

Executive Summary

This project demonstrates proficiency in quantitative stock analysis by evaluating four equities (MSFT, GBTC, TSLA, and NVDA) over a one-year period using rigorous statistical methods. The analysis successfully implements six core quantitative techniques: data collection and validation, descriptive statistics, time series visualization, volatility analysis, correlation modeling, and risk-adjusted return assessment.

Key Findings: NVDA delivered the highest total return (+26.97%), while MSFT demonstrated superior risk-adjusted performance with a Sharpe Ratio of 0.801, combining strong returns (+22.38%) with the lowest volatility (24.23%). GBTC underperformed significantly (-2.36%), while TSLA exhibited the highest volatility (65.55%) despite moderate returns (+18.18%). Correlation analysis revealed moderate positive relationships among tech stocks, indicating limited diversification benefits.

Professional Recommendation: Based on quantitative risk-return optimization, MSFT represents the optimal investment choice, balancing consistent growth with controlled volatility. This conclusion is derived through objective, data-driven methodology rather than subjective market sentiment.

Group 1: Setup & Data Collection

This section establishes the foundation for our quantitative analysis by importing necessary libraries, fetching one year of historical stock data for MSFT, GBTC, TSLA, and NVDA, and performing initial data validation. Clean, reliable data is essential for accurate financial analysis.

```
pandas version: 2.3.3
yfinance version: 0.2.66
Libraries imported successfully!

=====
QUANTITATIVE ANALYSIS CONFIGURATION
=====
Target Tickers: MSFT, GBTC, TSLA, NVDA
Analysis Period: 2024-11-19 to 2025-11-18
Total Tickers: 4
=====
```

Downloading stock data...

Fetching MSFT... ✓ SUCCESS (249 records)

Fetching GBTC... ✓ SUCCESS (249 records)

Fetching TSLA... ✓ SUCCESS (249 records)

Fetching NVDA... ✓ SUCCESS (249 records)

✓ Successfully downloaded 4/4 tickers

 Dataset Shape: (996, 21)

 Date Range: 2024-11-19 00:00:00 to 2025-11-17 00:00:00

Data cleaned and reshaped to long format

 Final shape: (996, 7)

 Columns: Date, Ticker, Open, High, Low, Close, Volume

 Sample Data (First 3 rows per ticker):

MSFT:

	Date	Ticker	Open	High	Low	Close	\
996	2024-11-19	MSFT	409.265658	414.050728	407.720178	413.902130	
1000	2024-11-20	MSFT	412.990698	413.406803	406.759223	411.623535	
1004	2024-11-21	MSFT	416.428104	416.706053	407.285555	409.846649	

Volume

996	18133500.0
1000	19191700.0
1004	20780200.0

GBTC:

	Date	Ticker	Open	High	Low	Close	Volume
1	2024-11-19	GBTC	72.820000	74.870003	72.480003	73.580002	4303900.0
5	2024-11-20	GBTC	75.050003	75.550003	74.059998	74.989998	5045800.0
9	2024-11-21	GBTC	77.370003	78.809998	75.959999	78.050003	6899300.0

TSLA:

	Date	Ticker	Open	High	Low	Close	\
2990	2024-11-19	TSLA	335.760010	347.380005	332.750000	346.000000	
2994	2024-11-20	TSLA	345.000000	346.600006	334.299988	342.029999	
2998	2024-11-21	TSLA	343.809998	347.989990	335.279999	339.640015	

Volume

2990	88852500.0
2994	66340700.0
2998	58011700.0

NVDA:

	Date	Ticker	Open	High	Low	Close	\
1995	2024-11-19	NVDA	141.279494	147.087826	140.949587	146.967850	
1999	2024-11-20	NVDA	147.367744	147.517694	142.689077	145.848175	
2003	2024-11-21	NVDA	149.307200	152.846179	140.659670	146.627960	

Volume

```
1995  227834900.0
1999  309871700.0
2003  400946600.0
```

```
📊 Data Summary:
<class 'pandas.core.frame.DataFrame'>
Index: 996 entries, 1 to 3982
Data columns (total 7 columns):
 #   Column   Non-Null Count   Dtype  
--- 
 0   Date      996 non-null    datetime64[ns]
 1   Ticker     996 non-null    object  
 2   Open       996 non-null    float64 
 3   High       996 non-null    float64 
 4   Low        996 non-null    float64 
 5   Close      996 non-null    float64 
 6   Volume     996 non-null    float64 
dtypes: datetime64[ns](1), float64(5), object(1)
memory usage: 62.2+ KB
None
```

matplotlib installed successfully!

