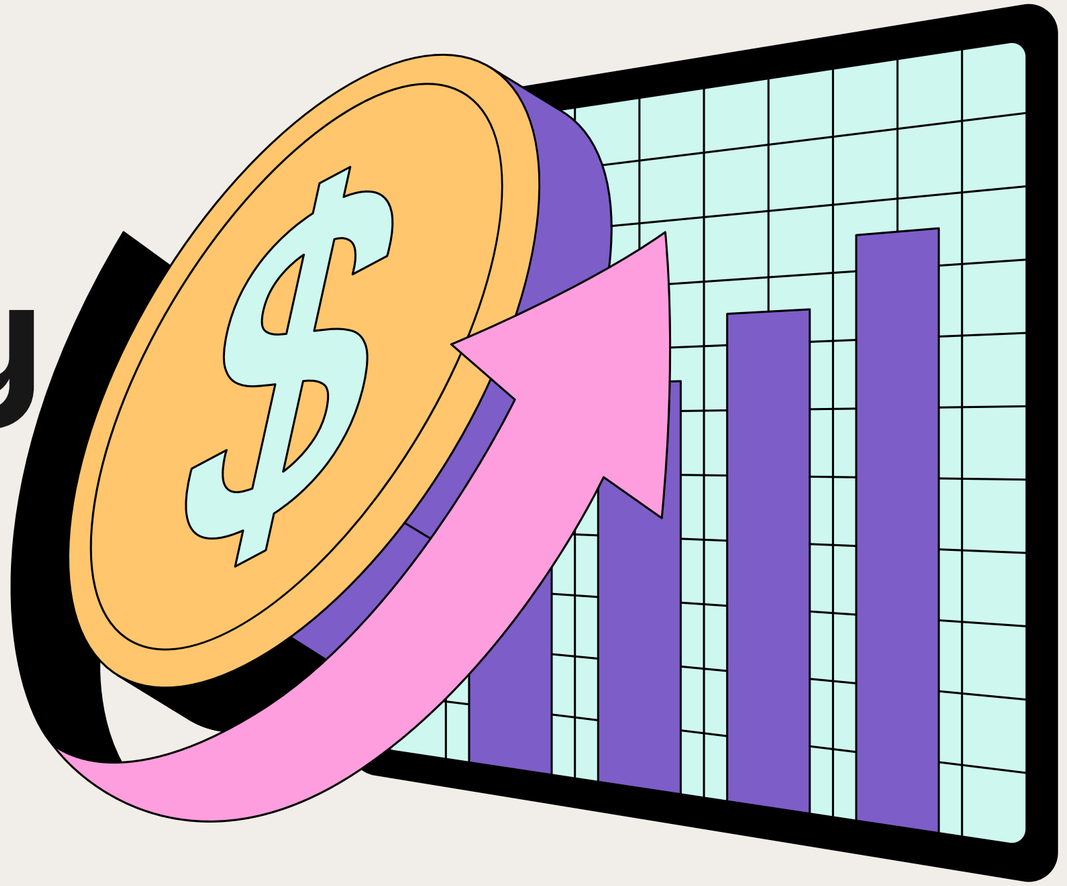
PROJECT 2

Quantitative Trading Strategy Construction and Evaluation



Presented by Well Done Group

Content

- **Strategy Design & Implementation**

- Explain the volatility signal used
- Describe long-short portfolio construction method
- Clarify null and alternative hypotheses
- Walk through the code implementation process

- **Market Selection & Result Interpretation**

- Introduce the selected stock exchange
- Explain investment universe
- Interpret average return, t-statistic and their meaning
- Discuss reliability of results

- **Alternative Strategy & Outlier Analysis**

- Propose another investment strategy
- Justify alternative approach
- Explain outlier detection method
- Analyze impact of outliers on return and volatility

Strategy Design & Implementation

- **Characteristic Used**: Monthly total volatility (from daily returns)
- **Motivation**: Low-volatility stocks are expected to yield better risk-adjusted returns

