Pairs Trading Strategy

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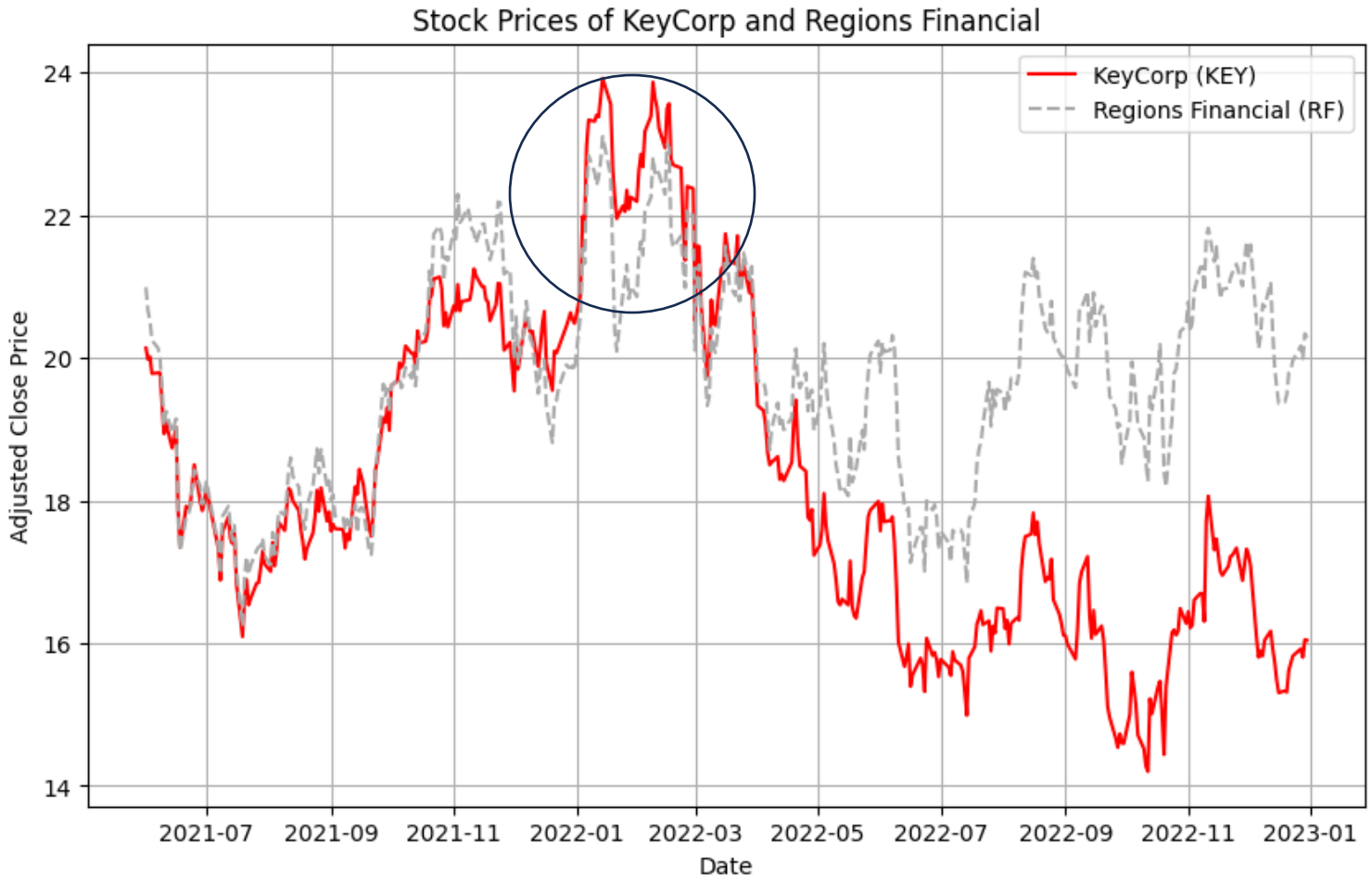
MAIF

