Design and Comparative Analysis of Advanced Quantitative Trading Strategies in Python

CS973 (Foundations of Data Science)

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Overview

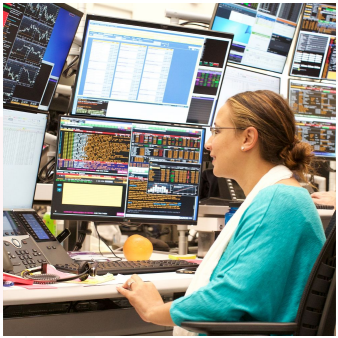
Overview

What is Quantitative Trading?

- **Quantitative/Algorithmic Trading**: Automated execution of trades using computer programs and quantitative models
- Leverages data science to identify profitable opportunities based on:
  - Statistical patterns
  - Historical data
  - Real-time market signals
- Project focuses on two strategies:
  - Momentum Trading
  - Mean Reversion
- Applied to AAPL stock data from Yahoo Finance API

Data Science in Algorithmic Trading

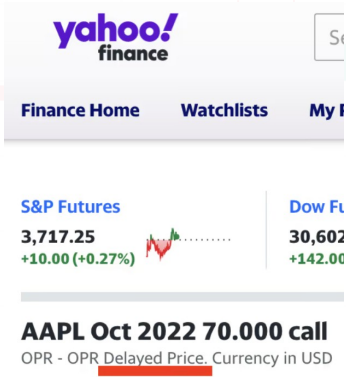
- **Time Series Analysis**
  - Identify trends using historical stock price data
- **Technical Indicators**
  - Momentum: RSI, percentage change
  - Mean reversion: Z-score, Bollinger Bands
- **Visualization**
  - Interactive plots (Plotly) for strategy analysis
- **Automation**
  - Python scripts fetch data, compute signals, and execute trades
- **Outcome**
  - Data-driven trading decisions for financial markets



Overview

Data Collection & Preprocessing

- **Source**: Yahoo Finance (`yfinance`)
- **Stock**: AAPL (Apple Inc.)
- **Parameters**:
  - Period: 1 year
  - Interval: Daily (`1d`)
  - Features: OHLC + Volume
- **Error Handling**:
  - Checks for empty/missing data
  - Raises exceptions on fetch failure



Preprocessing Steps

Momentum Strategy

- Compute: 1D/5D % price changes, 14-day RSI
- Signals:
  - Buy: Momentum 5D > 0 & RSI $\in (30,70)$
  - Sell: Momentum 5D < 0 & RSI > 70
  - Neutral: Otherwise

Mean Reversion Strategy

- Compute: 20-day SMA, STD, Bands (SMA $\pm$ 1.5$\times$STD), Z-Score
- Signals:
  - Buy: Price $<$ Lower Band (Z-Score < -1.5)
  - Sell: Price $>$ Upper Band (Z-Score > 1.5)

Overview

Performance Metrics & Results

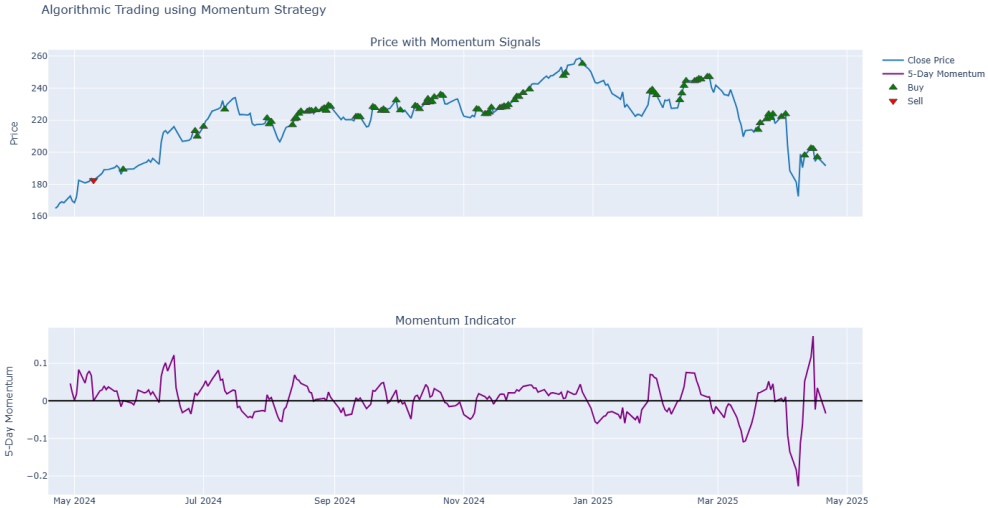
Momentum Strategy

- Effective in trending markets with RSI 30-70
- Avoids false signals (RSI > 70)
- Generates buy signals during bullish phases

