

Quantitative Asset Management

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Course Description and Content

This course offers an in-depth exploration into the principles and practices of modern portfolio management and investment strategies grounded in quantitative analysis. The course covers theoretical foundations and empirical applications spanning mean-variance optimization, factor models, return predictability, financial machine learning, Bayesian and robust portfolio construction techniques. The focus of the course is on the models' application in the context of real-world financial markets.

Throughout the course, emphasis is placed on the development of analytical skills and the application of quantitative methods, including practical implementations in Python. The course aims to equip students with a nuanced understanding of how quantitative techniques can be effectively used to navigate parameter uncertainty and enhance portfolio performance.

1 Mean-Variance Portfolio Choice

1.1 Theory

1. Mean-Variance portfolio choice with N risky assets and a riskless asset
2. Sharpe ratios, mean-variance portfolios and the mean-variance frontier
3. Mean-Variance portfolio choice with N risky assets and no riskless asset

1.2 Empirical Performance and Applications

1. Portfolio sensitivity analysis
2. Out-of-sample performance
3. Shrinkage estimation
4. Portfolio constraints
5. Resampling
6. Naive diversification: risk parity and $1/N$ rules

2 Factor Models

2.1 Risk Decompositions

1. A one-factor model
2. A K -factor model
3. Building portfolios with constrained factor exposures

2.2 Asset Pricing Models

1. Beta-pricing and mean-variance efficiency
2. Capital Asset Pricing Model
3. Arbitrage Pricing Theory
4. Empirical multifactor models
5. Regression-Based Tests of Linear Factor Models

2.3 Factor Investing

1. Multifactor models and portfolio management
2. Separating alpha and factor investment
3. Portfolio constraints

3 Return Predictability

3.1 In-Sample Evidence

1. Market timing and efficient markets
2. Predictive regressions
3. Present value formulas

3.2 Out-of-Sample Analysis

3.2.1 Time-series returns forecasts

1. Machine learning methods: LASSO, Elastic-Net, Combination Elastic-Net
2. Empirical evidence (S&P500)

3.2.2 Cross-Sectional return forecasts

1. Machine learning methods: Combination, Smoothed, and Encompassing LASSO
2. Empirical evidence (common stocks on NYSE, AMEX, and NASDAQ)

4 Bayesian and Robust Portfolio Choice

4.1 The Black-Litterman Model

1. Incorporating CAPM prior and investor views
2. Alternative benchmark portfolios
3. Alternative asset pricing priors

4.2 Bayesian Portfolio Analysis

1. Bayesian vs. classical framework
2. Bayesian allocation with i.i.d. returns
3. Bayesian allocation with predictable returns

4.3 Robust Portfolio Analysis

1. Uncertainty aversion and the max-min approach
2. Robust portfolio analysis with parameter and model uncertainty
3. Robust-Bayesian portfolio analysis