Morningstar EnCorr

Resampling Mean Variance Optimization

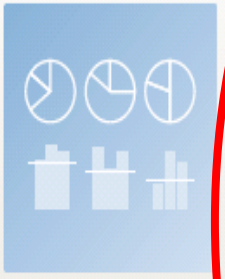
MORNINGSTAR®

EnCorr Modules

Analyzer

Explore historical and current investment data

Inputs Generator

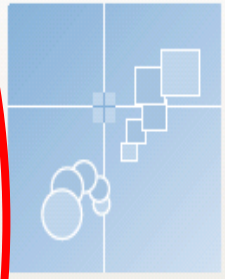


Develop, refine, and test asset class assumptions

Optimizer Plus

Build and analyze portfolios along the efficient frontier

Attribution



Examine manager style consistency and investment decisions

Allocator

Determine manager mix to implement asset allocation plan

Scenario Builder

Perform "what if" analyses under multiple conditions

Overview

- Traditional Mean Variance Optimization (Asset Only)
- Liability-Modeling Mean Variance Optimization (Asset and Liabilities)

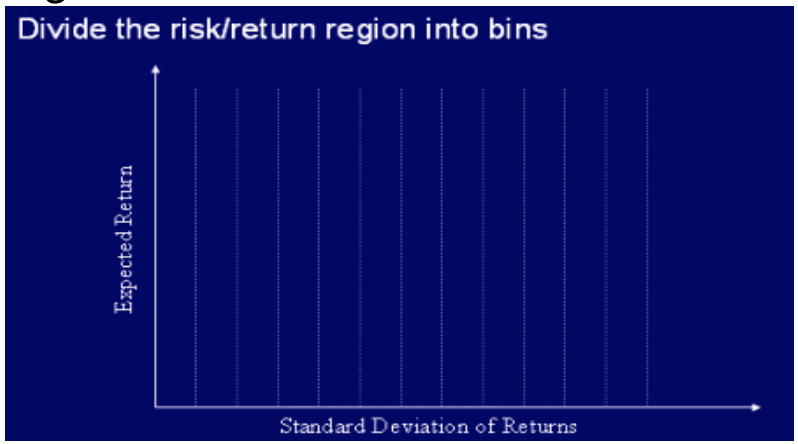
- **Resampling Mean Variance Optimization**

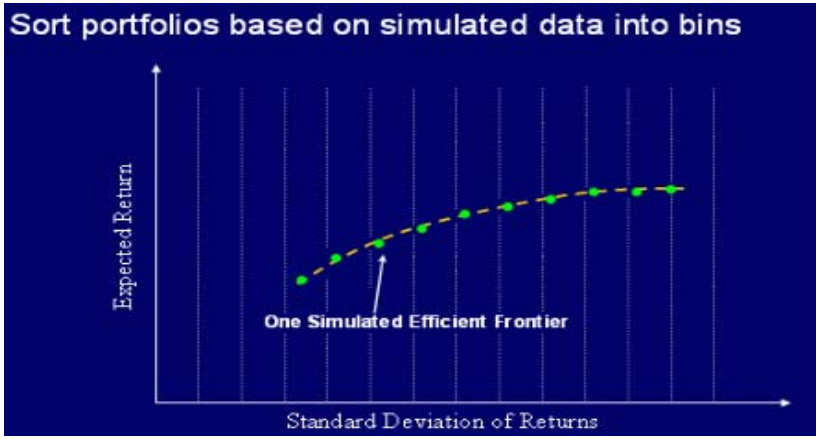
Overview

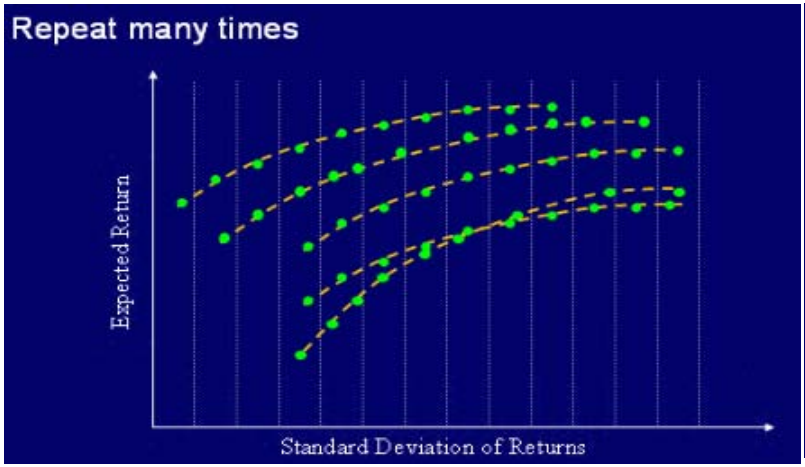
- Resampling Mean Variance Optimization
  - Resampling is a combination of the Base Case Optimization (traditional MVO) and Monte Carlo Simulations.
  - Resampling recognizes that Capital Market Assumptions are forecasts and not a "sure thing". Therefore, there is no "certainty" to lead to highly concentrated portfolios.
    - Result: resampling produces more diversified and robust portfolios.