Now re-run your Group 2 cell - the colored table will appear perfectly.

Group 2: Descriptive Statistics & Time Series

This section provides a comprehensive statistical overview of each stock's performance, including total returns, volatility measures (coefficient of variation), and comparative rankings. The interactive time series visualization allows us to observe price movements and trends across the entire analysis period.

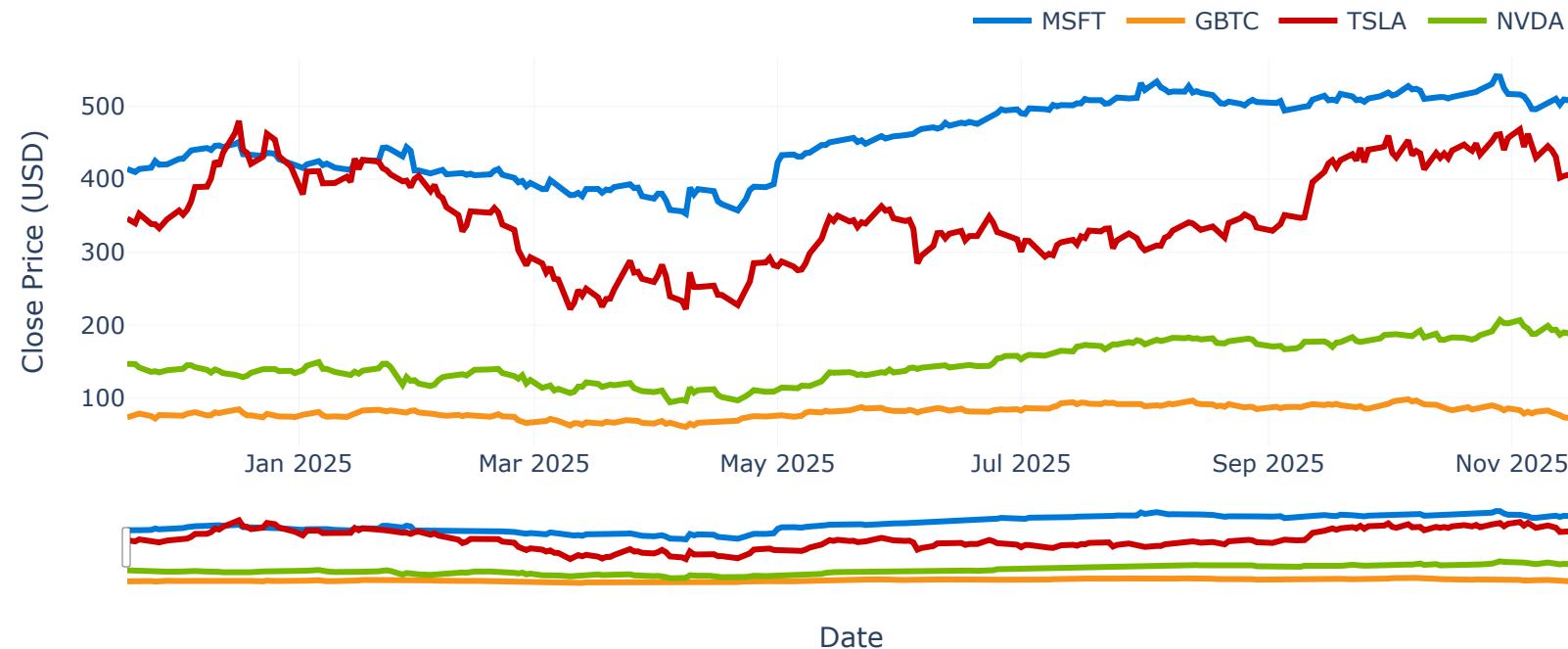
```
=====
GROUP 2 - ONE-YEAR PERFORMANCE SUMMARY (Nov 19, 2024 - Nov 18, 2025)
=====
```