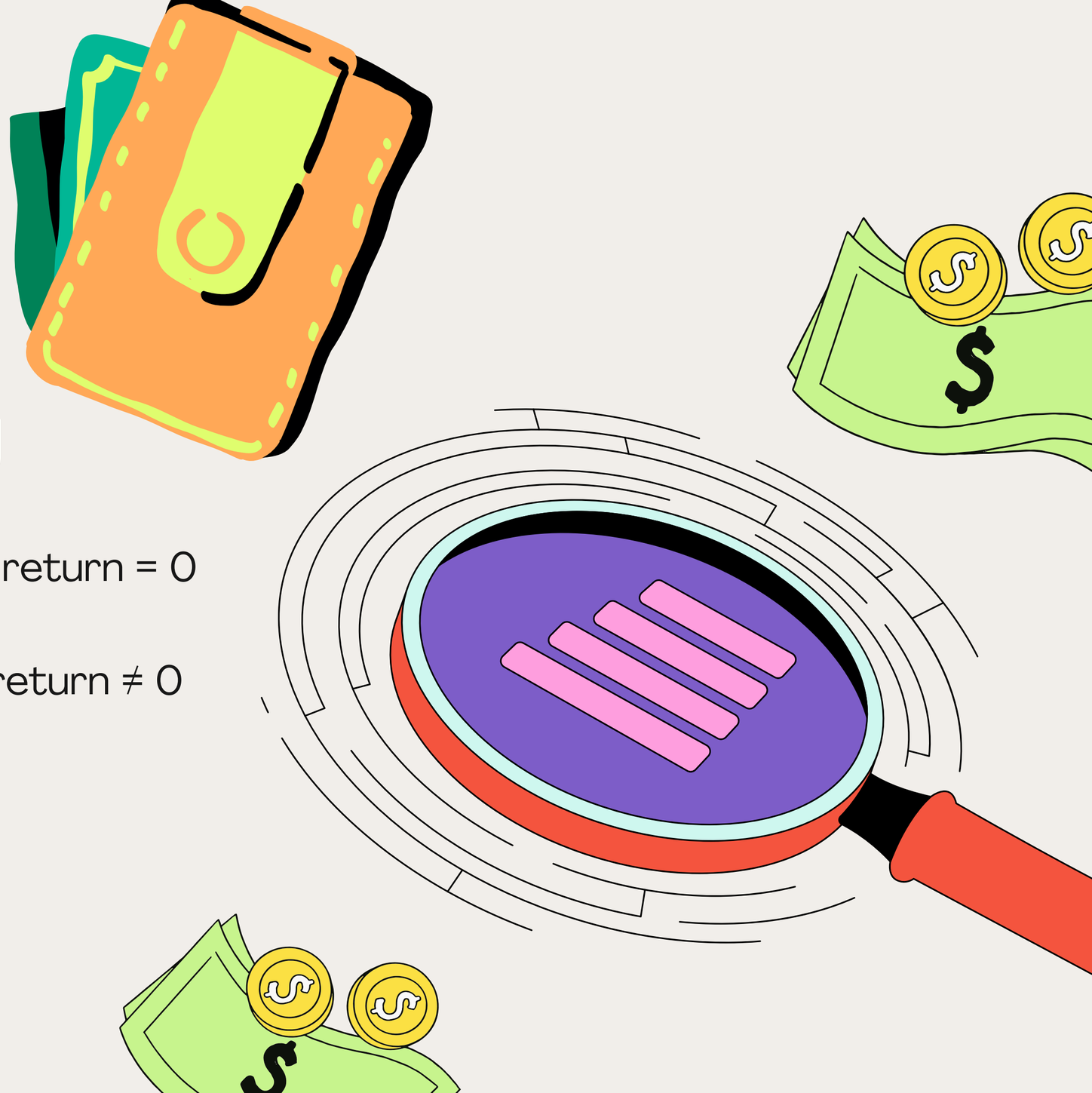
Strategy Overview

Portfolio Construction

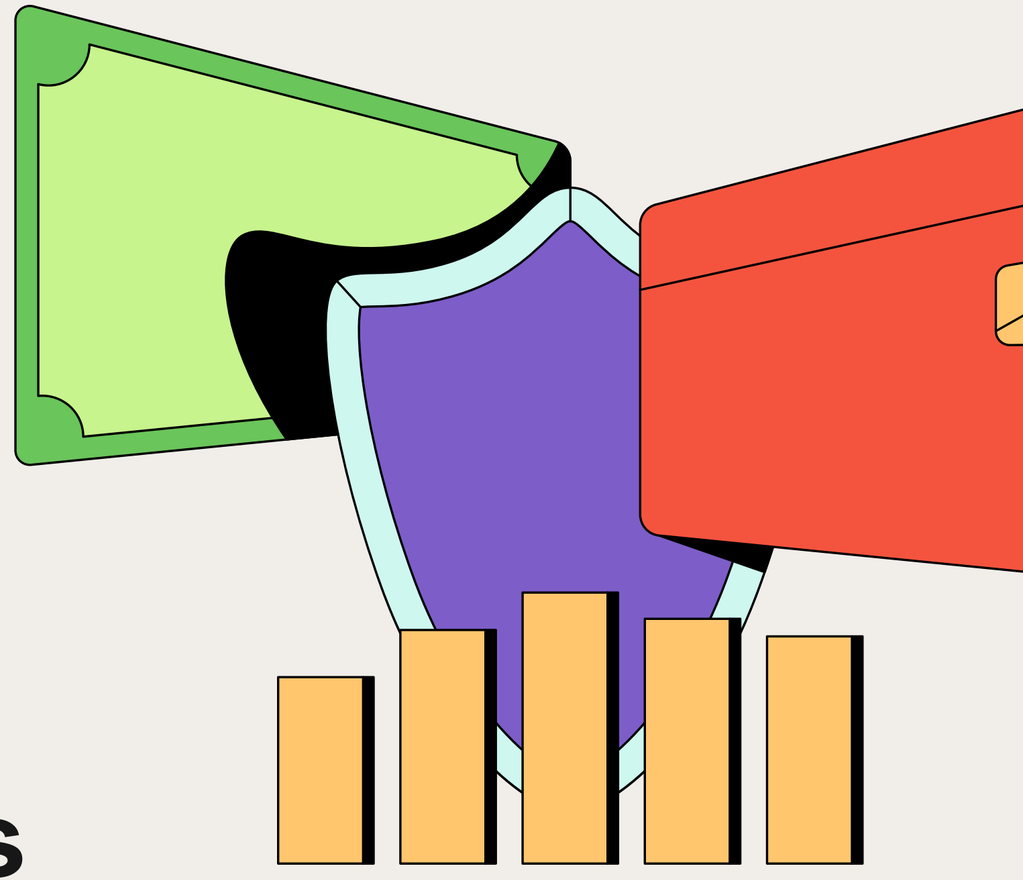
- **Quantile sorting:** Based on total volatility
- **Long:** Lowest-volatility quantile
- **Short:** Highest-volatility quantile
- **Weighting:** Equal within each quantile
- **Frequency:** Monthly rebalancing

Hypothesis Testing

- **H_0** (**Null**): Long-short portfolio average return = 0
- **H_1** (**Alt**): Long-short portfolio average return ≠ 0