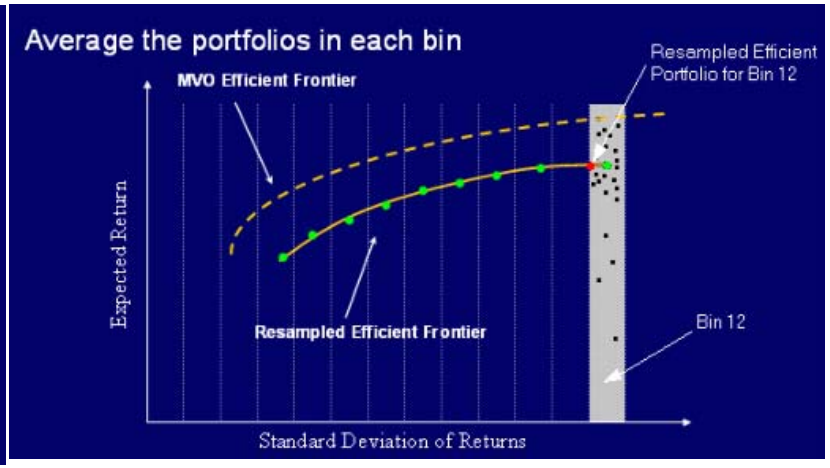
Methodology

- Big Picture









Methodology

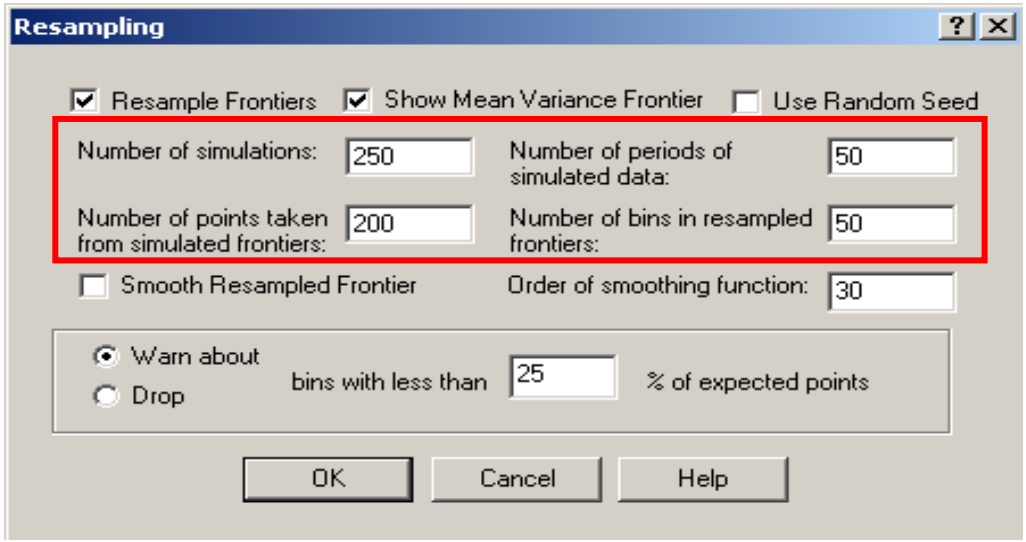
- Simulation Process Summary
    1. Form Inputs
    2. Draw random sample based on inputs
    3. Compute means, standard deviation, and correlations
    4. Run MVO based on sample statistics to create simulated efficient frontiers
    5. Repeat Steps 2 to 4 based on your number of simulation settings

Methodology

- Resampled Frontiers Summary
  - Portfolios are then selected from these simulated frontiers and sorted into bins by their standard deviation.
  - The portfolios in each bin are then averaged to generate the resampled efficient portfolio.
  - The resampled efficient frontier is based on these resampled portfolios.