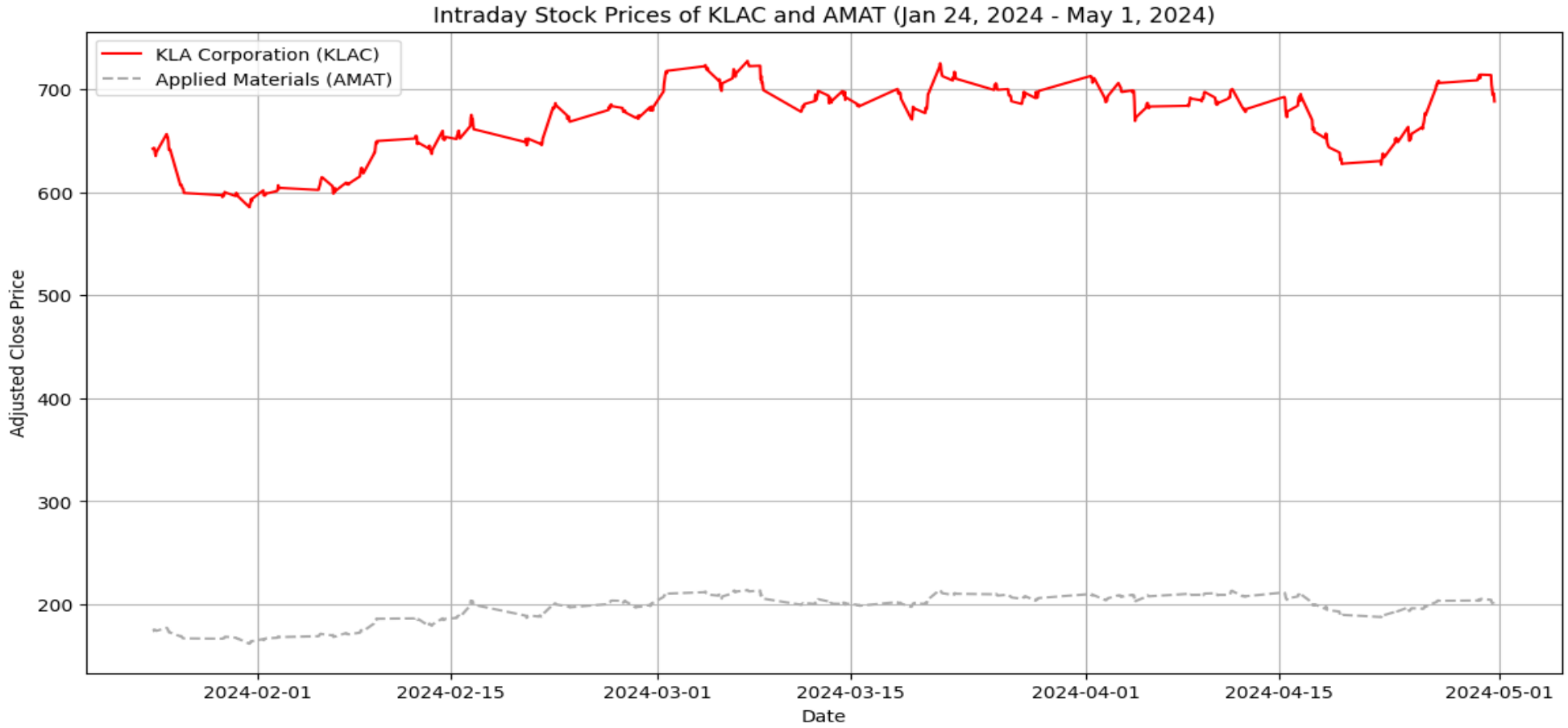
Minutemen Alternative Investment Fund

Pairs Trading at a High Level

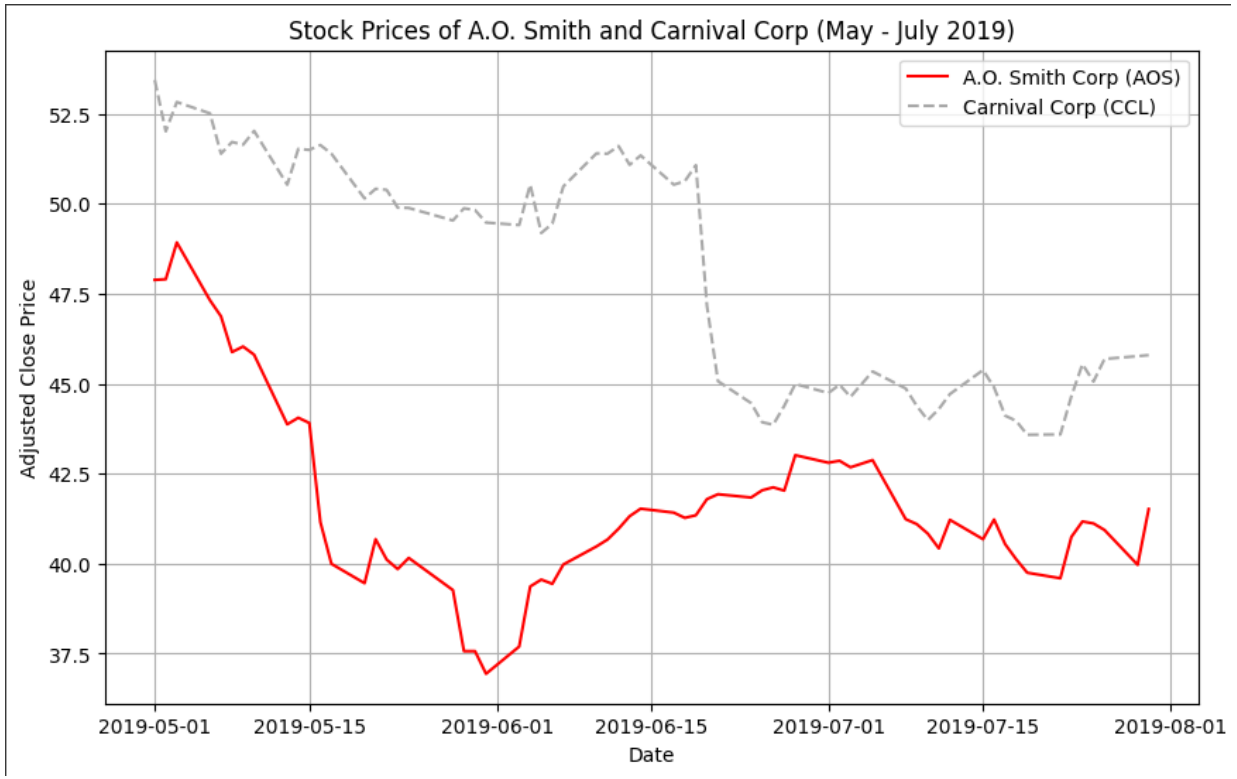
1. Find two assets with prices that move together
2. When their spread is larger than usual:
   - Long: Undervalued
   - Short: Overvalued
3. Exit positions when spread reverts to mean and profit from the change



