LAS TRADERS

Testing Asset Pricing Models

AILEEN LI, LUKE HARTFIELD, SAMAY MOHAPATRA
The University of Texas at Austin

INTRODUCTION

Build a reproducible Python framework that:

- Retrieves and cleans data from Ken French library.
- Runs time-series regressions for CAPM and FF3.
- Executes joint (alpha = 0) GRS-F tests and Fama-MacBeth cross-sectional tests.
- Outputs Excel summaries and diagnostics.

Key Goal: Assess whether the additional SMB (size) and HML (value) factors improve model fit and reduce pricing errors vs. CAPM.

DATA PREPROCESSING

Automated download and parsing from Ken French website
Extracted:
- 25 portfolio return series (monthly)
- Factor data: MKT - RF, SMB, HML, and RF
    - Converted returns to decimal format
    - Standardized and validated date inputs for flexible analysis windows
    - Aligned portfolio and factor data via monthly PeriodIndex
    - User Input Feature for Date Range and choice of CAPM, FF3F, or Both
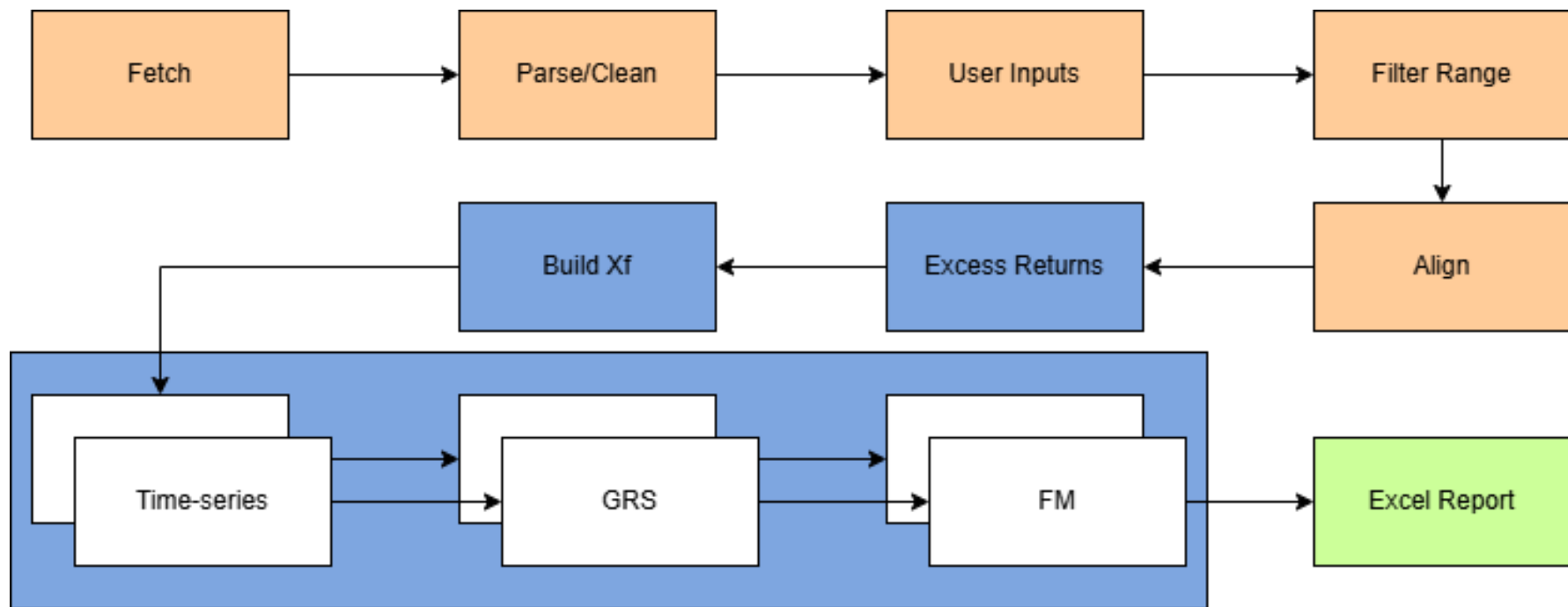
SUMMARY STATISTICS

- Computed for each portfolio:

  - Mean, Std. Dev., Sharpe Ratio, T

  - Provided an overview of portfolio-level risk and performance

  - Context for future model evaluations

MODEL ESTIMATION

CAPM

$$R_e = R_f + \beta(R_m - R_f)$$

FAMA FRENCH

$$r = r_f + \beta_1(r_m - r_f) + \beta_2(SMB) + \beta_3(HML) + \varepsilon$$

TEXAS
The University of Texas at Austin

REGRESSION RESULTS

- Alphas, Betas, R^2, t-stats, standard errors
- Predicted returns & residuals
- Covariance matrices (residuals & factors)

GRS - F Test

- Tests joint significance of portfolio alphas
- Null hypothesis: alphas are 0
- Accounts for residual and factor covariance structure
- Reports F-statistic and p-value
- Rejection → model fails to fully explain returns

CAPM Results

- GRS $F = 2.84$, $p = 1.2 \times 10^{-5}$ → Reject H_0.

- Significant alphas → CAPM fails to fully price portfolios.

- Market beta explains direction, not magnitude of returns.

FF3F Results
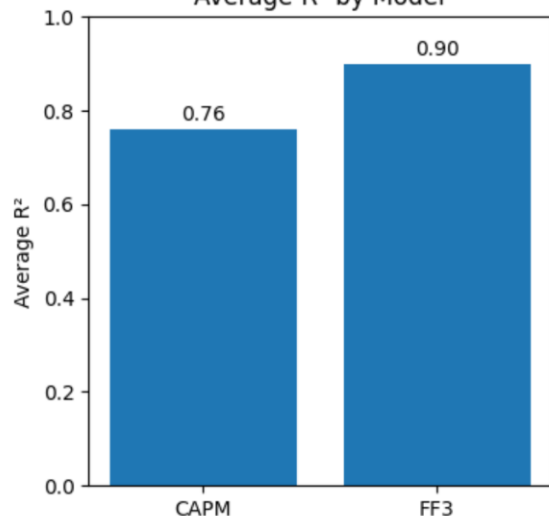
- R^2 improves (0.59 → 0.93)

- SMB and HML both significant → capture size and value effects

- GRS F = 1.99, p = 0.0036 → still reject H_0, but weaker

- Residual alphas smaller → FF3F dominates CAPM
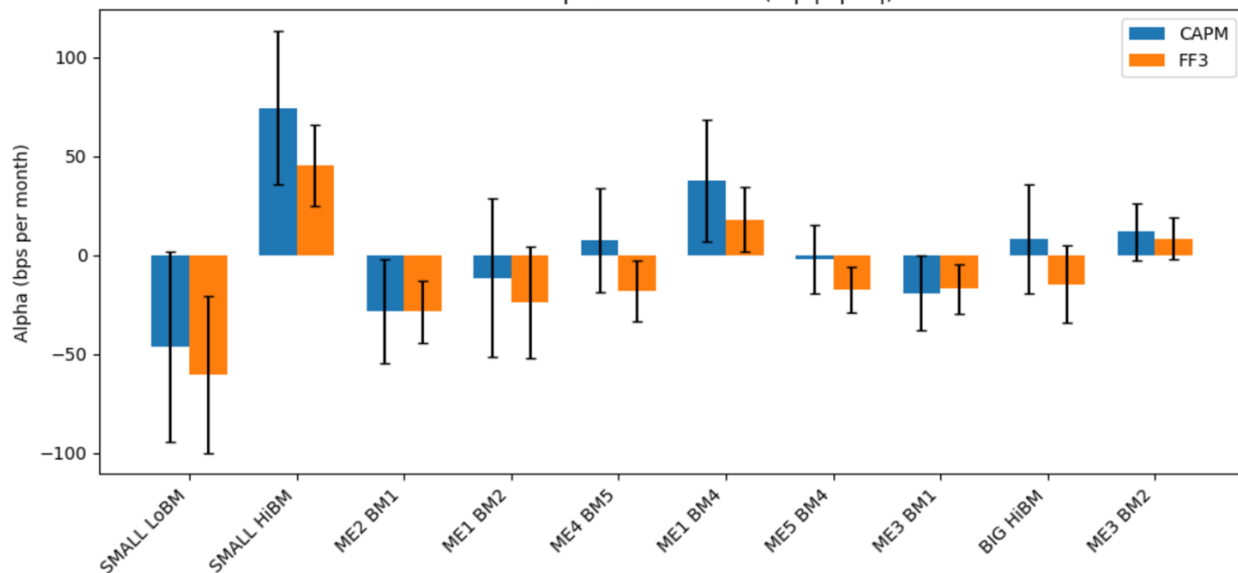
Observation: Value and small-cap portfolios deliver higher average returns → evidence of value and size premia.
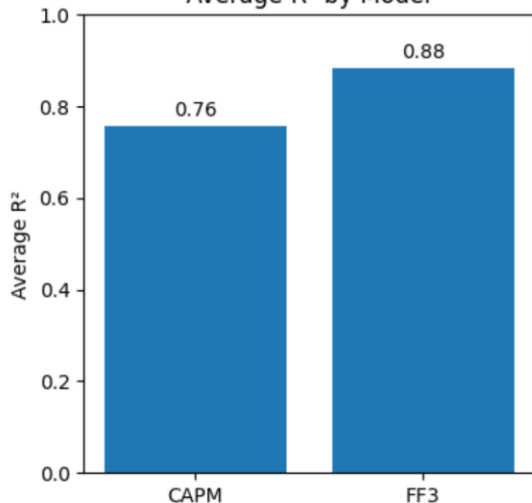
Jul-1926 to Aug-2025

