Quant Lunch & Learn

Hybrid Sector Rotation Strategies:
Robust Regression on Residual Momentum

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Existing Research Foundation

1. **Tactical Asset Allocation (TAA) (Faber et al., 2013)[4]**
   - Dynamic allocation across assets/sectors using predictive signals outperforms static allocations.
   - **Implication:** Rotate across sector ETFs ***guided by residual momentum signals*** rather than raw prices.

2. **Residual Momentum (Blitz et al., 2013)[6]**
   - Residual (alpha) returns show stronger, more persistent momentum than total returns.
   - **Implication:** ***Apply momentum to residual*** sector ETF returns, not raw returns.

3. **Factor Momentum (Ehsani et al., 2020)[5]**
   - Factors themselves exhibit momentum; allocating to strong factors generates alpha.
   - **Implication:** Sector residuals approximate factor-level alpha; ***rotate into sectors with high residual momentum***.

SPDR Sector ETFs and Workflow

1. **Decompose Returns**

   Extract sector-specific residuals (alpha) using robust regression vs. SPY.

2. **Generate Predictive Signals**

   Apply momentum, ARIMA, and ML (Random Forest) on residuals.

3. **Construct Market-Neutral Strategy**

   Rotate across 11 SPDR sectors[1] using residual-based momentum signals.

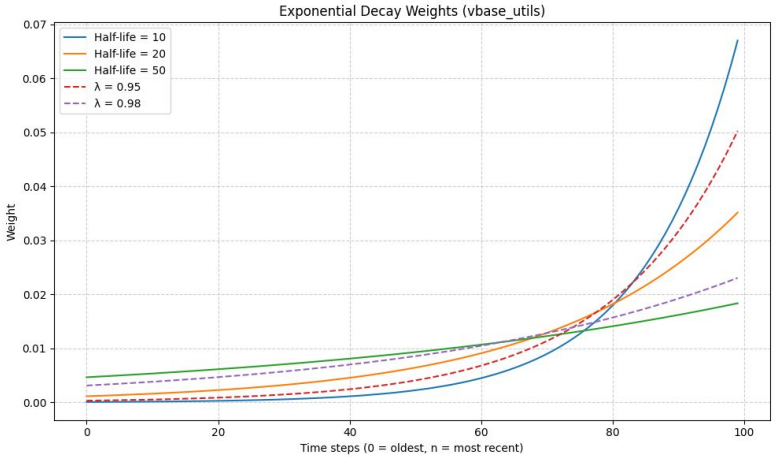
4. **Backtest & Evaluate**

   Test performance, diversification, and robustness of tactical allocation.

Robust Regression Framework

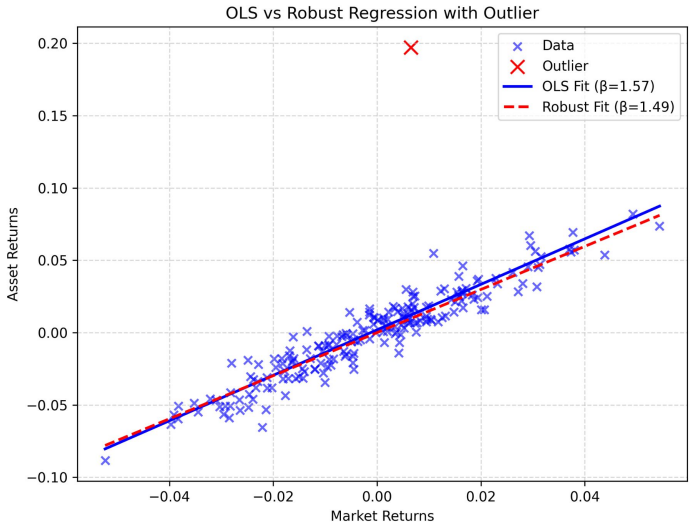
Time-Weighted Point-in-Time Regression[7]

- **Purpose:** Estimate time-varying betas and out-of-sample residuals for sector ETFs.
- **Methods:**
  - **Exponential decay weighting:** Half-life or λ-based weighting prioritizes recent data.
  - **Robust regression (HuberT norm)** to handle outliers.
- **Python utility:** `vbase_utils.stats.robust_betas`[3]
- **Impact:** Clean, reproducible market-neutral beta estimation and residual extraction.



OLS vs Robust Regression

Feature	OLS Regression	Robust Regression Framework
Sensitivity to outliers	Highly sensitive (one shock distorts beta)	Downweighs large residuals (stable beta)
Weighing of data	Equal weights on all history	Exponential decay (recent data emphasized)
Adaptability	Slow to reflect regime shifts	Tracks time-varying betas quickly
Small Sample Stability	Noisy, unstable fits	Smoother estimates
Statistical Assumption	Assumes Gaussian errors, thin tails	Handles fat-tailed and skewed returns



OLS is pulled strongly by the outlier, while robust regression (Huber) downweights it and keeps β close to the true value.

TAA Strategies

1. **Residual-Based Rotation**
   - Overweight sectors with high residual alpha; underweight low-residual sectors.
   - Weekly rebalancing with lookback windows aligned to factor autocorrelation.

