Boosted.ai

Boosted.ai Portfolio Optimization - Methodology

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Reduce Risk Optimization

Objective Function: $w\Sigma w^T$

$$Alternate\ Formula: \sum_{i=1}^{m} \sum_{j=1}^{n} w_i w_j Cov(r_i, r_j)\ w: weight\ of\ stock\ i/j, r: return\ of\ stock\ i/j$$

Where:

- **Weights** (w): represents the vector of portfolio weights for each asset.
- **Covariance Matrix** (Σ): is the covariance matrix of trailing 1 year returns.
- w^T is the transpose of the weight vector.

Understanding the variables

- **Covariance Matrix** (Σ)**:** This matrix is a key input and represents how different assets in the portfolio move relative to each other.
- **Weights** (w)**:** These are the proportions of the total portfolio value invested in each asset.
    - The operation results in a scalar value representing the variance of the portfolio.
    - Taking the square root of this variance gives us the standard deviation or volatility of the portfolio.

Iterative Weight Adjustments:

- The process involves adjusting the weights (w) of different assets in the portfolio to find the combination that results in the lowest possible portfolio volatility. This is typically done using multiple iterations to understand if increasing or decreasing weights result in reduced portfolio volatility.

Goal:

- To find the set of weights that minimizes the overall portfolio volatility.

Information Ratio

Objective Function:

$$Let\ w^* = w - w_{mkt\ cap}$$

$$(Weights \cdot Signals) \,/\, \sqrt{w^* \Sigma w^{*T}}$$

Where:

- **Weights** (w): Vector of stock weights the amount of the portfolio invested in each stock.
- **Signals** (s): Vector of stock signals, representing the ranking of each stock.
- $w^* \Sigma w^{*T}$: Represents the Tracking Error component, as found in the Tracking Error optimizer
    - **Weights** (w^*): the vector of portfolio weights - market cap weights of the universe for each asset.
    - **Covariance Matrix** (Σ): the covariance matrix of trailing 1 year returns.
    - w^{*T} is the transpose of the weight vector.

Iterative Weight Adjustments:

- The platform iteratively adjusts weights, analyzing how these changes impact the Information Ratio over the last 1Y period.
- This approach uses signals instead of historical data to ensure that the optimizer is forward-looking.

Goal:

- The objective is to find the weights that yield the highest Information Ratio.

Difference between v1 and v2 Optimizers

v1 Optimizers

- Stocks in the model's universe are ranked from 1 (highest) to the last position.
- After ranking, the stocks are grouped into buckets. Each bucket contains stocks within a certain range of rankings.
- For instance, the top-ranked stocks (e.g., ranks 1-10) might be in one bucket, the next set (e.g., ranks 11-20) in another, and so on.
    - Buckets are grouped based on ventiles of the stock universe, so in the S&P 500, there would be 25 names in each bucket
- Each bucket's performance is analyzed, typically based on historical data, to estimate expected returns or other metrics based on the optimizer.
- The analysis aims to identify which buckets historically have the highest Alpha, Sharpe, or VaR Sharpe (depending on the optimizer)

v2 Optimizers

- In contrast to the v1 optimization methods, any v2 method optimizes using the stock signal rather than bucketing based on rank.
- This means that names that have higher signals will get higher weightings in the portfolio.

Max Alpha & Max Alpha v2

Max Alpha v1

Objective Function: $Weights \cdot Expected\ Return\ (By\ Ventile)$

Where:

- **Weights** (w): These are the proportions of the portfolio allocated to each bucket of stocks, categorized by their rankings.
- **Expected Return (By Rank Interval):** The expected return for each bucket, is calculated based on 1Y historical performance data.

Iterative Weight Adjustments:

- Adjusts weights across different ranked buckets to maximize the overall expected return.

Goal:

- Aims to maximize alpha by focusing on higher-ranked stocks and their potential for higher expected returns.

Max Alpha v2

Objective Function: $Weights \cdot Signals$

Where:

- **Weights** (w): Vector of stock weights the amount of the portfolio invested in each stock.
- **Signals** (s): Vector of stock signals, representing the ranking of each stock.

Iterative Weight Adjustments:

- Weights are adjusted based on the strength of individual stock signals.

Goal:

- Continuously monitors stock signals and dynamically adjusts weights to respond to market changes and stock performance.
- Maintains a portfolio structure that is more attuned to real-time market dynamics and individual stock prospects.

Max Sharpe & Max Sharpe v2

Max Sharpe v1

Objective Function: $Weights \cdot Expected\ Return\ (By\ Ventile) \ / \ w\Sigma w^T$

Where:

- **Weights** (w): These are the proportions of the portfolio allocated to each bucket of stocks, categorized by their rankings.
- **Expected Return (By Rank Interval):** The expected return for each bucket, calculated based on 1Y historical performance data.
- $w\Sigma w^T$: Represents the risk component, as found in the reduce risk optimizer

Iterative Weight Adjustments:

- Focuses on adjusting weights to maximize the Sharpe ratio

Goal:

- Optimize the balance between high expected returns and controlled portfolio risk.

Max Sharpe v2

Objective Function: $Weights \cdot Signals \ / \ w\Sigma w^T$

Where:

- **Weights** (w): Vector of stock weights the amount of the portfolio invested in each stock.
- **Signals** (s): Vector of stock signals, representing the ranking of each stock.
- $w\Sigma w^T$: Represents the risk component, as found in the reduce risk optimizer

Iterative Weight Adjustments:

- Adjusts weights based on stock signals, focusing on optimizing the Sharpe ratio by balancing signal strength with risk control.