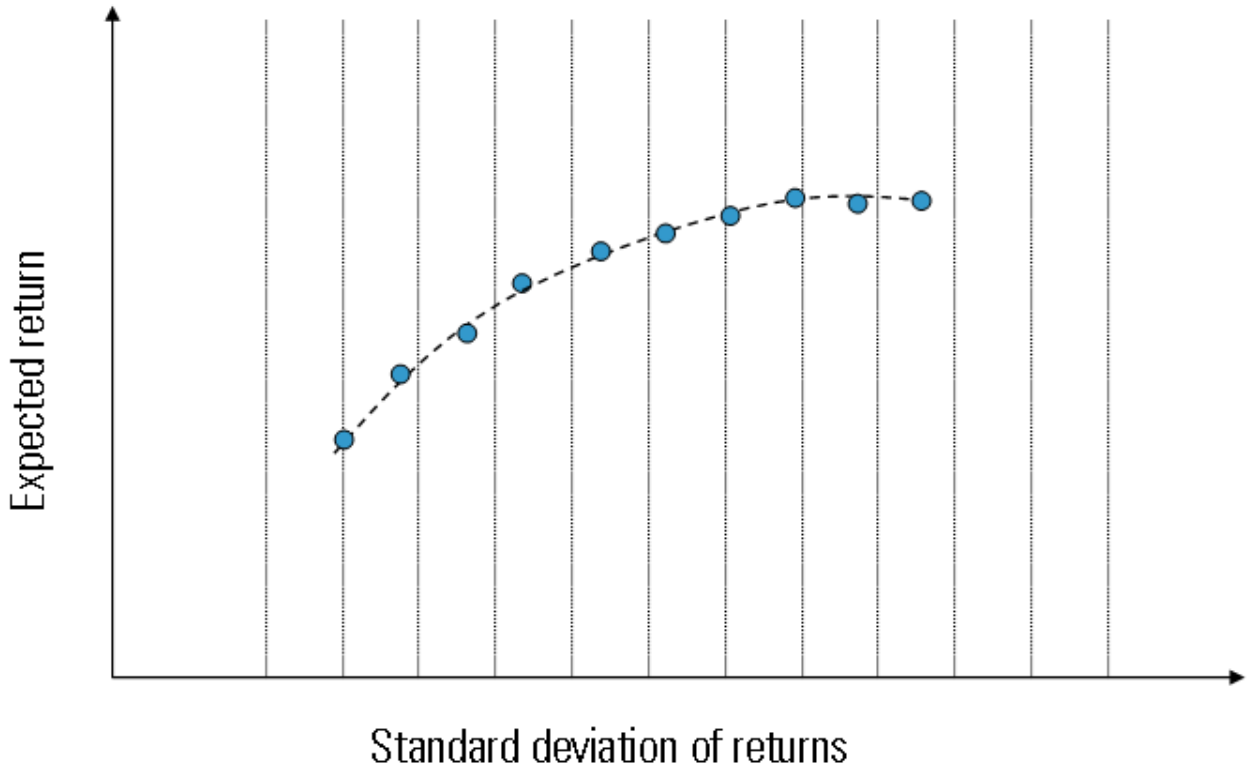
Methodology

- Settings
  - Number of simulations (250)
  - Number of points taken from simulated frontiers (200)
  - Number of periods of simulated data (50)
  - Number of bins in resampled frontiers (50)