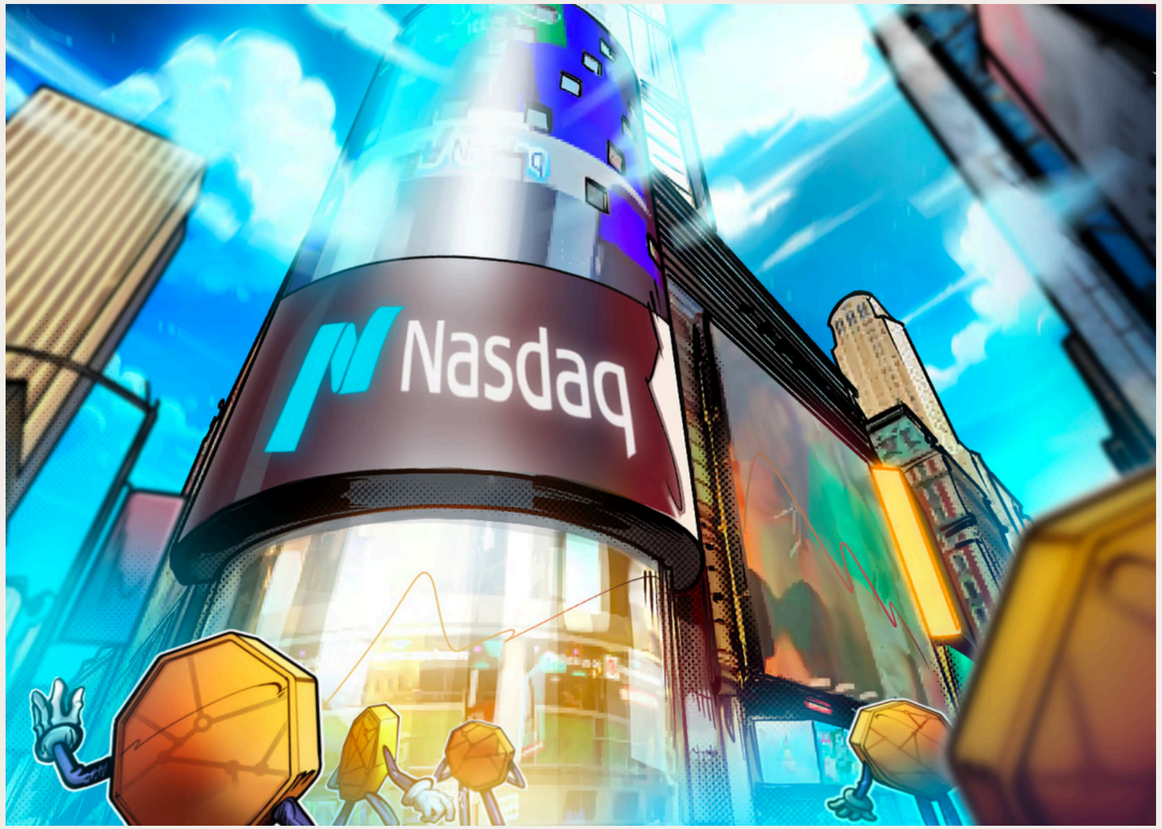
- **portfolio_main**() serves as the top-level controller orchestrates the pipeline
- **vol_cal**() computes the total volatility for each stock in each **monthmerge_tables**() combines the monthly return data with thecalculated volatility values
- **stock_sorting**() sorts stocks into quantiles
- **pf_cal**() calculates the monthly returns of the long-short strategyResults are stored in the dataframe EW _LS _pf_df for later evaluation