Goal:

- Achieve a portfolio structure that efficiently combines high-potential signals with effective risk management.

Max VaR Sharpe & Max VaR Sharpe v2

Max VaR Sharpe v1

Objective Function:

$$Weights \cdot Expected\ Return\ (By\ Ventile) \,/\, Historical\ Volatility\ of\ Returns$$

Where:

- **Weights**: These are the proportions of the portfolio allocated to each bucket of stocks, categorized by their rankings.
- **Expected Return (By Rank Interval):** The expected return for each bucket, is calculated based on 1Y historical performance data.
- **Historical Volatility of Returns:** Calculated as the historical volatility of the portfolio returns over the past year.

Iterative Weight Adjustments:

- Adjusts weights to maximize the VaR Sharpe Ratio, focusing on the ratio of expected return to the actual 1Y historic volatility of the returns.

Goal:

- Optimize the balance between high expected returns and portfolio volatility.

Max VaR Sharpe v2

Objective Function:

$$Weights \cdot Signals \,/\, Historical\ Volatility\ of\ Returns$$

Where:

- **Weights** (w): Vector of stock weights the amount of the portfolio invested in each stock.
- **Signals** (s): Vector of stock signals, representing the ranking of each stock.
- **Historical Volatility of Returns:** Calculated as the historical volatility of the portfolio returns over the past year.

Iterative Weight Adjustments:

- Adjusts weights based on stock signals, focusing on optimizing the VaR Sharpe Ratio by balancing signal strength with actual 1Y historic portfolio volatility.

Goal:

- Achieve a portfolio structure that efficiently combines high potential signals with effective risk management of actual volatility.

Min Skew

Objective Function: $\sigma\ (weights\ \cdot\ returns)$

Where:

- **Weights** (w): Vector of stock weights the amount of the portfolio invested in each stock.
- **Returns** (r): Vector of portfolio returns, representing the returns of each stock in the portfolio over a 1-year period.

Iterative Weight Adjustments:

- The optimizer adjusts the weights (w) of individual stocks in the portfolio to achieve a distribution of returns with minimal skewness.
- Skewness in this context refers to the asymmetry in the distribution of returns. A minimization of skewness aims to avoid portfolios that are biased towards extreme returns (either positive or negative).

1Y Time Frame

- The calculation and adjustments are based on the trailing 1-year portfolio returns (r), providing a recent historical perspective for decision-making.

Goal:

- The primary goal of this optimizer is to create a portfolio that ensures returns are not prone to extreme variations.

Minimize Var

Objective Function: $\boldsymbol{min}\ (Max\ 1D\ Drawdown)$

Where:

- **Max 1D Drawdown is calculated using** $(weights\ \cdot\ returns)$
  - **Weights** (w): Vector of stock weights the amount of the portfolio invested in each stock.
  - **Returns** (r): Vector of portfolio returns, representing the returns of each stock in the portfolio over a 1-year period.

Static Portfolio Weights:

- The optimizer operates under the assumption that the portfolio **Weights** (w) remain constant over the last year.
- These weights represent the fixed proportion of the portfolio allocated to each stock.

Iterative Weight Adjustments:

- The optimizer simulates various weight combinations, keeping an eye on the worst single-day performance for each scenario. The key is to identify a set of weights that, when applied retrospectively, results in the least severe maximum drawdown.

Goal:

- The primary goal of the Min VaR optimizer is to identify a portfolio structure that minimizes the risk of significant short-term losses, characterized by the lowest single-day drawdown.

Tracking Error

This optimizer is very similar to the reduce risk optimizer, but instead of the weights being the portfolio weights multiplied by the covariance matrix, it is instead the weight of the portfolio minus the market cap weight of the universe multiplied by the covariance matrix.

Objective Function:

$$Let\ w^* = w - w_{mkt\ cap}$$

$$Min\ Tracking\ Error\ =\ w^* \Sigma w^{*T}$$

Where:

- **Weights (w)**: represents the vector of portfolio weights for each asset.
- **Weights ($w_{mkt\ cap}$)**: represents the vector of market cap weights for each asset in the universe.
- **Weights** (w^*): the vector of portfolio weights - market cap weights of the universe for each asset.
- **Covariance Matrix (Σ)**: the covariance matrix of trailing 1 year returns.
- w^{*T} is the transpose of the weight vector.

Iterative Weight Adjustments:

- The process involves adjusting the weights (w^*) of different assets in the portfolio to find the combination that results in the lowest possible portfolio tracking error.

Goal:

- To find the set of weights that minimizes the overall portfolio tracking error.

Additional Constraints for Portfolio Optimizers

Optimizer settings, particularly in the context of portfolio management, dictate how closely the optimizer will adhere to certain constraints or parameters.

Tight Optimizer Setting

- The "Tight" setting is designed to keep the portfolio weights very close to the initial portfolio weights of the stocks.
- Constraint: Portfolio weights are allowed to deviate by ±Deviation Amount
    - **Deviation Amount** = (Total % Portfolio Long / # of Stocks) / 5

Loose Optimizer Setting

- The "Loose" setting takes flexibility a step further.
- **New Constraints:**
    - **New Max Weight**: The maximum weight of any stock is adjusted to be three times its current maximum weight.
        - New Max Weight = (Max % Long) * 3
    - **New Min Weight:** The minimum weight is similarly adjusted to be three times less than its current minimum weight.
        - New Min Weight = (Min % Long) / 3

Wide Optimizer Setting

- The "Wide" setting offers much more flexibility in terms of weight allocation.
- **Constraint**: There's no specified lower bound, but the upper limit is set to the stock's maximum allowable weight based on the portfolio construction max % long setting.