

Portfolio Risk Analysis

1. Introduction

This project conducts a multi-factor risk analysis of a U.S. equity portfolio, focusing on predicting returns and identifying key sources of risk. Techniques used include Lasso, Gradient Boosting, and PCA regression. Portfolio downside risk is also assessed using Value at Risk (VaR) methods.

2. Data Sources

Factor Category	Key Components	Data Sources
Macroeconomic	10Y-2Y Treasury Spread, CPI, GDP Growth, Credit Spread	FRED
Style	Fama-French 5F (Mkt-RF, SMB, HML, RMW, CMA)	Kenneth French Data Library
Market	S&P500, Gold, Crude Oil	yfinance

3. Methodology

- Predictive Modeling:**
Applied Lasso, Gradient Boosting, and PCA regression to forecast portfolio returns. PCA was used to extract uncorrelated latent factors explaining 90% of return variance.
- Model Evaluation:**
Compared models using R^2 , RMSE, MAE, and Q-Q plots to assess fit and residual normality.
- Risk Attribution:**
Computed Marginal Risk Contribution (MRC) to decompose portfolio variance across model-identified factors.
- VaR Estimation:**
Estimated and backtested VaR using historical simulation, ARIMA+GARCH, and model-based simulations from the best-performing predictive model.

4. Future Enhancements

- Rolling Window Modeling:**
Implement time-varying models to better capture changing market conditions and risk exposure.
- Expanded Factor Universe:**
Include global macro indicators, sentiment data, and alternative style factors for a more comprehensive risk assessment.