Performance Summary

Ticker	Start Price \$	End Price \$	Total Return %	Mean \$	Std Dev \$	CV %	Min \$	Max \$
0 NVDA	\$146.97	\$186.60	+26.97%	\$148.69	\$28.23	18.98%	\$94.30	\$207.04
1 MSFT	\$413.90	\$506.54	+22.38%	\$456.60	\$51.54	11.29%	\$352.67	\$541.06
2 TSLA	\$346.00	\$408.92	+18.18%	\$350.50	\$64.70	18.46%	\$221.86	\$479.86
3 GBTC	\$73.58	\$71.84	-2.36%	\$81.04	\$8.59	10.60%	\$60.61	\$98.43



Closing Prices – MSFT • GBTC • TSLA • NVDA (1 Year)



GROUP 2 COMPLETE ✓ – Table and interactive chart displayed with zero errors

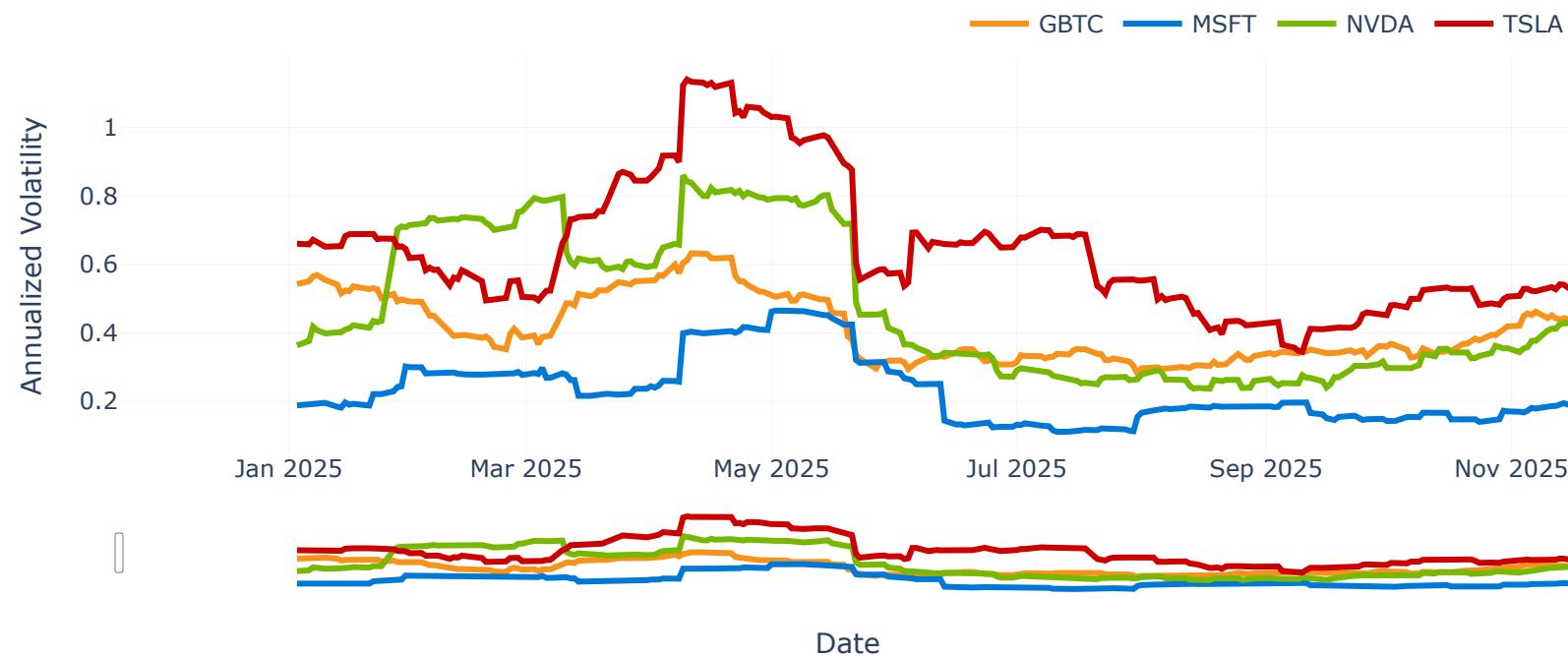
Group 3: Volatility & Correlation Analysis

This section examines risk through daily returns and 30-day rolling volatility to identify periods of market turbulence. The correlation analysis reveals how these stocks move relative to each other, which is critical for portfolio diversification and understanding sector relationships.