2. **ARIMA-Enhanced TAA**
   - Forecast short-term sector returns.
   - Combine with residual signals: allocate only when both indicate favorable momentum.

3. **Random Forest (RF) Hybrid TAA**
   - Predict sector outperformance using residuals, lagged returns, and macro indicators.
   - Integrate RF probabilities with regression hedges for position sizing.

Backtesting and Results

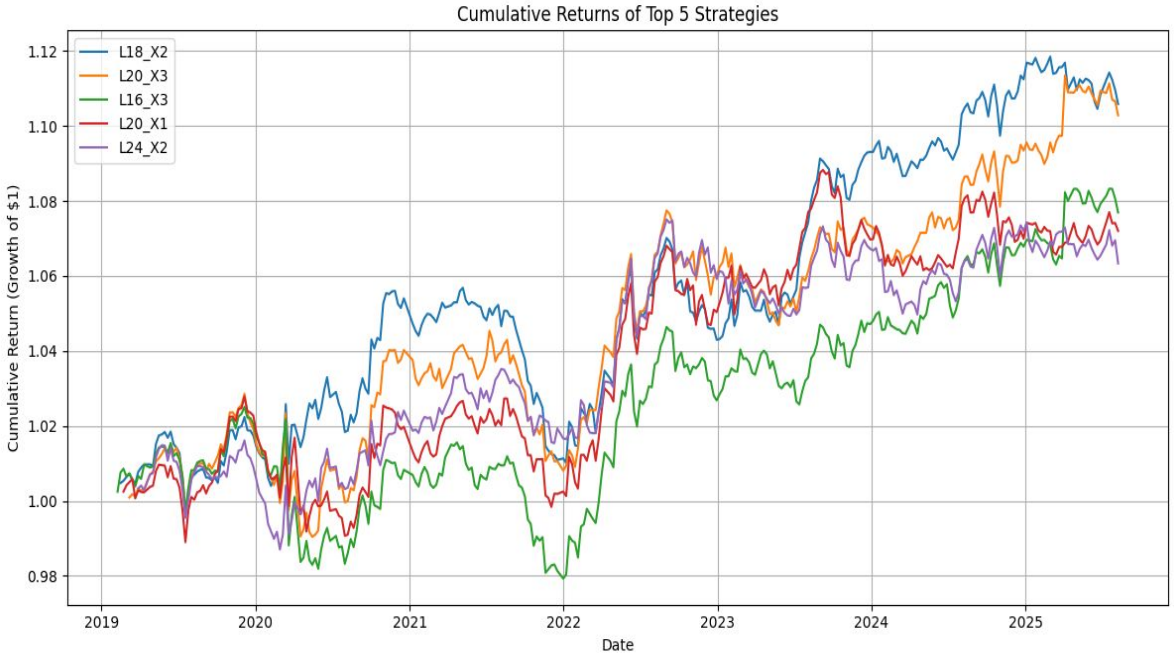
Backtested 22 indices based on the 11 ETFs constructing long and short alpha sector indices: **residual only, residual + ARIMA, residual + RF**.

Metrics: Sharpe ratio, drawdowns, CAGR

Observations:

- Residual momentum outperforms raw sector returns.
- Hybrid strategies improve predictive quality and risk-adjusted returns.
- Market-neutral hedging (residuals) enhances alpha purity.
- ARIMA gives negative returns (pending further research).

Backtesting (TAA)



TAA for different lookback periods and exclusion windows (in weeks) using sector rotation on weekly data and rebalancing every 4 weeks. This plot demonstrates the top 5 series obtained from the grid search.

We use an exclusion window to avoid look-ahead bias, mimicking a realistic delay in data availability or trade execution.

Captures a long-term trend

Backtesting (TAA + RF)

- Stronger cumulative growth
- Robust trend capture with fewer sharp drawdowns
- Improved risk-adjusted returns by learning nonlinear patterns (attributed to RF)

Improves both alpha generation and downside control

Advancements and Contributions

- Developed modular, reusable Python pipeline for robust regression and TAA.
- Combined statistical, machine learning, and time-series forecasting techniques.
- Integrated market-neutral hedging via regression-based betas.
- Enabled systematic, reproducible, hybrid sector rotation strategies.

Future Directions

- Integrate macroeconomic indicators with residual momentum signals.
- Optimize hyperparameters for ARIMA, VAR (Vector Auto Regression) and weighting.
- Automate real-time pipelines for continuous rotation and dynamic updating.
- Explore regime-switching models to adjust strategy aggressiveness.
- Refine trade execution strategy

References

1. Sector SPDR ETFs
2. https://logical-invest.com/trading-academy/etf-investing/sp500-sector-etfs/
3. https://github.com/vkorde3/portfolio_spdrs/
4. A Quantitative Approach to Tactical Asset Allocation by Meb Faber :: SSRN
5. Factor Momentum and the Momentum Factor by Sina Ehsani, Juhani Linnainmaa :: SSRN
6. Residual Momentum by David Blitz, Joop Huij, Martin Martens :: SSRN
7. Custom Hybrid Risk Models

THANK YOU