent monetary policy tightening.

Practical Implications

These results support the **application of Modern Portfolio Theory (MPT)** in technology equity investment. Investors seeking balanced exposure to the technology sector should consider a **quantitatively optimized allocation** across AAPL, GOOGL, and MSFT rather than relying on a single stock. Periodic rebalancing and ongoing risk monitoring are recommended to preserve optimal weights as market conditions evolve.

Limitations and Future Work

The study focuses on three U.S. technology stocks and daily return data, excluding macroeconomic variables, transaction costs, and alternative assets such as bonds or cryptocurrencies. Future research could extend the model to a broader set of securities, incorporate macroeconomic indicators or sentiment data, and explore **machine learning or AI-based forecasting** to enhance predictive power and portfolio adaptability.

This conclusion reinforces the central message that **data-driven diversification materially improves risk-adjusted performance**, offering actionable insights for both individual investors and professional portfolio managers.

5. References

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6. Appendices

A. Figures and Tables

- Figure 1. Stock Prices (Adjusted Close)
- Figure 2. Boxplot of Daily Returns
- Figure 3. Stock Volatility (30-Day Rolling)
- Figure 4. Correlation Heatmap of Daily Returns
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B. Key Python Code

The following Python code illustrates the core workflow for data retrieval, return and risk computation, and portfolio optimization. Full source code is available on request.

```
import yfinance as yf
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns


# 1. Fetch historical adjusted closing prices
def fetch_data(tickers, start, end):
```

```
    data = yf.download(tickers, start=start, end=end, auto_adjust=False)
    return data['Adj Close']

# 2. Calculate daily returns and 30-day rolling volatility
def calculate_daily_returns(price_data):
    return price_data.pct_change().dropna()

def calculate_volatility(daily_returns, window=30):
    return daily_returns.rolling(window).std()

# 3. Summary statistics and correlation
def summarize_statistics(daily_returns):
    summary = pd.DataFrame({
        "Mean": daily_returns.mean(),
        "Median": daily_returns.median(),
        "Std Dev": daily_returns.std()
    })
    return summary

def plot_correlation_heatmap(daily_returns):
    corr = daily_returns.corr()
    sns.heatmap(corr, annot=True, cmap="coolwarm", fmt=".2f")
    plt.title("Correlation Heatmap of Daily Returns")
    plt.show()

# 4. Portfolio performance and Sharpe ratio
def calculate_portfolio_performance(daily_returns, weights=None):
    if weights is None:
        weights = [1 / len(daily_returns.columns)] * len(daily_returns.columns)
    portfolio_returns = (daily_returns * weights).sum(axis=1)
```

```
    cumulative_portfolio = (1 + portfolio_returns).cumprod()
    cumulative_stocks = (1 + daily_returns).cumprod()
    return portfolio_returns, cumulative_portfolio, cumulative_stocks

def calculate_sharpe_ratio(returns, risk_free_rate=0.02 / 252):
    return (returns.mean() - risk_free_rate) / returns.std()



# Plot adjusted closing prices
def plot_prices(prices, title):
    prices.plot(figsize=(10, 6))
    plt.title(title)
    plt.xlabel("Date")
    plt.ylabel("Adjusted Closing Price")
    plt.legend(title="Ticker")
    plt.show()
```

This function provides a representative example of how time-series visualizations were produced. Other plotting functions (e.g., rolling volatility, boxplots, Sharpe ratio charts) follow a similar pattern and are omitted for brevity.

C. Execution Example

```
tickers = ["AAPL", "MSFT", "GOOGL"]
start = "2020-01-01"
end = "2025-07-30"

prices = fetch_data(tickers, start, end)
daily_returns = calculate_daily_returns(prices)
volatility = calculate_volatility(daily_returns)
summary = summarize_statistics(daily_returns)
```

```
portfolio_returns, cumulative_portfolio, cumulative_stocks =
calculate_portfolio_performance(daily_returns)

sharpe_ratios = calculate_sharpe_ratio(daily_returns)

portfolio_sharpe = calculate_sharpe_ratio(portfolio_returns)
```

D. Full Source Code

The complete Python source code is publicly available at:

GitHub: https://github.com/tommy26022004

This repository contains all scripts for data retrieval, computation of daily returns and volatility, risk-adjusted performance evaluation, and portfolio optimization.