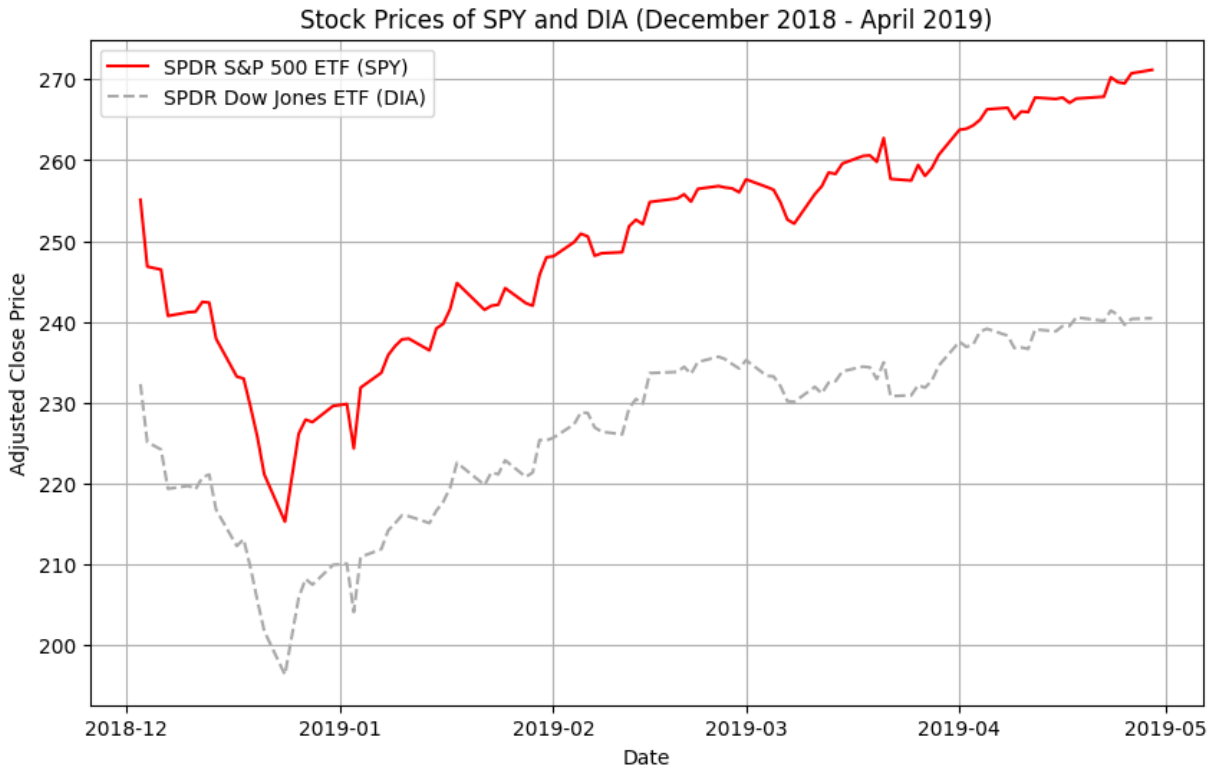
Pairs Trading at a High Level



Pairs Trading is a Market Neutral Strategy



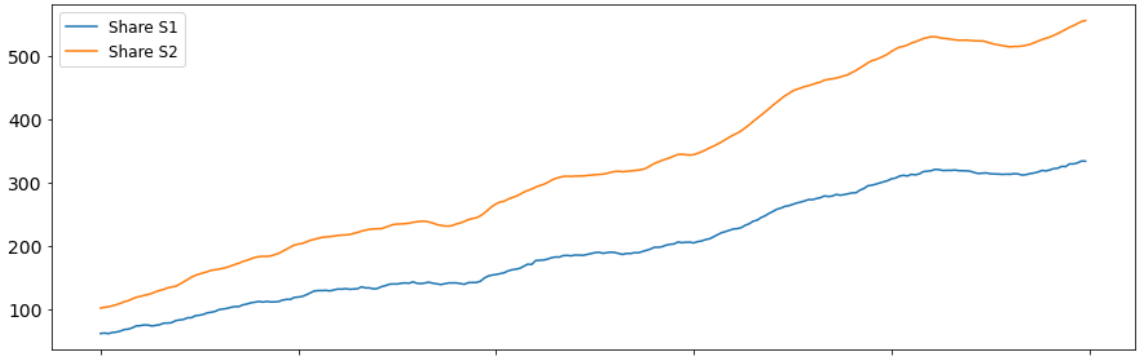
Pairs Trading on a Downward Trend



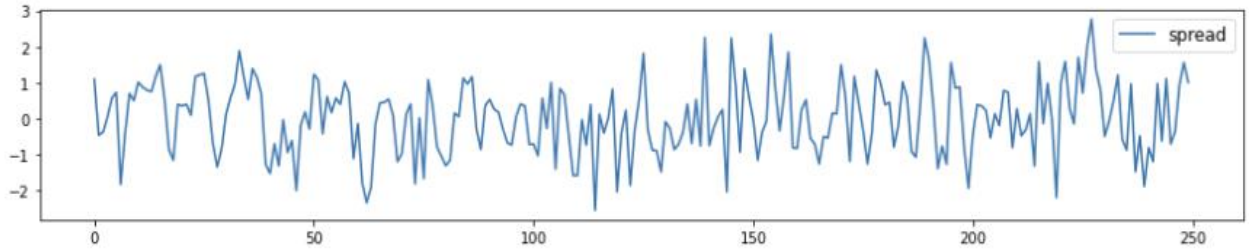
Pairs Trading on an Upward Trend

Correlation VS Cointegration

CORRELATION	COINTEGRATION
Describes a **short-term** relationship between the **returns**	Describes a **long-term** mean reverting relationship between the **prices**



Returns of two correlated assets



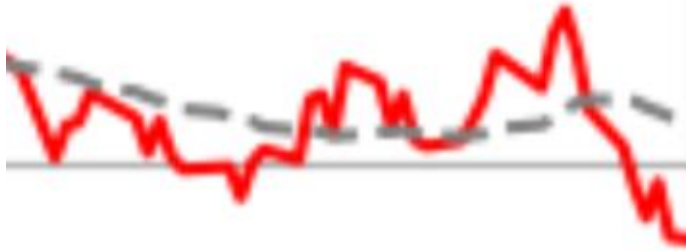
Spread (difference in prices) of these assets

Quantitative and Qualitative Pairs Relationships

Effective pairs trading strategies integrate both quantitative and qualitative analyses.

Quantitative Relationships	Qualitative Relationships
- Utilize two important statistical properties to identify relevant numerical patterns between two assets: Correlation and Cointegration - Stock prices must historically move in the same direction and have a spread that historically remains constant - Qualitative factors are necessary in providing context to the numbers	- Non-numerical factors that influence asset behavior: Industry trends, company fundamentals, market sentiment, etc. - Two highly correlated companies are not guaranteed to maintain that relationship over the long-term due to unexpected events and catalysts - Effectively utilizing most recent company news is necessary

Mean Reversion and Predicting Deviations

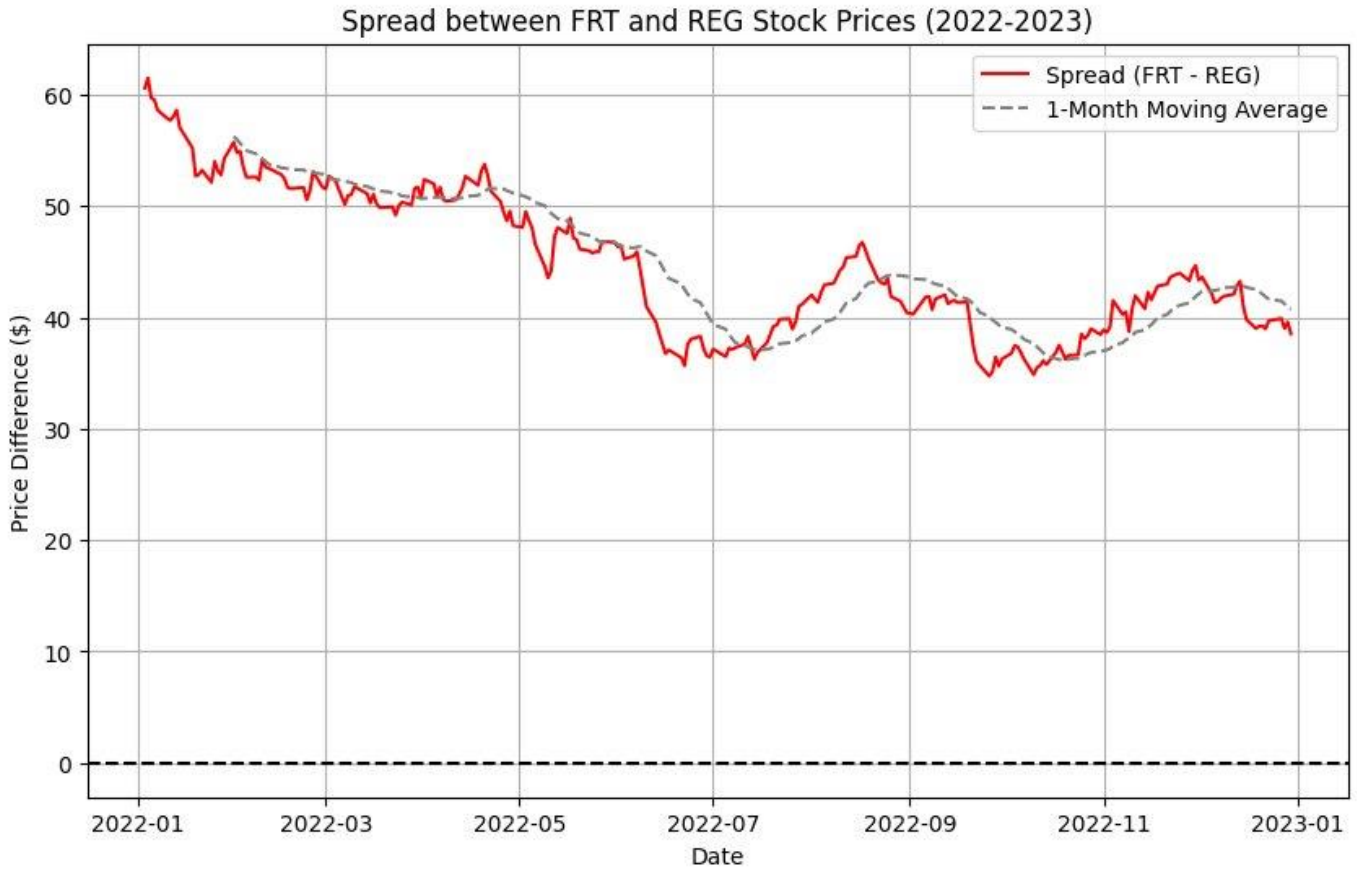


Mean Reversion:

