

Project: Sharpe Ratio Optimization

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Objective

Identify portfolio weights for a multi-asset portfolio that maximize the Sharpe ratio. We evaluate thousands of random weight combinations on synthetic daily returns and select the allocation with the highest annualized Sharpe.

Methodology

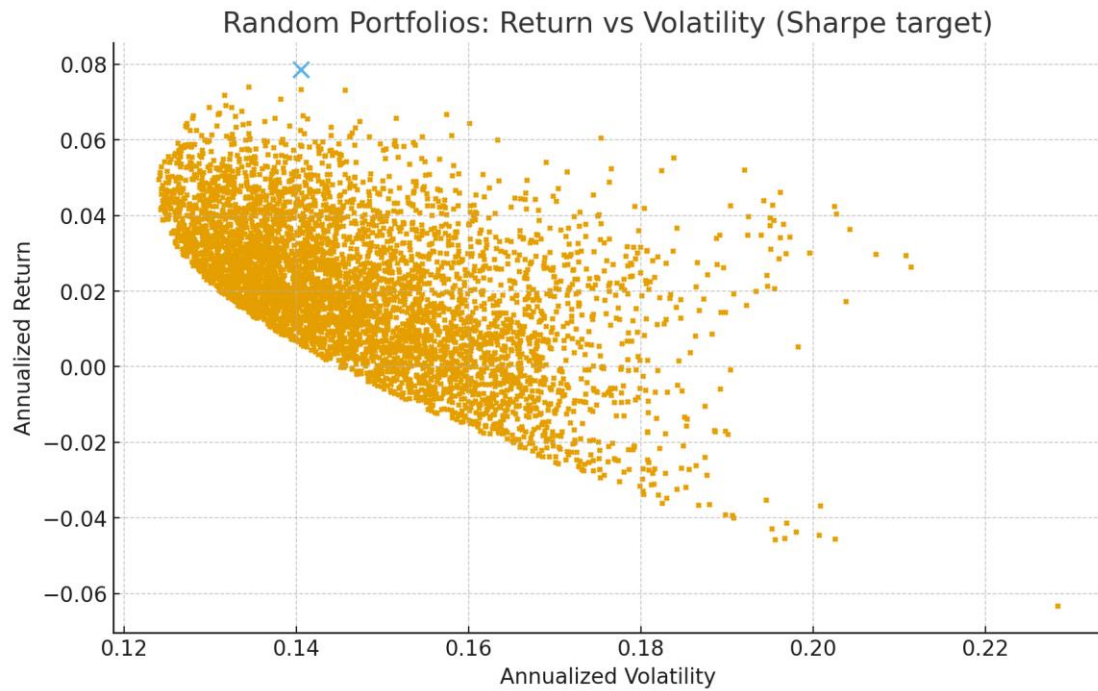
- Universe: 4 synthetic assets with realistic mean and covariance.
- Data: 1,000 trading days of simulated multivariate returns; prices built by compounding.
- Portfolios: 5,000 random weight vectors (long-only, fully invested).
- Metrics: Annualized return, volatility, and Sharpe with $r_f=0$.
- Selection: Portfolio with maximum Sharpe.

Results

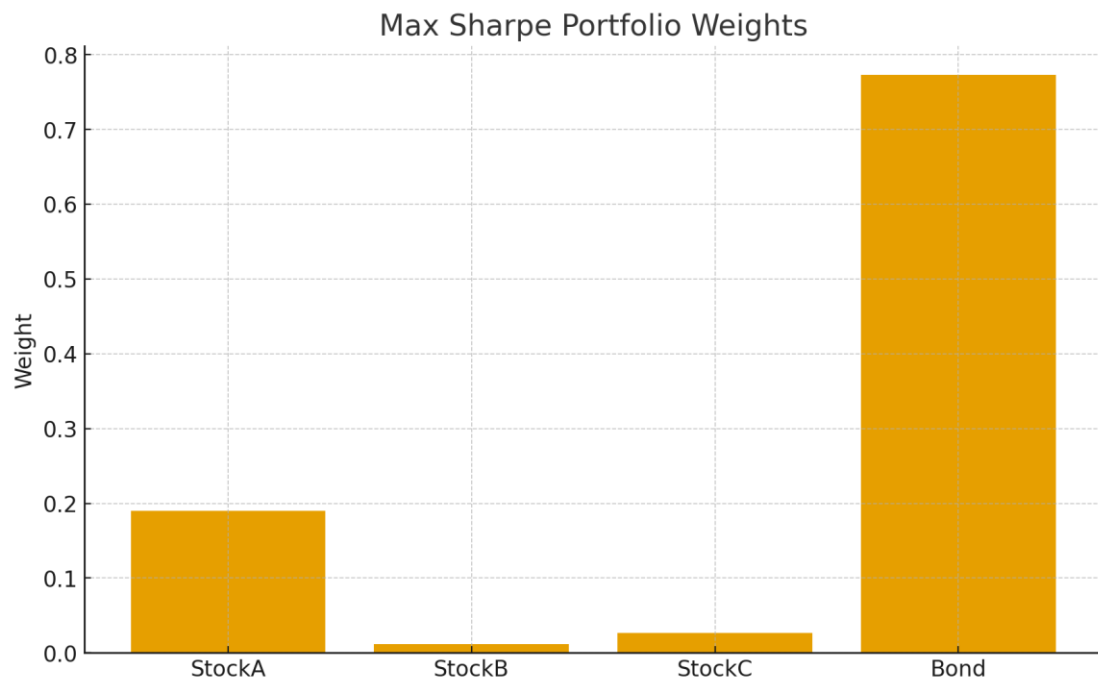
Max Sharpe portfolio metrics (synthetic):