Code Implementation Process

Investment Universe & Market Justification

Description of the Selected Exchange and Its Features



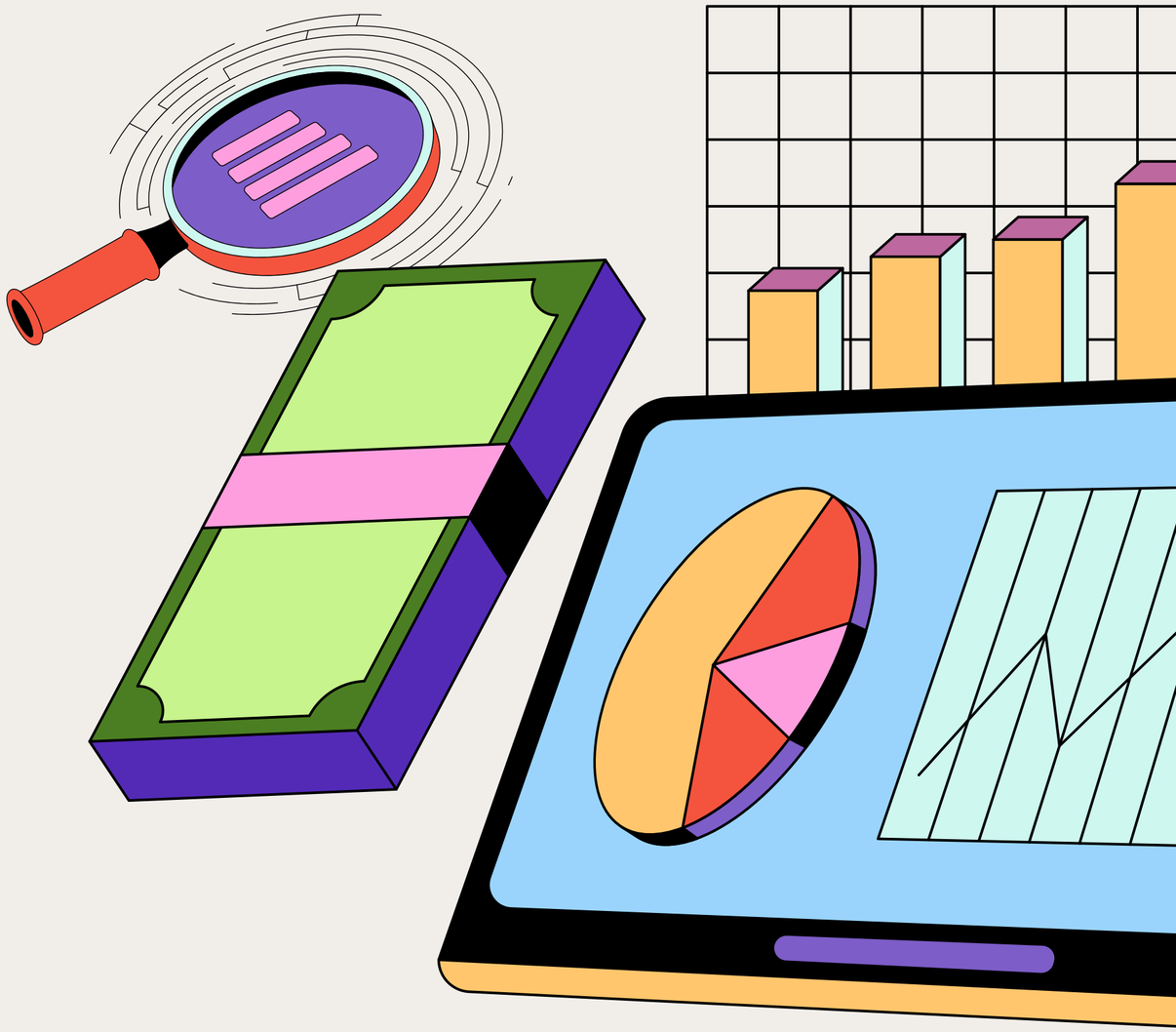
- The NASDAQ exchange was founded in 1971 by and it is the world's largest stock market by volume and one of the most influential exchanges.