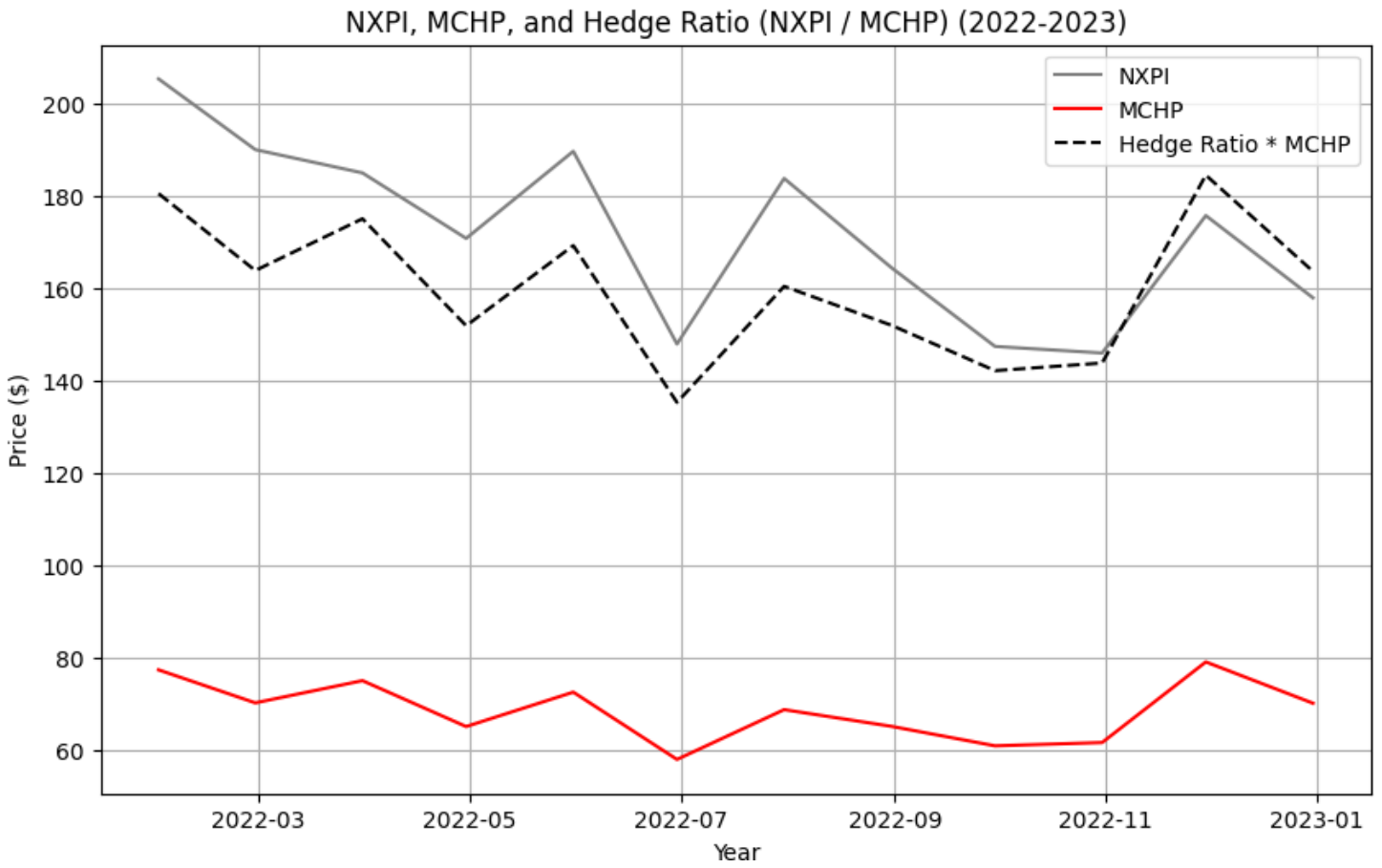
- Asset prices tend to move back toward their historical average over time
- The spread between two correlated assets will eventually revert to its long-term average

Spread Deviations:

- Deviations from the historical spread between paired assets provide trading opportunities
- Predictive models utilize historical data and statistical analysis techniques to anticipate potential deviations



Understanding Dynamic Hedge Ratios



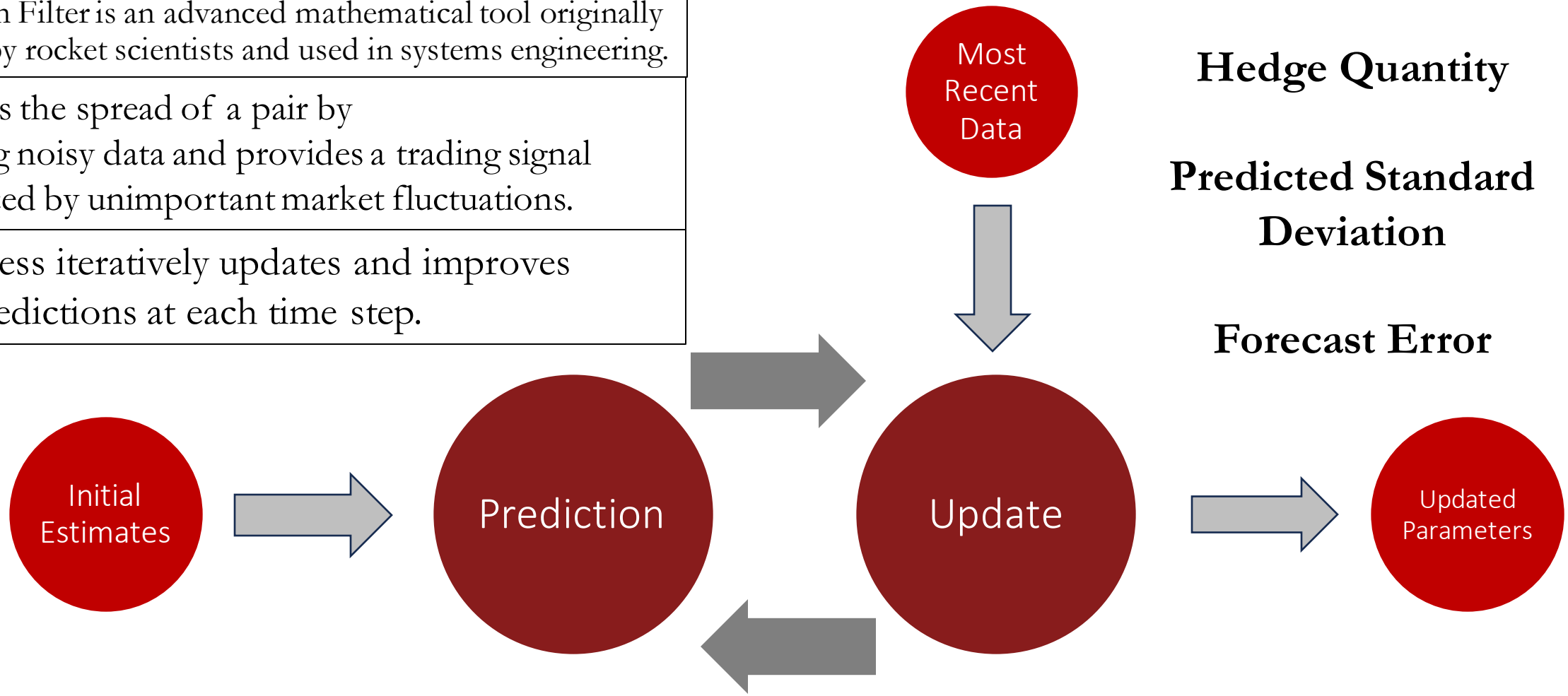
Hedge Ratio: How much of one stock to long/short relative to the other?

Dynamic hedge ratios adjust continuously based on changing market dynamics.