- Sharpe = 0.560
- Annual return = 7.861%
- Annual volatility = 14.049%
- Weights = {'StockA': 0.18954271410795087, 'StockB': 0.011354690009082215, 'StockC': 0.026312378442963812, 'Bond': 0.7727902174400031}

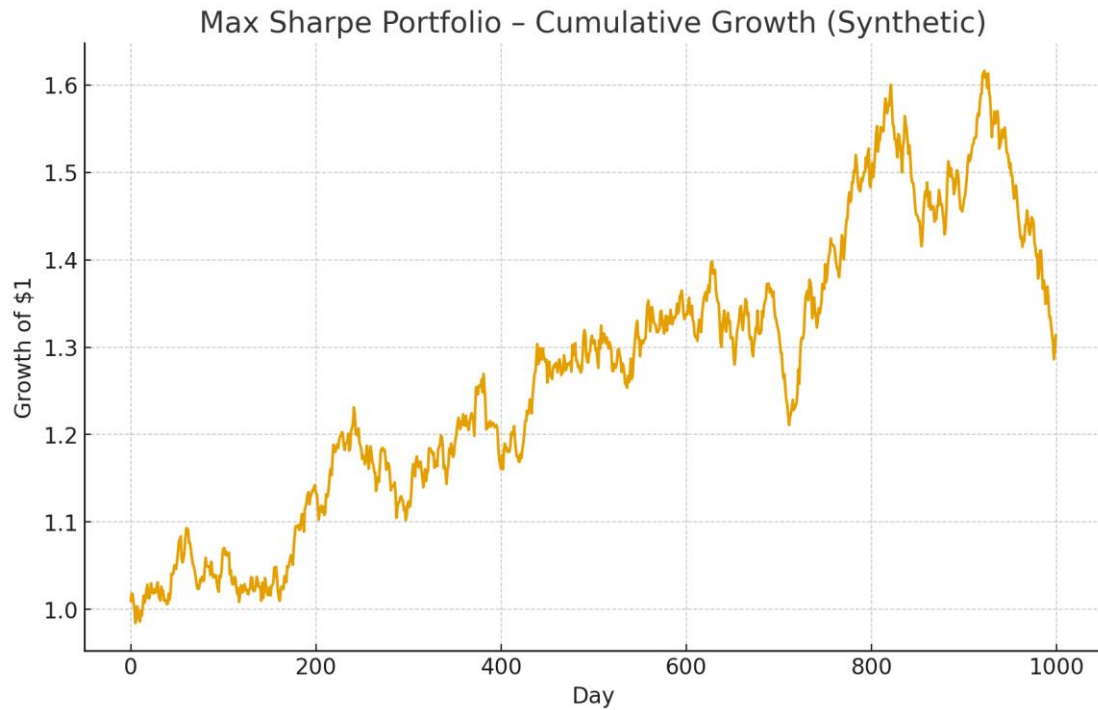
Return vs Volatility (all simulated portfolios) and the selected max-Sharpe point:



Allocation of the max-Sharpe portfolio:



Cumulative growth of \$1 for the max-Sharpe portfolio:



Discussion & Next Steps

The max-Sharpe portfolio allocates more weight to assets with strong risk-adjusted returns and low covariance. Extensions: add constraints (e.g., weight caps), incorporate transaction costs, and compare with mean-variance optimization.