- The exchange is **unique** because it's an electronic exchange

More than 3,300 companies are listed on the NASDAQ with a daily volume of **more than $1.8 billion.**

Justification for Market Selection

- Nasdaq's focus on technology companies, especially companies in software, cloud computing, e-commerce, and artificial intelligence, fields that will be the world's future.
- With a fully electronic trading system, traders and investors can optimise their investments and profits.
- Popular for unicorn startups looking to go public with its flexibility in listing requirements.



Overview of tickers and characteristics

- **Apple** has been a leader in technology products.
- **Microsoft** is still at the forefront of technology software, cloud computing and, recently, quantum chips.
- **Amazon**, which started as an online bookstore, has become a global e-commerce giant.

Overview of tickers and characteristics

- **NVIDIA** Corporation (NVDA) is a big name in gaming and artificial intelligence.
- **Meta** Platforms, Inc. (META), better known as Facebook, continues to push its social media and virtual reality products, the metaverse.
- **Tesla**, Inc. (TSLA) has become a household name in electric vehicles and sustainable energy

Evaluation and Interpretation of Strategy Results

```
Sanity checks for inputs of characteristics script passed.
df_cha table is in monthly frequency
df_cha includes stocks' monthly returns and respective characteristics
Sanity checks for inputs of long short portfolio construction passed
df_reshape function done
stock_sorting function done
pf_cal function done
portfolio script done
Portfolio Construction All Done!
    ls_bar    ls_t  n_obs
ls  0.0166  3.9643    246
```

Average Monthly Return (ls_bar): 0.0166
T-Statistic (ls_t): 3.9643
Number of Observations (n_obs): 246

The approach has practical significance for portfolio management and can produce economically significant returns.

The computed **t-statistic of 3.9643** exceeds the conventional threshold of 1.96, indicating that the result is statistically significant at the 5% level. This allows us to confidently reject the null hypothesis that the average return of the long-short portfolio is zero.

Alternative Strategy & Outlier Management

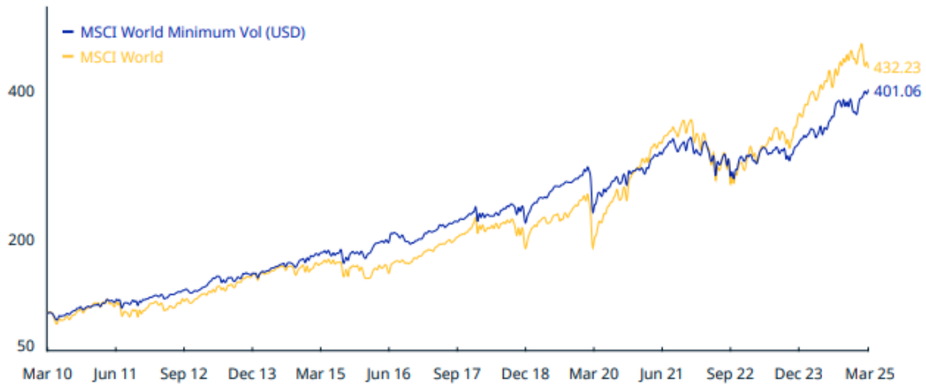
Exploring an Alternative Strategy: Low Volatility Investing

- **Opposes CAPM:** Low volatility stocks can outperform high volatility ones
- Backed by behavioural finance and empirical research
- **Key Drivers:**
  - Institutional constraints (benchmark chasing)
  - Lottery preferences among retail investors
  - Attention bias inflating high-volatility stocks

- **Implementation Steps:**
  - **Define universe** (e.g., S&P 500)
  - **Calculate historical volatility** (standard deviation of daily returns)
  - **Select the bottom 20-30%** of the lowest volatility stocks
  - **Assign weights** (equal or inverse volatility)
  - **Rebalance** monthly or quarterly
- **Real-world examples:** MSCI Min Vol Index, ETF strategies
- **Real-world evidence:** Higher Sharpe Ratio, Lower Drawdown (2010–2025)

For a complete description of the index methodology, please see Index methodology - MSCI.

