Financial Analytics

Submitted By:

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Internship:

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Tools Used:

Python, Pandas, NumPy, Matplotlib, Seaborn, Tableau

1. Introduction

Financial markets are uncertain and volatile in nature. Investors require analytical tools to evaluate portfolio risk, optimize asset allocation, and test portfolio performance under adverse market conditions.

This project focuses on building a multi-stock portfolio consisting of **TCS, Reliance, HDFC, and SBI**, analyzing historical price behavior, measuring risk using statistical techniques, simulating future outcomes through Monte Carlo methods, and developing an interactive Tableau dashboard for market shock scenarios.

2. Objective of the Project

The main objectives of this project are:

- ✓ To calculate daily log returns of portfolio stocks.
- ✓ To analyze volatility using rolling standard deviation.
- ✓ To compute Value at Risk (VaR) at 95% confidence.
- ✓ To simulate future portfolio performance using Monte Carlo simulation.
- ✓ To construct the Efficient Frontier for portfolio optimization.
- ✓ To identify optimal portfolios based on maximum Sharpe ratio and minimum volatility.
- ✓ To build an interactive Tableau dashboard for stress testing using market shock scenarios.

3. Dataset Description

The dataset consists of historical daily adjusted closing prices of:

- ✓ TCS
- ✓ Reliance
- ✓ HDFC
- ✓ SBI

Time Period: 2015 – 2020
Source: NSE / Yahoo Finance

Each dataset contains:

Date

Adjusted Close Price

These datasets were merged to form a portfolio price table used for analysis.

4. Data Preprocessing

The following preprocessing steps were applied:

- ✓ Date column converted to datetime format.

- ✓ Missing values handled appropriately.
- ✓ Prices aligned by date.
- ✓ Log returns calculated using:

log_returns = log(price_t / price_t-1)

Rolling volatility was calculated using a 30-day moving window.

5. Monte Carlo Simulation

Monte Carlo simulation was performed to estimate possible future portfolio values.

Methodology:

- ✓ Mean returns and covariance matrix were computed.
- ✓ Random multivariate normal returns were generated.
- ✓ 5000 simulations were run for 252 trading days.
- ✓ Portfolio values were compounded over time.

Purpose:

This helps visualize the distribution of possible future outcomes and understand downside and upside risks.
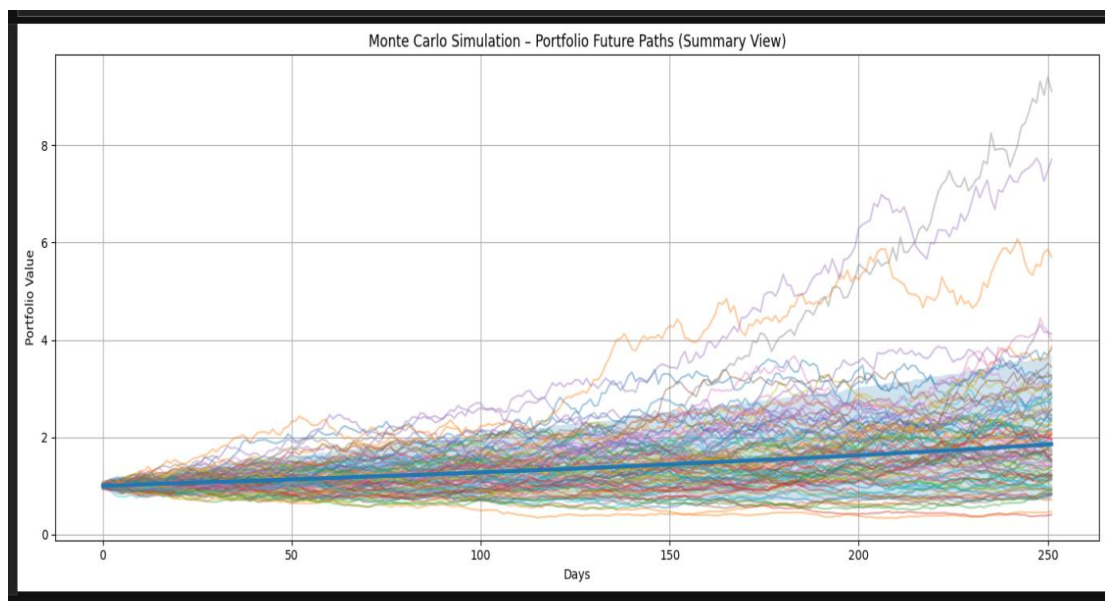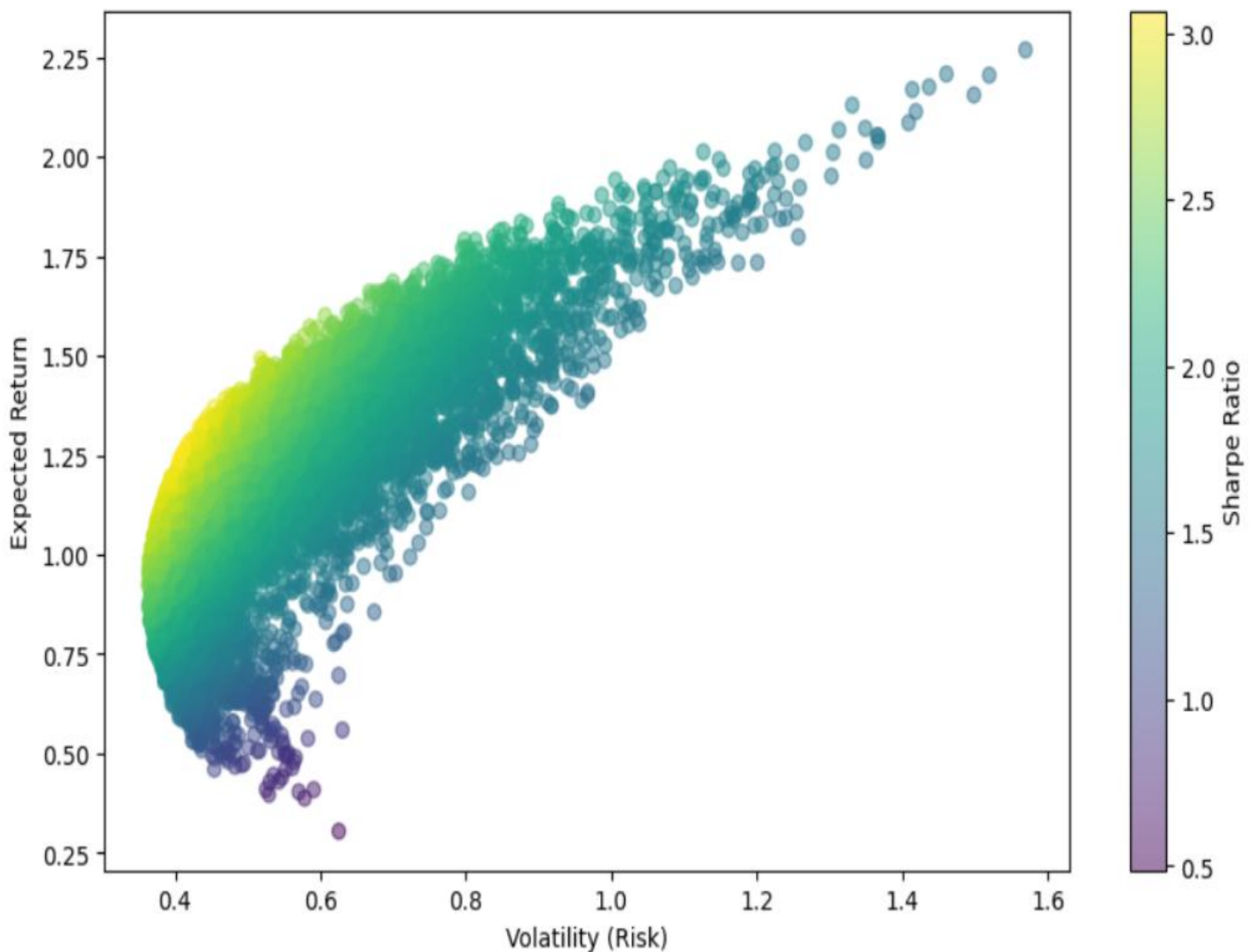
6. Efficient Frontier Analysis