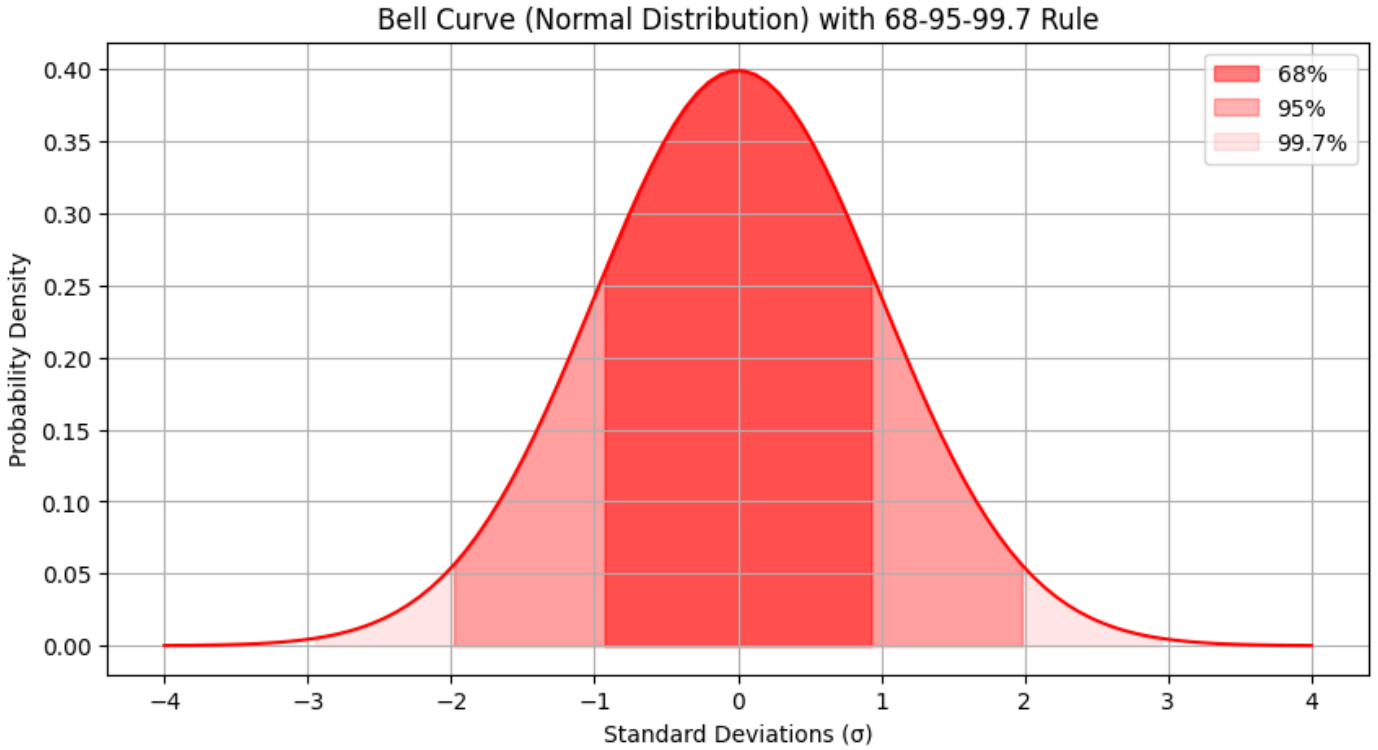
Optimize the portfolio's risk-return profile by dynamically rebalancing positions and finding the optimal ratio of long and short positions that would currently maximize profitability.

The Kalman Filter

The Kalman Filter is an advanced mathematical tool originally developed by rocket scientists and used in systems engineering.
It measures the spread of a pair by minimizing noisy data and provides a trading signal uninfluenced by unimportant market fluctuations.
This process iteratively updates and improves spread predictions at each time step.



Pairs Selection Process: Our Prerequisites



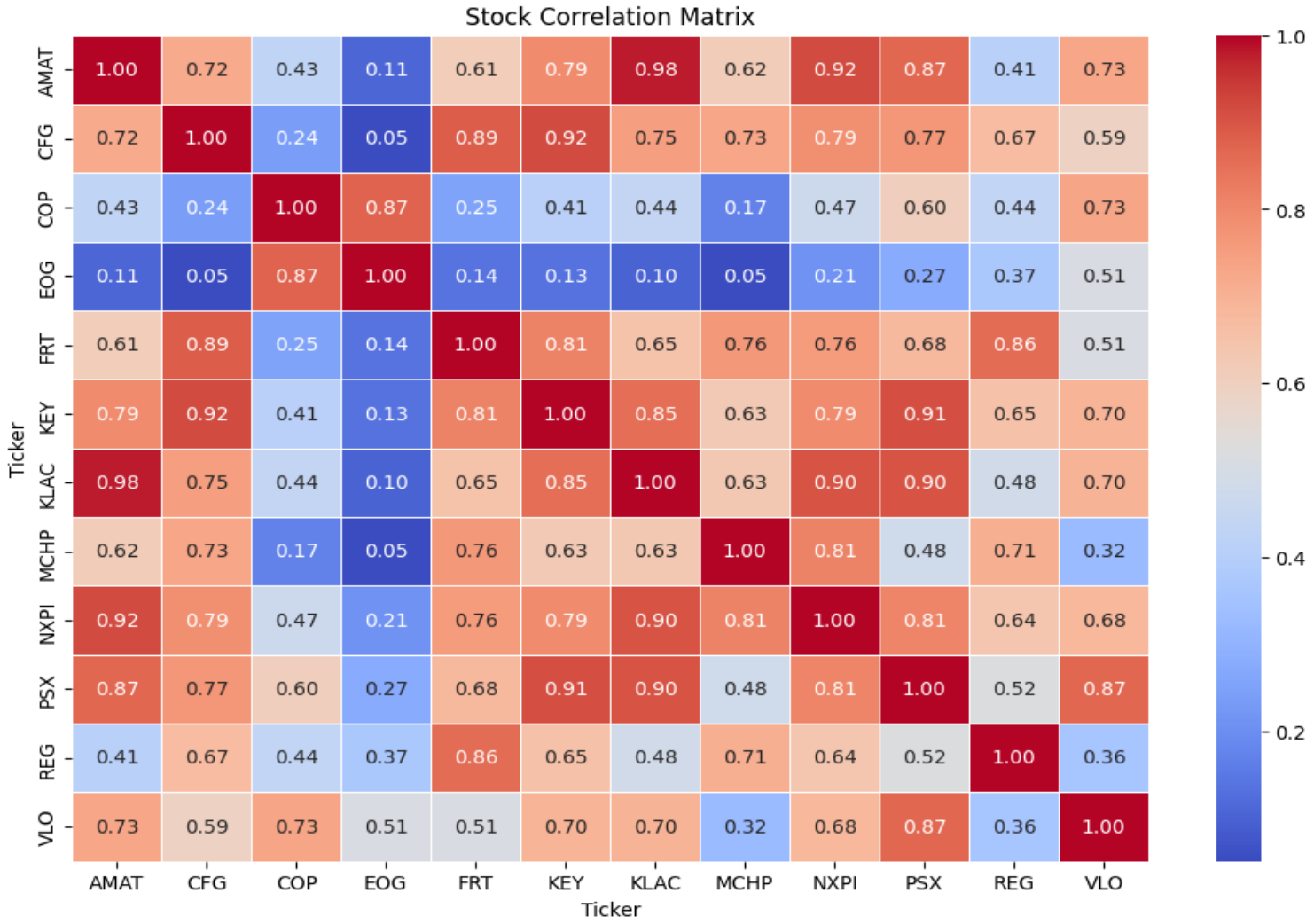
Criteria Required for Kalman Filter

A stock's **daily returns** must follow a normal distribution.

What does this mean?

Test for Skewness: Between –0.5 and 0.5 (normal: 0)
Test for Kurtosis: Between 1.7 and 4.3 (normal: 3)

Pairs Selection Process: The Correlation Matrix



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Pairs Selection Process: Cointegration Tests

Purpose: Find cointegrated asset pairs

Key Concept: Stable long-term relationship despite short-term price deviations.

Method: Statistical hypothesis testing for cointegration → confidence level

- Engle-Granger Test
- Augmented Dickey Fuller Test

Trading Application: Identifies pairs for strategies that capitalize on prices converging over time.

Pairs Selection Process: Ranking by Aggregate Volatility

1. NXPI - MCHP: 0.022131
2. KLAC - AMAT: 0.019921
3. KEY - CFG: 0.019349
4. VLO - PSX: 0.015638
5. FRT - REG: 0.012392

Volatility Ratings in Pairs Trading:

Low: val < 0.015
Moderate: 0.015< val <0.020
High: val > 0.020

Values reflects how much the prices of two correlated assets fluctuate.

Higher agg. volatility → greater risk and potential profit;
Lower agg. volatility → stability but lesser gains.