CUMULATIVE INDEX PERFORMANCE — GROSS RETURNS (USD)
(MAR 2010 – MAR 2025)



ANNUAL PERFORMANCE (%)

Year	MSCI World Minimum Vol (USD)	MSCI World
2024	11.53	19.19
2023	8.14	24.42
2022	-9.28	-17.73
2021	14.84	22.35
2020	3.26	16.50
2019	23.97	28.40
2018	-1.42	-8.20
2017	18.04	23.07
2016	8.18	8.15
2015	5.82	-0.32
2014	12.06	5.50
2013	19.41	27.37
2012	8.87	16.54
2011	8.04	-5.02

INDEX PERFORMANCE — GROSS RETURNS (%) (MAR 31, 2025)

	1 Mo	3 Mo	1 Yr	YTD	ANNUALIZED 3 Yr	5 Yr	10 Yr	Since May 31, 1988
MSCI World Minimum Vol (USD)	0.78	8.05	13.89	8.05	6.74	10.63	8.33	8.65
MSCI World	-4.40	-1.68	7.50	-1.68	8.10	16.67	10.07	8.24

FUNDAMENTALS (MAR 31, 2025)

	Div Yld (%)	P/E	P/E Fwd	P/BV
MSCI World Minimum Vol (USD)	2.17	19.98	17.74	3.08
MSCI World	1.83	21.47	18.15	3.38

INDEX RISK AND RETURN CHARACTERISTICS (MAY 31, 1988 – MAR 31, 2025)

	Beta	Tracking Error (%)	Turnover (%) [1]	ANNUALIZED STD DEV (%) [2] 3 Yr	5 Yr	10 Yr	SHARPE RATIO [2,3] 3 Yr	5 Yr	10 Yr	Since May 31, 1988	MAXIMUM DRAWDOWN (%)	Period YYYY-MM-DD
MSCI World Minimum Vol (USD)	0.68	6.91	20.43	12.21	12.16	11.26	0.25	0.68	0.60	0.50	47.73	2007-10-31—2009-03-09
MSCI World	1.00	0.00	2.39	16.74	16.35	15.06	0.30	0.87	0.59	0.39	57.46	2007-10-31—2009-03-09

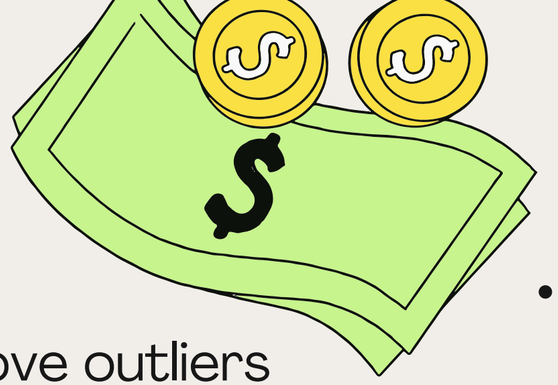
[1] Last 12 months [2] Based on monthly gross returns data [3] Based on NY FED Overnight SOFR from Sep 1 2021 & on ICE LIBOR 1M prior that date

SOURCE: MSCI (2025). MSCI WORLD MINIMUM VOLATILITY INDEX FACTSHEET. RETRIEVED FROM HTTPS://WWW.MSCI.COM/DOCUMENTS/10199/4D26C754-8CB9-4FA8-84E6-A51930901367

