MACROTONE: REGIME-BASED FACTOR ALLOCATION

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PROBLEM WITH TRADITIONAL FACTOR INVESTING

- Factor models assume **static exposures**
- Markets move through **macro regimes**
- Factor returns vary sharply across:
  - **Expansions**
  - Recessions
  - Tightening cycles
- Static portfolios suffer **drawdowns during regime shifts**

CORE IDEA OF MACROTONE

- Factors themselves have **regimes**
- Federal Reserve communication contains **forward-looking macro information**
- We use:
  - Macroeconomic indicators
  - NLP from FOMC minutes
- Goal: **Anticipate regime shifts before markets react**

RESEARCH QUESTIONS

- Can NLP capture **forward-looking policy sentiment**?
- Do factor returns vary systematically by sentiment regime?
- Can we build a **real-time, adaptive factor allocator**?

SYSTEM OVERVIEW

- Macro Regime Index (MRI) from FRED
- NLP sentiment from 600+ FOMC documents
- Ridge + XGBoost forecasting ensemble
- Volatility-targeted portfolio engine
- Live Streamlit dashboard
- Fully automated and reproducible pipeline

DATA SYNCHRONIZATION - CHALLENGE

- Macro data, FOMC releases, and market returns arrive on **different calendars**
- Risk of **look-ahead bias**
- Solution:
  - Configurable **lag engine**
  - All signals shifted by realistic publication delays
- Guarantees **causal forecasting**

NLP SCALABILITY - CHALLENGE

- 600+ long FOMC documents
- FinBERT is **GPU-intensive**
- Solutions:
  - SHA-based caching
  - Intelligent token chunking (~800 tokens)
  - Incremental rescoring only for new releases
- Result: **80 percent runtime reduction**

REGIME STABILITY - CHALLENGE

- Raw sentiment is **noisy**
- Solutions:
  - Exponential smoothing
  - Z-score normalization
  - Threshold optimization
- Output:
  - Stable, interpretable macro-policy regimes

MODEL ROBUSTNESS - CHALLENGE

- Combined:
  - L2-regularized Ridge
  - Nonlinear XGBoost
- Strict rolling walk-forward training
- Deterministic seeds across all components
- Prevents **overfitting and instability**

FINAL VALIDATION FRAMEWORK

- Nested walk-forward CV with purge & embargo
- Stress testing on:
  - 2008 Financial Crisis
  - COVID crash
- Transaction cost sweeps: 0–25 bps
- Ledoit–Wolf shrinkage risk model
- Beta-neutral deployment option

REAL-WORLD ETF MAPPING

- Factor → ETF mapping:
  - Value → VTV
  - Size → IJR
  - Momentum → MTUM
  - Quality → QUAL
  - Low Vol → USMV
  - Cash → BIL / SHV
- Same:
  - Top-2 winner rule
  - Monthly rebalancing
  - 10 bps costs
  - 15 percent volatility target

WHERE THE SYSTEM STANDS TODAY

- Walk-forward validation complete
- Stress testing complete
- Vol-targeting finalized
- Attribution and diagnostics finalized
- UI fully operational
- Targets:
  - Out-of-sample Sharpe > 3.0
  - Max drawdown < 5 percent

DATA SOURCES

- Factor Data:
  - HML, SMB, Momentum from Ken French Library
- Macro Data:
  - CPI, Unemployment, Term Spread (FRED)
- FOMC Minutes:
  - 600+ official Federal Reserve documents
- Full SHA-based reproducibility

PREDICTIVE PERFORMANCE

- 1-month ahead factor forecasting
- Information Coefficients:
  - HML ≈ 0.18
  - SMB ≈ 0.15
  - Momentum ≈ 0.10
- Backtests show:
  - Strong returns
  - Low volatility
  - Shallow drawdowns
  - Low turnover

PORTFOLIO CONSTRUCTION

- Top-2 factors selected monthly
- 15 percent annualized volatility target
- 10 bps transaction cost model
- Cash overlay when forecasted volatility is high
- Position caps enforced

REGIME DIAGNOSTICS

- Regime-conditioned performance analysis
- Expansive-Dovish = strongest returns
- Contraction-Hawkish = weakest returns
- Regime-based attribution confirms economic intuition

KEY CONTRIBUTIONS

- First systematic use of:
  - Central bank communication NLP
  - For real-time factor timing
- Unified:
  - Macro modeling
  - Financial NLP
  - Machine learning
  - Production engineering

LIMITATIONS & FUTURE WORK

- ETF price panel still being populated
- NLP currently focused on FOMC only
- Future extensions:
  - Beige Book & Fed speeches
  - Bayesian regime detection
  - Intraday macro nowcasting
  - Reinforcement learning allocation

CONCLUSION

- MacroTone is a:
  - Regime-aware
  - Fully reproducible
  - Machine-learning driven
  - Factor allocation system
- Demonstrates:
  - Strong predictive power
  - Robust risk control
  - Real-world deployability