Introducing Our Pairs

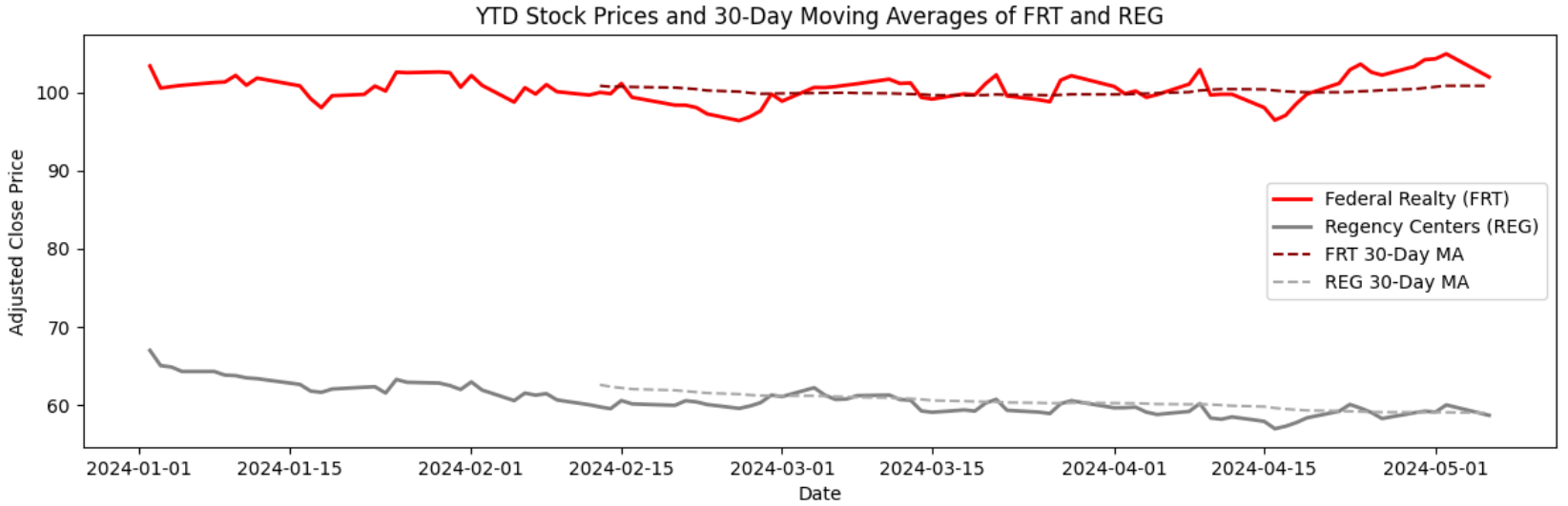
Tickers: FRT – REG

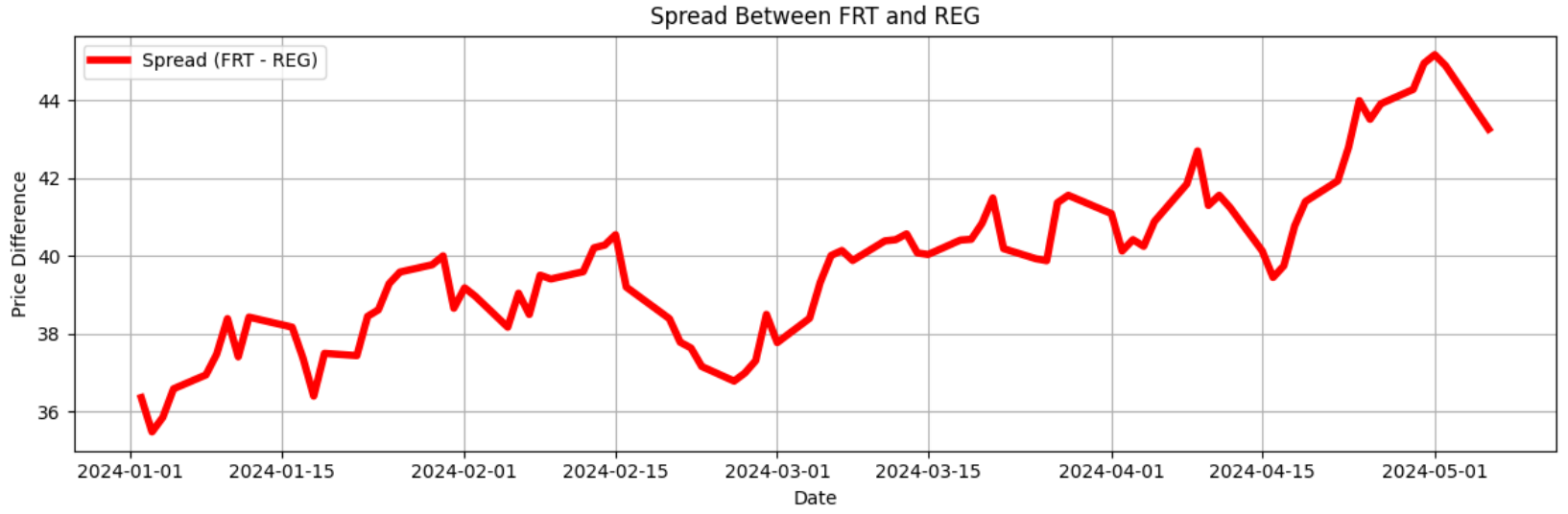
Federal Realty Investment Trust (FRT)

- **Industry**: Real Estate

Regency Centers Corporation (REG)