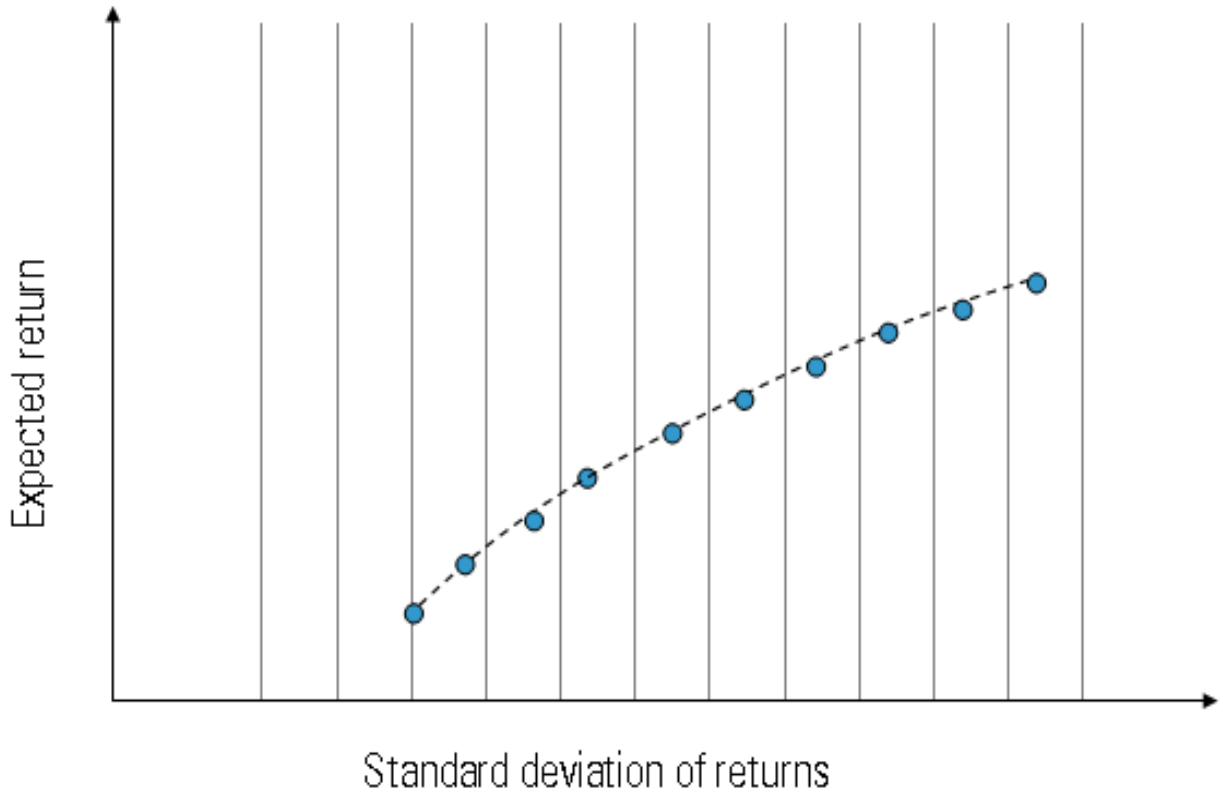
Methodology

- Each set of simulated Capital Market Assumptions results in one simulate MVO efficient frontier