Random portfolio weights were generated and for each portfolio:

- ✓ Expected annual return
- ✓ Volatility (risk)
- ✓ Sharpe ratio were computed.

The Efficient Frontier represents the best possible portfolios that maximize return for a given level of risk.

Efficient Frontier – Random Portfolio Simulation

7. Optimal Portfolio Summary

Two optimal portfolios were identified:

Maximum Sharpe Ratio Portfolio

Return ≈ 1.27

Volatility ≈ 0.41

Sharpe Ratio ≈ 3.06

This portfolio provides the highest risk-adjusted performance.

Minimum Volatility Portfolio

◆ Return ≈ 0.92
◆ Volatility ≈ 0.36
◆ Sharpe Ratio ≈ 2.54

This portfolio is suitable for conservative investors who prefer lower risk.

	Metric	Max Sharpe	Min Volatility
0	Return	1.277269	0.922926
1	Volatility	0.416534	0.362868
2	Sharpe	3.066421	2.543422

8. Value at Risk (VaR – 95%)

Value at Risk was calculated at the 95% confidence level for each stock.

Example:

$TCS \approx -3.9\%$

$Reliance \approx -4.2\%$

$HDFC \approx -2.0\%$

$SBI \approx -6.5\%$

Interpretation:

There is a 95% probability that the daily loss will not exceed these values under normal market conditions.

```
VaR_95 = log_returns.quantile(0.05)

VaR_95
```

```
TCS          -0.039356
Reliance     -0.042212
HDFC         -0.201192
SBI          -0.065635
Name: 0.05, dtype: float64
```

9. Tableau Stress Testing Dashboard

An interactive Tableau dashboard was developed to analyze portfolio behavior under various market shock scenarios.

Dashboard Features:

Portfolio price trends.

30-day rolling volatility.

Market shock percentage slider.

Dynamic adjustment of prices based on shock.

Comparative visualization of all stocks.