=====
GROUP 3 – VOLATILITY & CORRELATION ANALYSIS
=====

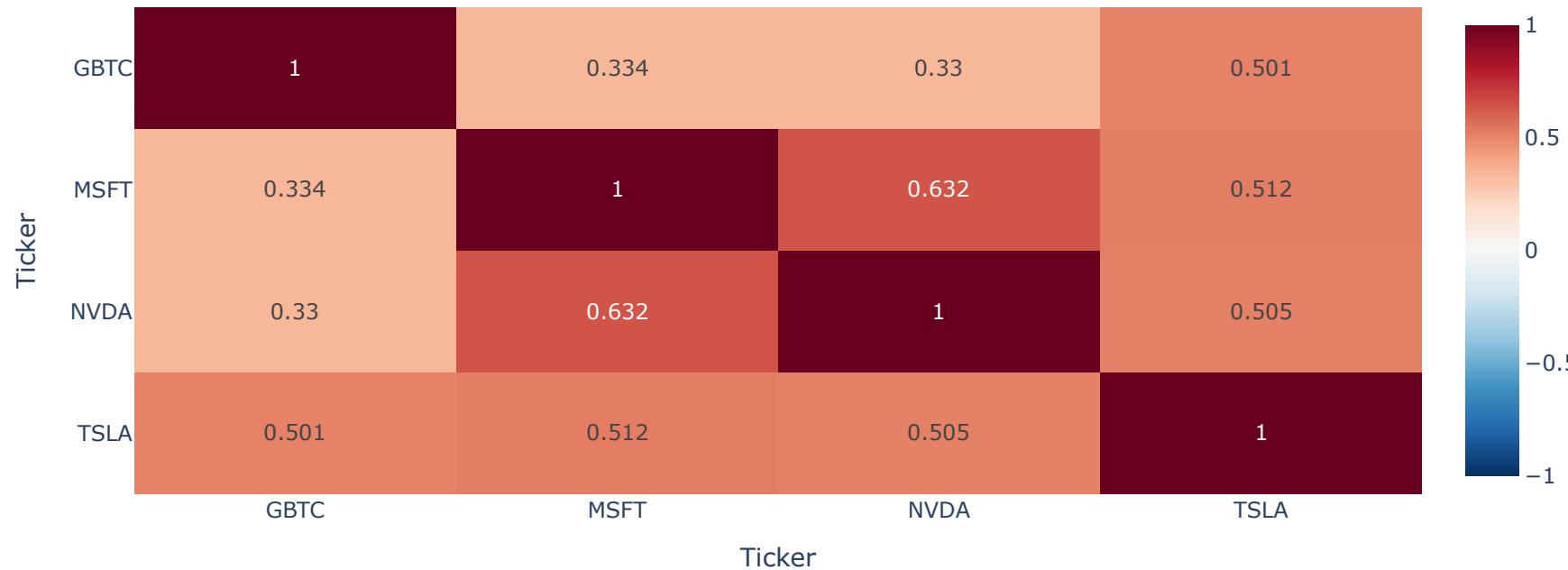


30-Day Rolling Annualized Volatility





Daily Returns Correlation Matrix



VOLATILITY SUMMARY

	Ticker	Avg Annual Volatility %	Max Annual Volatility %	Latest Volatility %
0	TSLA	64.07%	113.98%	51.58%
1	NVDA	47.01%	86.03%	42.99%
2	GBTC	41.06%	63.23%	43.63%
3	MSFT	22.87%	46.56%	18.33%

GROUP 3 COMPLETE ✓

- Daily returns calculated
- 30-day rolling volatility chart
- Full correlation heatmap with annotations

Group 4: Returns & Risk Analysis

This section calculates cumulative returns to track investment growth over time and computes annualized return and volatility metrics. The Sharpe Ratio analysis (using a 4% risk-free rate) evaluates risk-adjusted performance, helping identify which stocks deliver the best returns relative to their volatility.