- **Industry**: Real Estate





Introducing Our Pairs

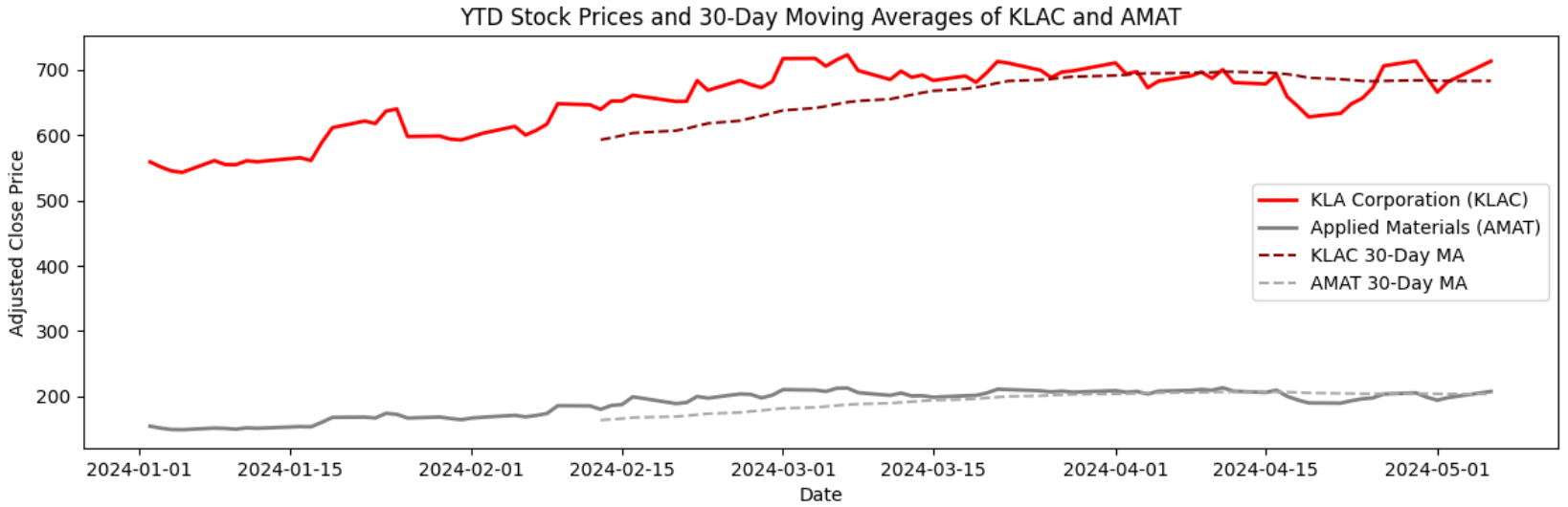
Tickers: KLAC – AMAT

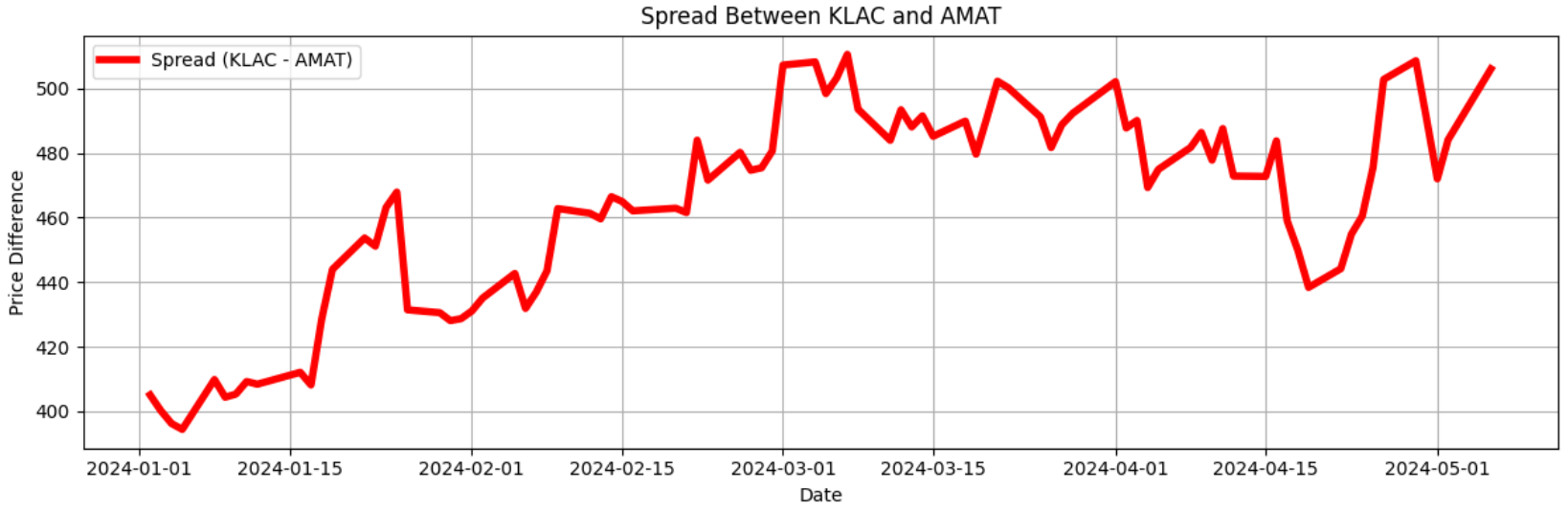
KLA Corporation (KLAC)

- **Industry**: Semiconductor Equipment & Materials

Applied Materials, Inc. (AMAT)

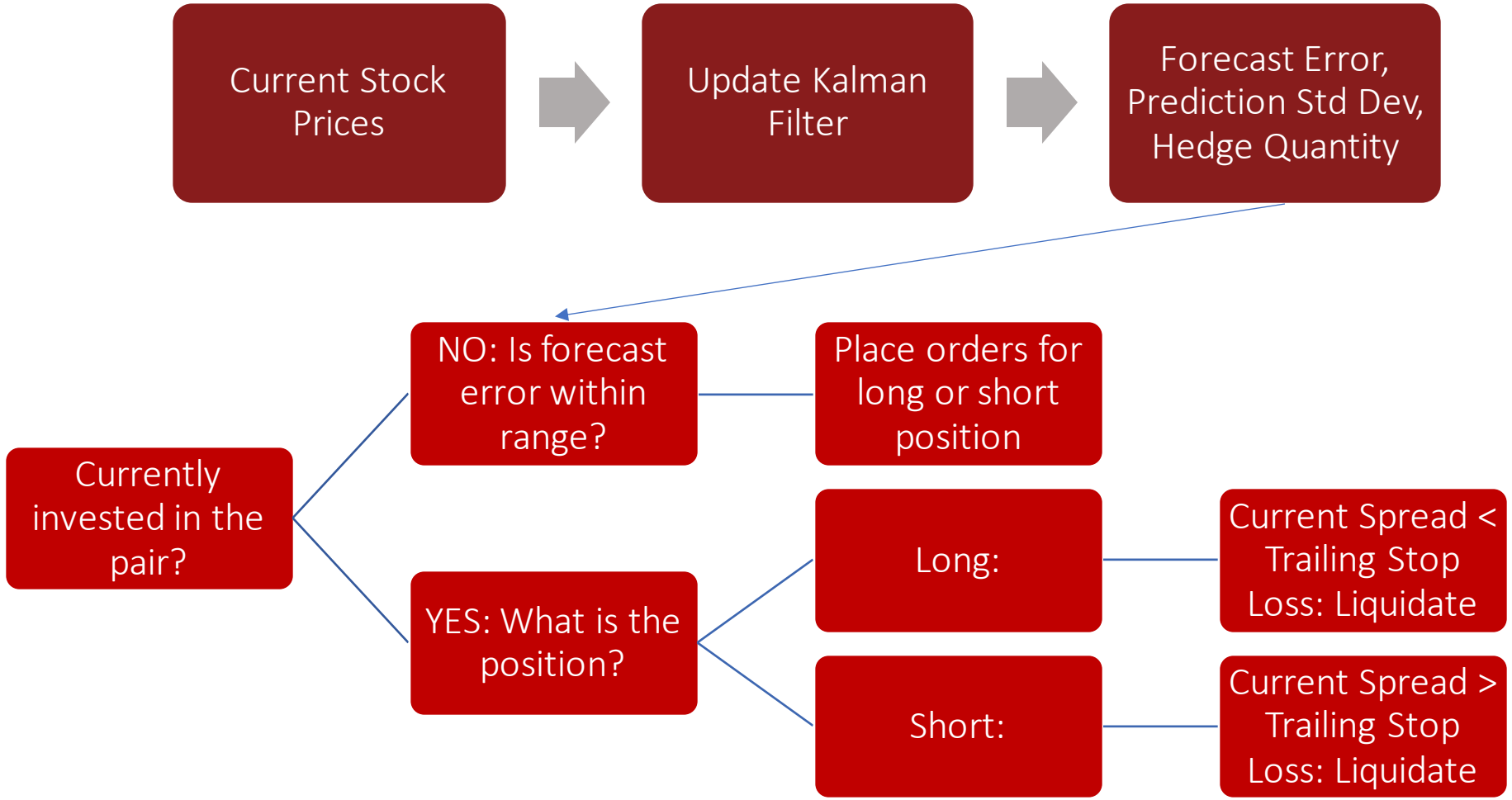
- **Industry**: Semiconductor Equipment & Materials