Users can move the slider to simulate market crashes or bullish rallies and instantly observe the impact.
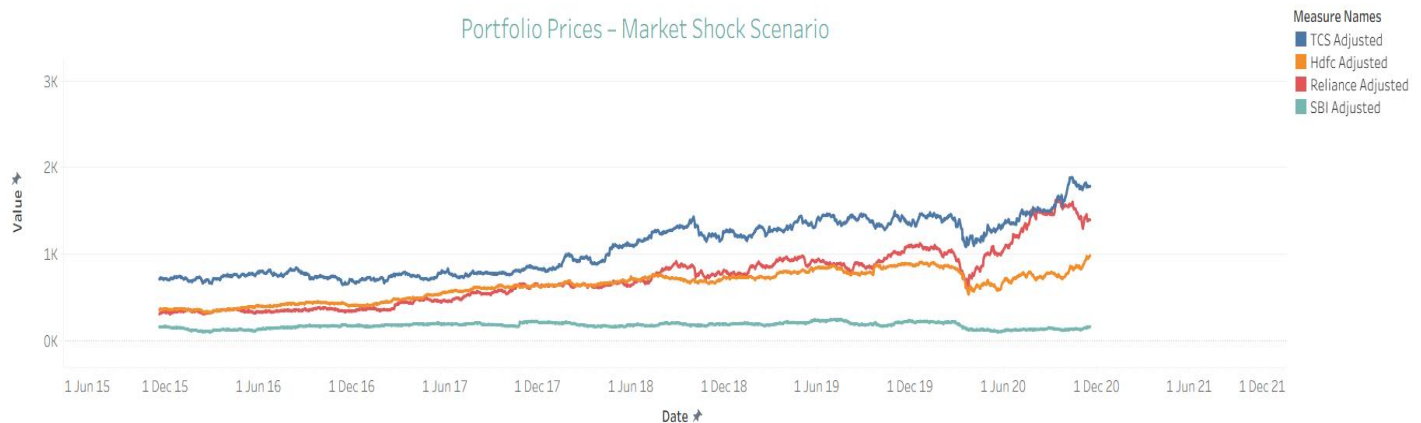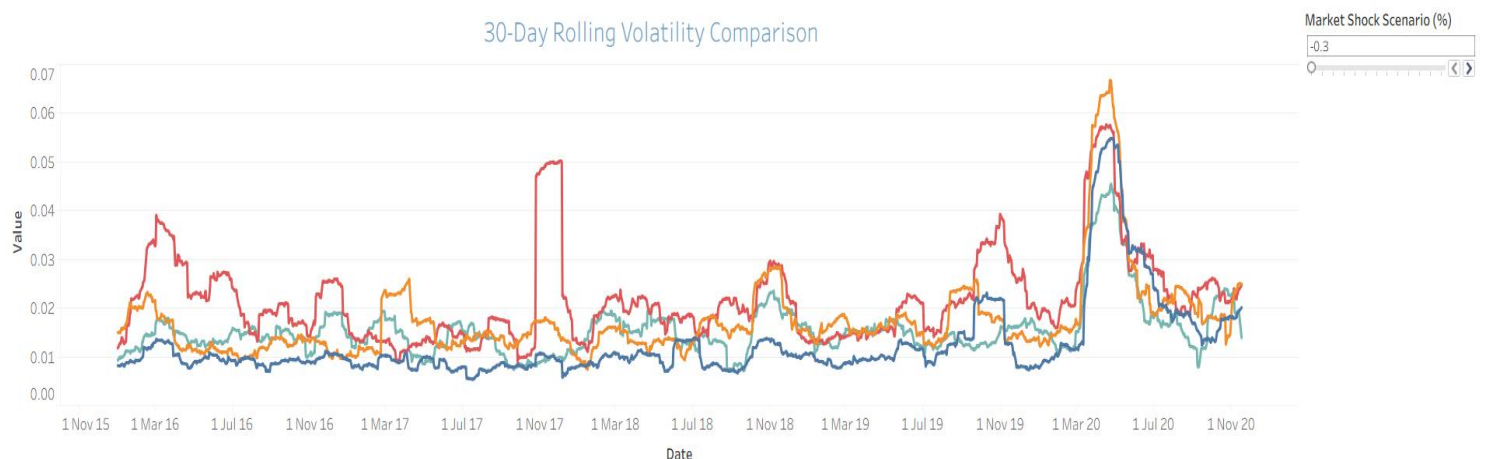
Portfolio Stress Testing Dashboard – Market Shock Simulation

Use the Market Shock slider to simulate positive or negative market scenarios and observe portfolio price movements and volatility changes in real time.

Portfolio Prices – Market Shock Scenario

Measure Names
- TCS Adjusted
- Hdfc Adjusted
- Reliance Adjusted
- SBI Adjusted

30-Day Rolling Volatility Comparison

Market Shock Scenario (%)
-0.3

10. Conclusion

This project successfully demonstrates the application of quantitative finance techniques for portfolio optimization and risk analysis.

Monte Carlo simulations and Efficient Frontier analysis provide insight into possible future outcomes and optimal asset allocations, while the Tableau dashboard enables real-time stress testing under different market scenarios.

Such tools are extremely valuable for investment firms, analysts, and risk management teams