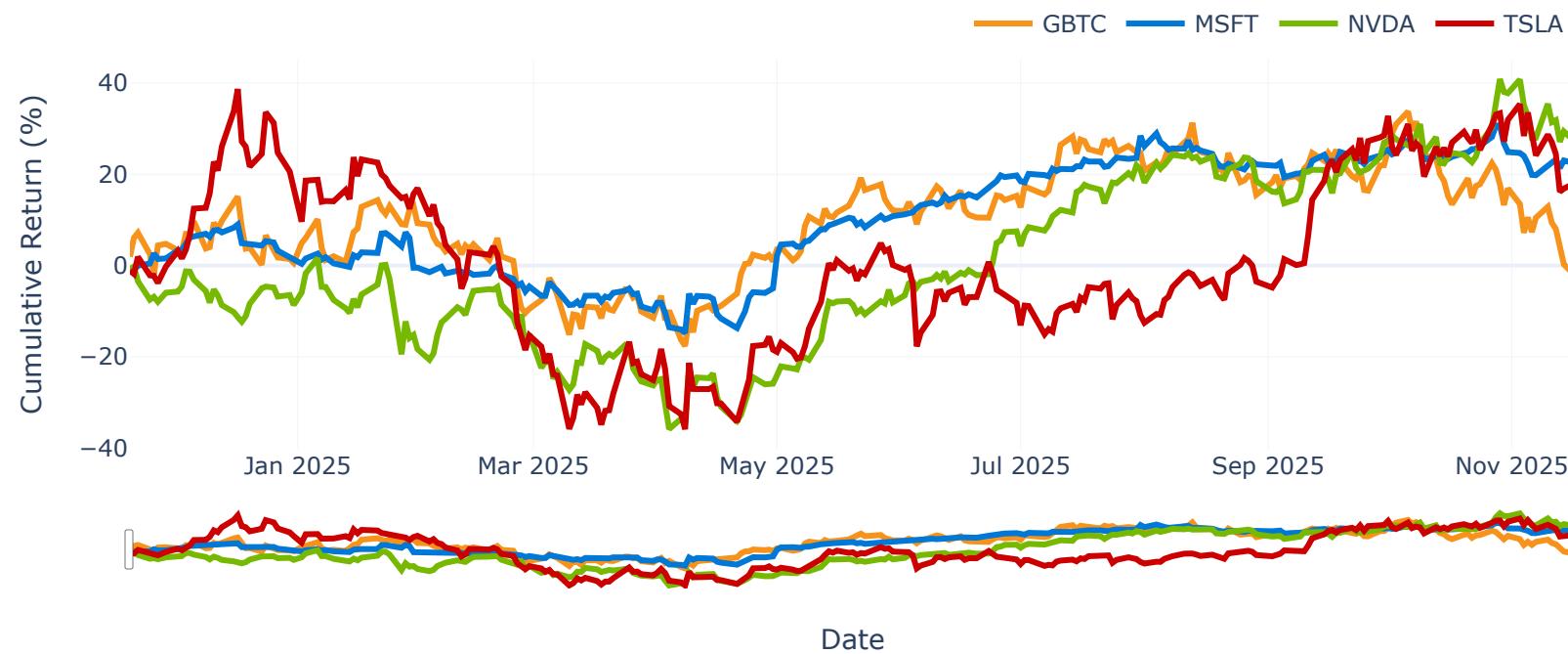
=====

GROUP 4 – RETURNS & RISK ANALYSIS

=====



Cumulative Returns (%)