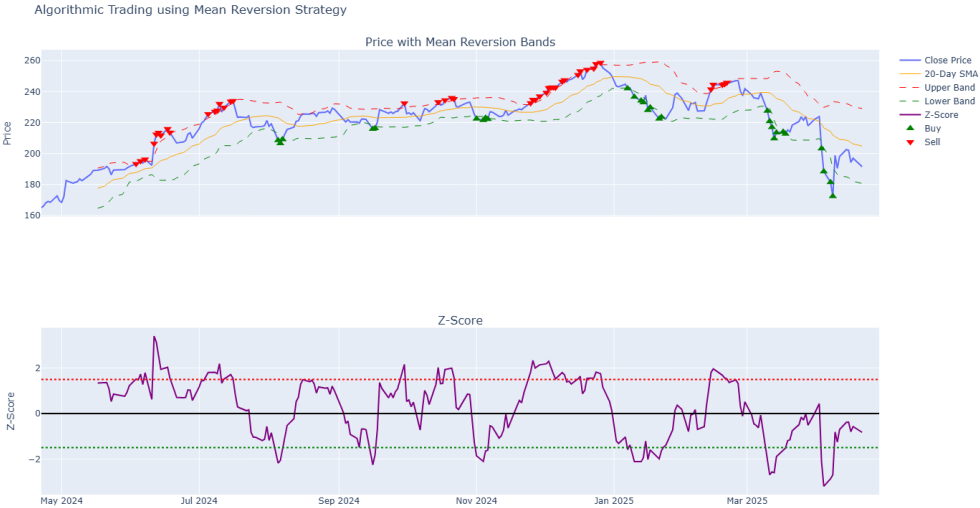
Mean Reversion Strategy

- Identifies extremes via Z-Score
- Buy: Price $<$ Lower Band (potential rebound)
- Sell: Price $>$ Upper Band (likely pullback)

Results of Momentum Model



Results of Mean Reversion Model



Key Findings and Conclusions

- **Strategy Insights**:
  - Momentum works best in trends, mean reversion in ranges
  - Combined strategy shows improved robustness
  - Signals validate indicator effectiveness
- **Future Directions**:
  - Enhance with multi-asset support
  - Expand backtesting for stronger validation
- Successfully demonstrated data science application in trading

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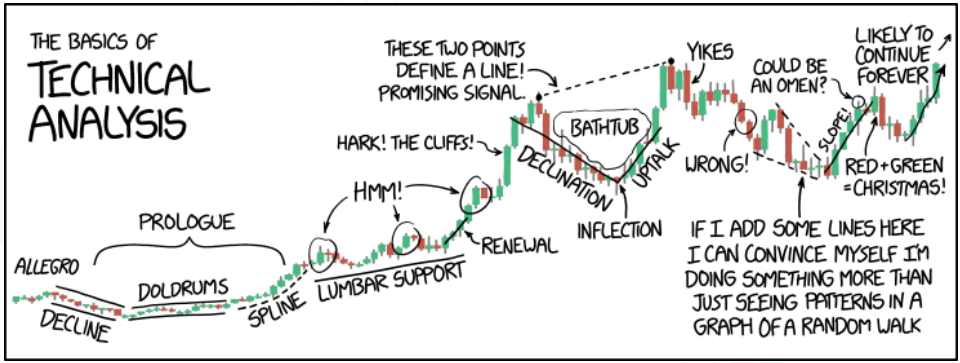
THE BASICS OF
TECHNICAL ANALYSIS
ALLEGRO
DECLINE
DOLDRUMS
PROLOGUE
SPLINE
LUMBAR SUPPORT
HMM!
HARK! THE CLIFFS!
RENEWAL
THESE TWO POINTS DEFINE A LINE! PROMISING SIGNAL.
DECLINATION
BATHTUB
INFLECTION
UPTALK
YIKES
WRONG!
COULD BE AN OMEN?
SLOPE!
LIKELY TO CONTINUE FOREVER
RED+GREEN =CHRISTMAS!
IF I ADD SOME LINES HERE I CAN CONVINCE MYSELF I'M DOING SOMETHING MORE THAN JUST SEEING PATTERNS IN A GRAPH OF A RANDOM WALK

Thanks!