Algorithm Flowchart

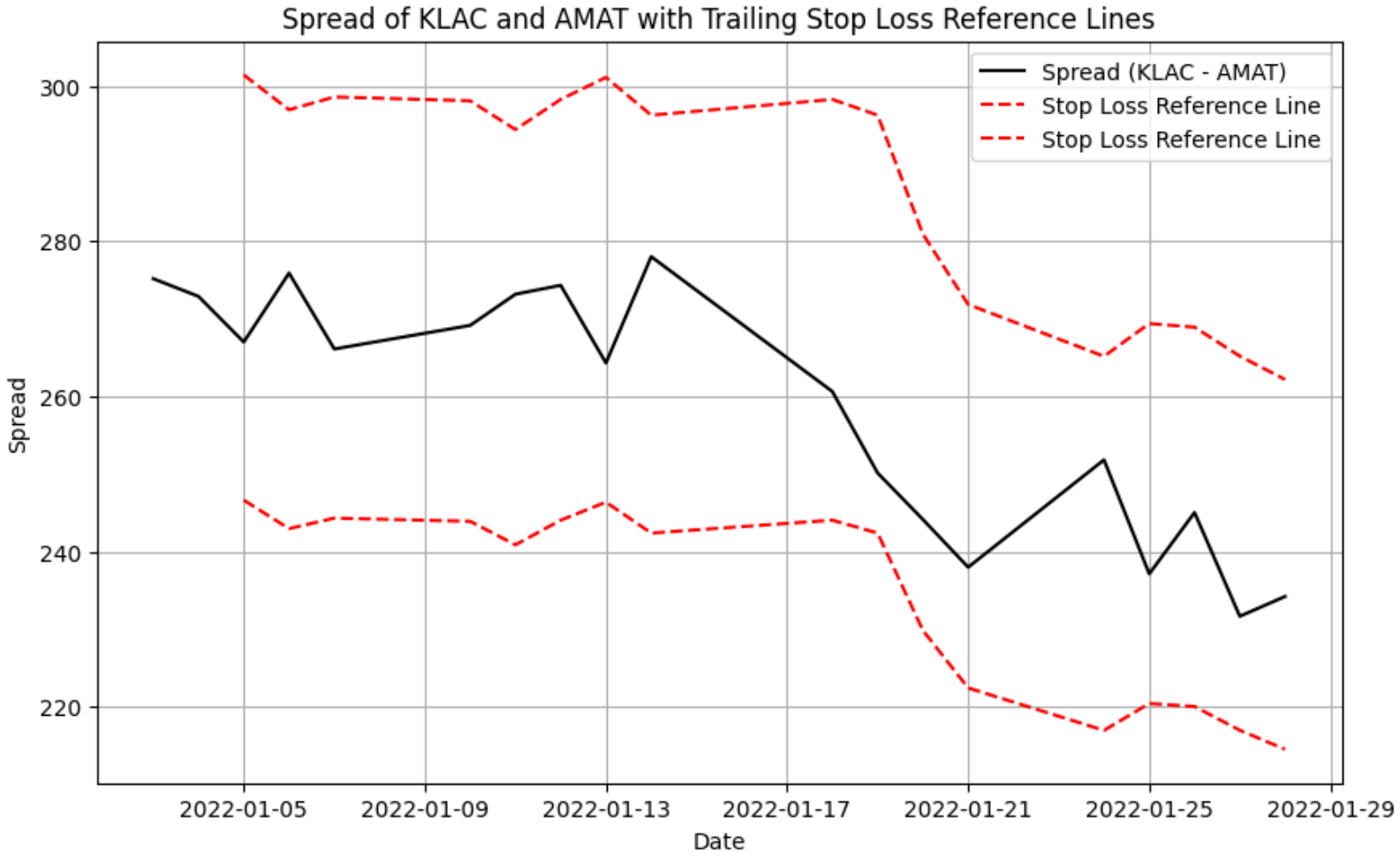
For each pair: Execute the function every 3-5 minutes of each trading day



Risk Management: Trailing Stop Loss

Dynamic Protection: Automatically adjusts liquidation orders as prices move, protecting against potential losses.

Preserves Profits: It secures gains by selling if prices fall, ensuring capital preservation.



Back-Testing Results (2023 + YTD)

~70% trading in KLAC-AMAT,
30% trading in FRT-REG

Returns: 109.66%

Sharpe Ratio: 1.77

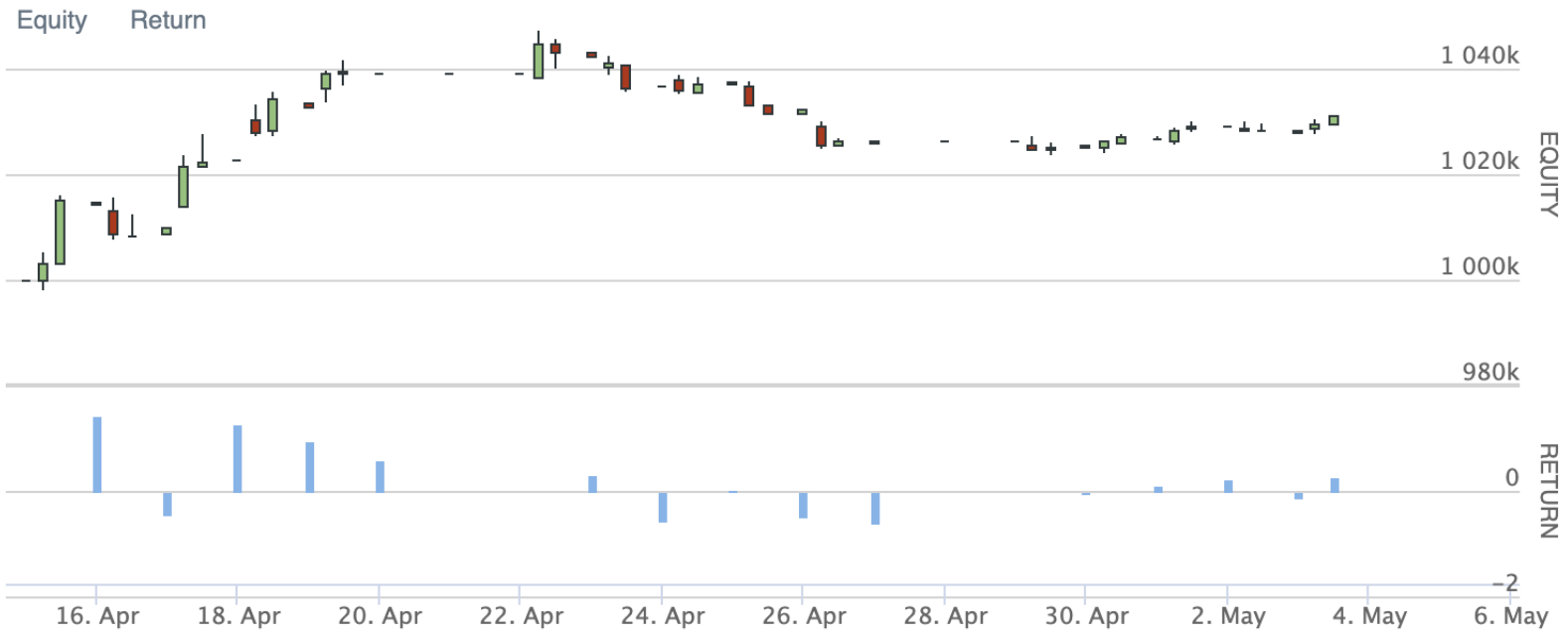
Compounding Annual Return: 77.6%

Alpha: 0.292

Max Drawdown: 15.3%

No trailing stop loss measure

Live Trading Results



KLAC-AMAT Only

91% in trading at first, goes down to 58% by the end, rest is liquid reserves

Rolling 10% stop loss

3.11% returns over 2 weeks

Max Drawdown: 2.3%

Compounding Annual Returns: 82.123%

Alpha: 0.242

Sharpe Ratio: 2.585

SPY Returns over same period: 0.086%

Summary

- Utilized a 4-step statistical analysis process to selectively filter and rank the best possible pairs to trade with out of the S&P 500
- Leveraged the Kalman Filter to dynamically compute and update the hedge ratio between each pair
- Cointegration can break down unexpectedly – qualitative analysis is critical
- KLAC-AMAT is a pair that shows promising returns

Thank You

Questions?

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