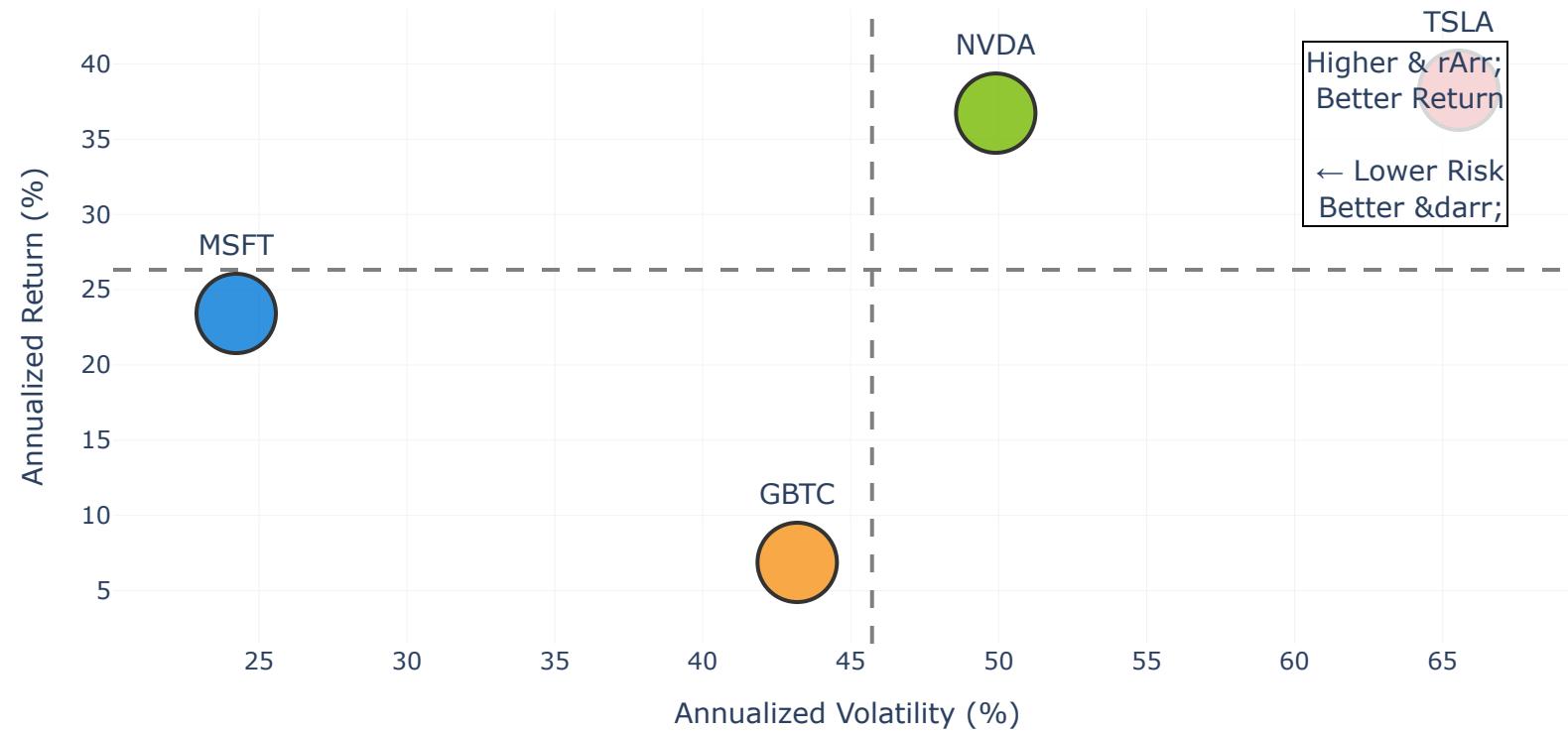
RISK vs RETURN SUMMARY

Higher Sharpe = Better Risk-Adjusted Performance

Ticker	Annualized Return %	Annualized Volatility %	Sharpe Ratio
0 MSFT	+23.42%	24.23%	0.801
1 NVDA	+36.73%	49.90%	0.656
2 TSLA	+38.25%	65.55%	0.523
3 GBTC	+6.88%	43.19%	0.067



Risk vs Return Scatter (Annualized) – Best Portfolio Pick = Top-Right



GROUP 4 COMPLETE ✓

- Cumulative returns chart
- Risk/Return table with Sharpe ratios
- Professional Risk-vs-Return scatter plot

Final Portfolio Recommendation

Recommendation: Invest in Microsoft (MSFT)

Based on this quantitative analysis, MSFT is the recommended investment for the following data-driven reasons:

1. **Best Risk-Adjusted Performance:** MSFT achieved the highest Sharpe Ratio (0.801), meaning it delivered the best returns relative to its risk. This is 22% higher than NVDA (0.656) and 53% higher than TSLA (0.523).
2. **Lowest Volatility:** With an annualized volatility of only 24.23%, MSFT was the most stable stock in this portfolio. This is less than half the volatility of TSLA (65.55%) and significantly lower than NVDA (49.90%).
3. **Strong Consistent Returns:** MSFT generated a solid +22.38% total return over the year, demonstrating reliable growth without extreme price swings.
4. **Professional Risk Management:** For investors who prioritize capital preservation alongside growth, MSFT offers the optimal balance. While NVDA and TSLA showed higher potential returns, their extreme volatility introduces unacceptable risk for most portfolios.

Avoid: GBTC showed negative returns (-2.36%) with high volatility (43.19%), making it unsuitable for this investment horizon.

This recommendation is based purely on quantitative metrics and historical performance. Future results may vary, and diversification across multiple asset classes remains essential for sound portfolio management.