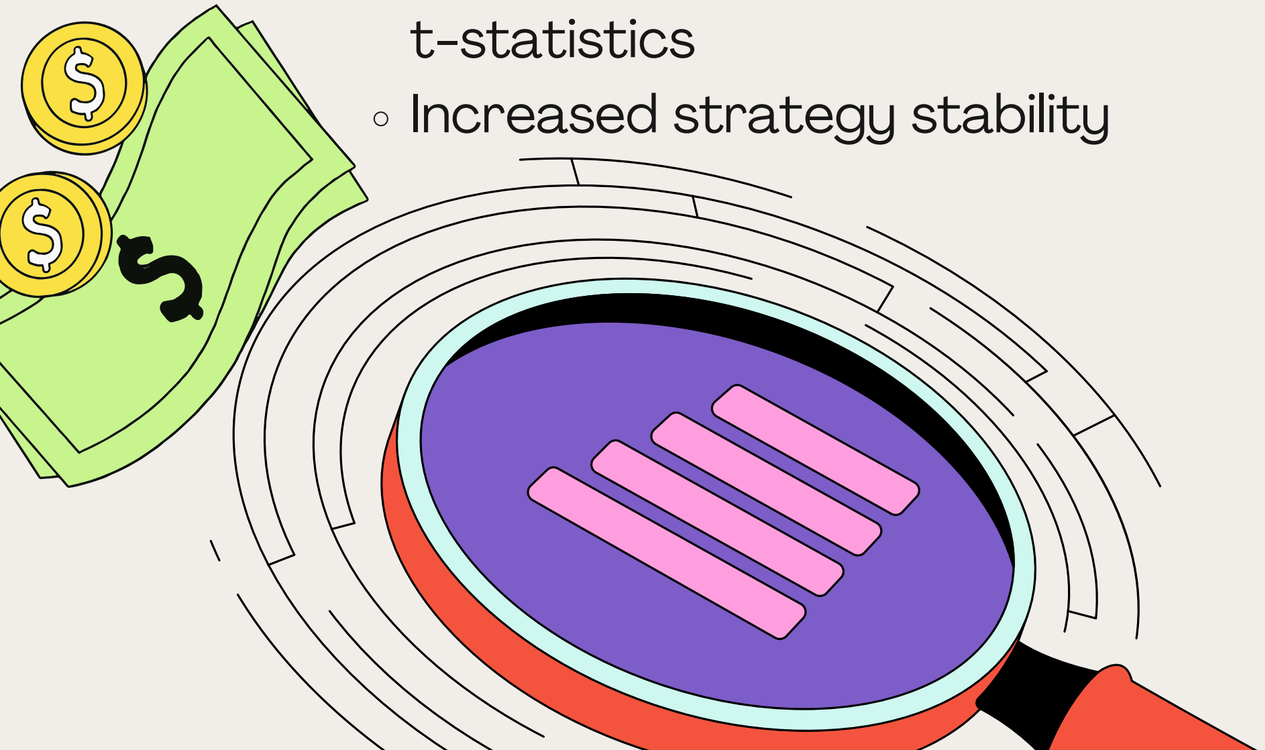
Outlier Detection and Cleaning

Enhancing Robustness: Outlier Detection in Returns

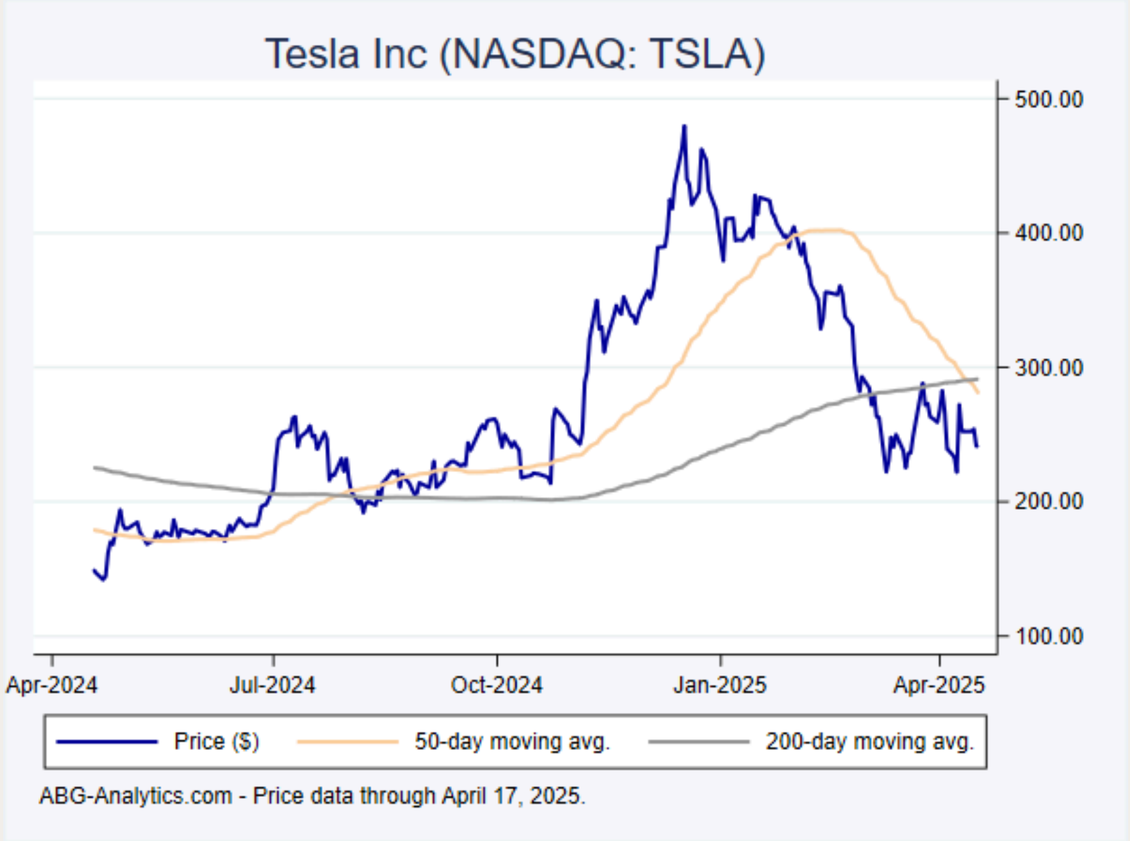
- **Why detect outliers?**
  - Outliers distort volatility and bias portfolio sorting
  - May result from market shocks, firm-specific events, or data errors
- **Detection Methods:**
  - Z-score Method (preferred): $|z| > 3$
  - IQR Method: $[Q1 - 1.5IQR, Q3 + 1.5IQR]$
- **Why Z-score?**
  - Suitable for normally distributed daily returns
  - Easy to apply across all stocks
  - Consistent thresholds