Average R² by Model

Portfolio Alphas with 95% CIs (Top |alpha|)

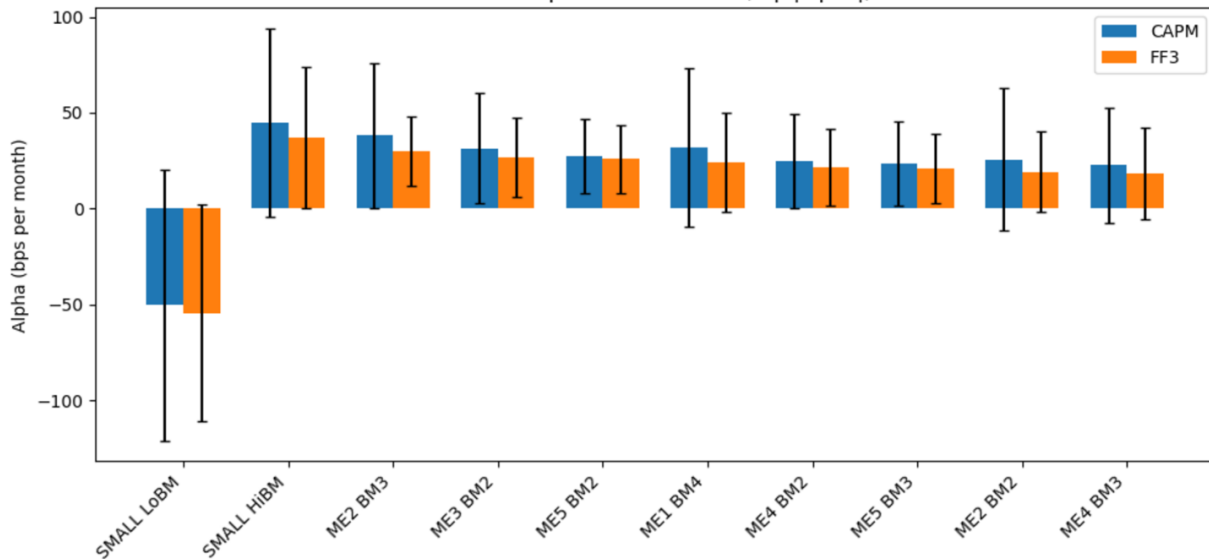# Jul-2000 to Aug-2020

Fama–MacBeth Cross-Sectional Results

	lambda_mean	se_fm	t_fm	se_shanken	t_shanken
Const	0.011296599	0.003389249	3.333068974	0.003389249	3.333068974
Mkt-RF	-0.00625534	0.004068211	-1.537614579	0.004204582	-1.487743514
SMB	0.00189542	0.001567639	1.209092081	0.001620188	1.169876331
HML	0.005482863	0.001385259	3.958004215	0.001431695	3.829630117

After accounting for market, size, and value factors, there remains **an average unexplained return (pricing bias)** across portfolios.

The FF3 model still doesn't completely explain returns (though it does better than CAPM).

- HML (p < 0.01) → strong value premium.

- SMB weakly priced.

- Negative λ_m implies market factor may be over-compensated.

- Shanken adjustment did not alter significance materially.

Interpretation

Key Takeaways

- CAPM fails jointly (large pricing errors).

- Adding SMB & HML improves fit → $R^2\uparrow$ & $\alpha\downarrow$.

- Value effect dominant driver of returns.

- Partial support for multi-factor models in explaining cross-section.

Economic Implication

- Markets reward exposure to systematic value risk.

- Investors should account for multi-dimensional risk beyond market beta.