- **Cleaning Approach:**
  - Winsorize or remove outliers
  - Applied to daily and monthly returns
- **Impact:**
  - Smoother volatility estimates
  - More accurate rankings and higher t-statistics
  - Increased strategy stability



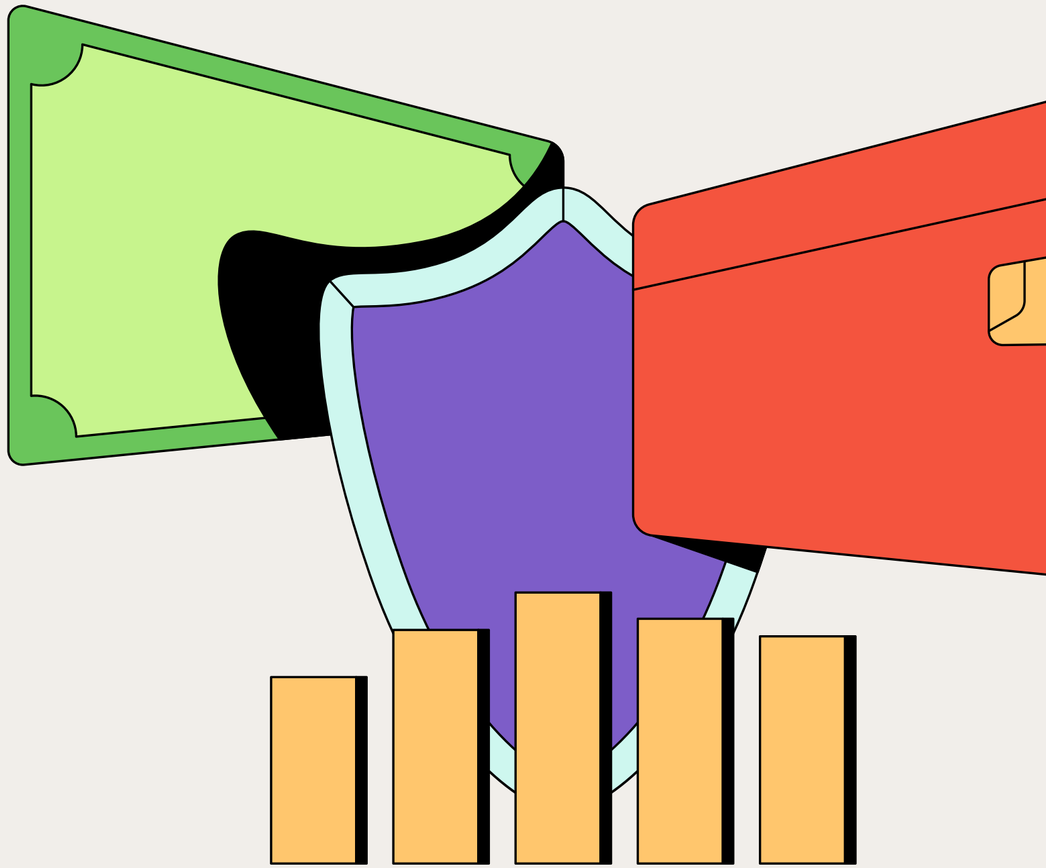
- **Examples:** TSLA event-driven anomalies removed



TSLA PRICE DATA: STOCK ANALYSIS. (2025). TESLA HISTORICAL STOCK PRICES. RETRIEVED FROM HTTPS://WWW.ABG-ANALYTICS.COM/STOCKS/TSLA.SHTML

Summary & Next Steps

- Volatility-based long-short strategy shows statistically significant returns
- Low volatility investing offers a viable and robust alternative
- Outlier detection improves signal reliability and t-statistics
- **Next steps for enhancement:**
  - Apply rolling estimation windows
  - Test multi-factor combinations (e.g., value, momentum)
  - Introduce transaction cost and turnover control



Thank you for listening