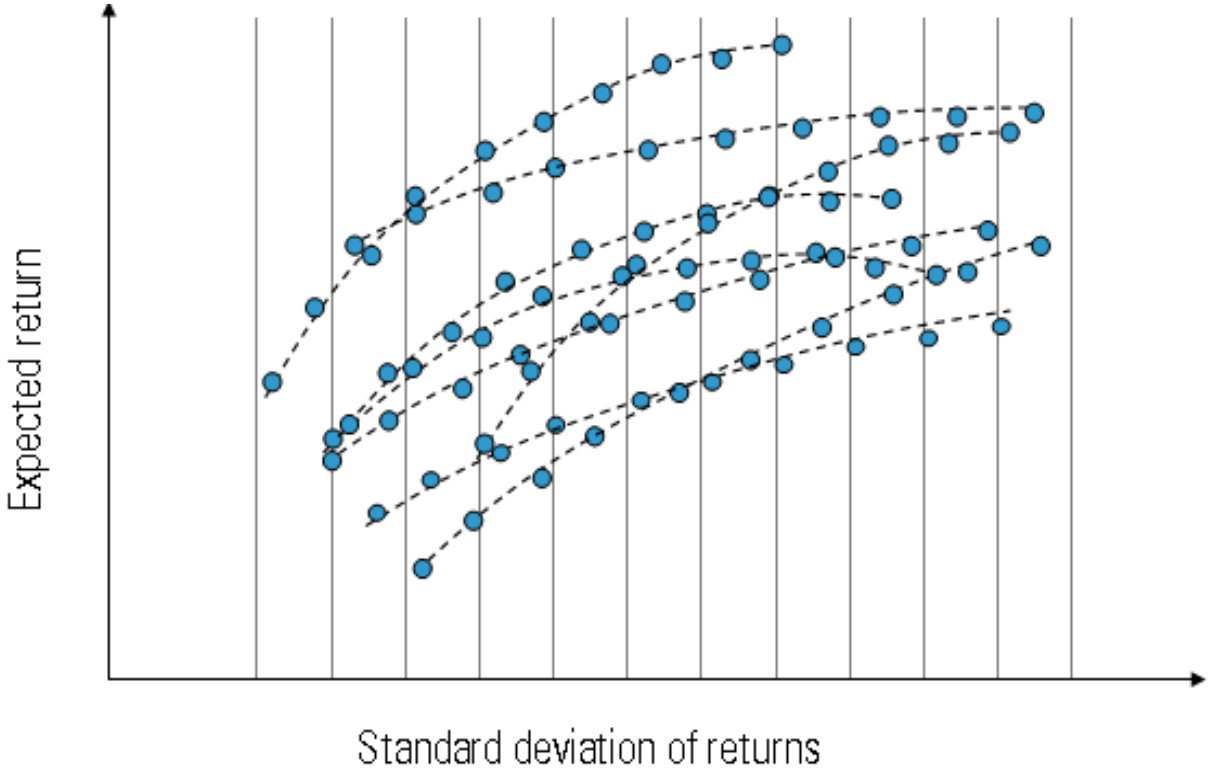
Methodology

- Repeatedly generate *simulate* Capital Market Assumptions, each time generating a *simulate* MVO efficient frontier



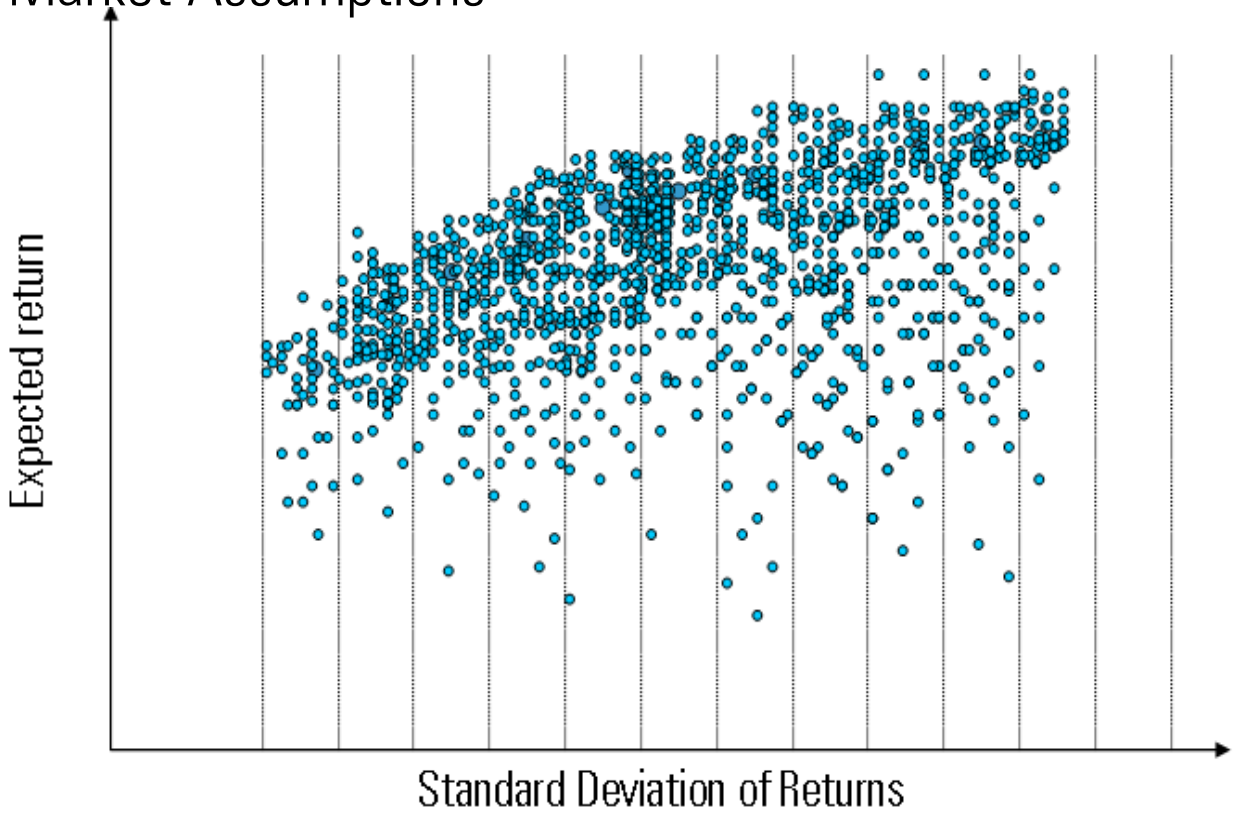
Methodology

- Repeatedly generate *simulate* Capital Market Assumptions, each time generating a *simulate* MVO efficient frontier



Methodology

- Each dot represents an asset allocation based on simulated Capital Market Assumptions

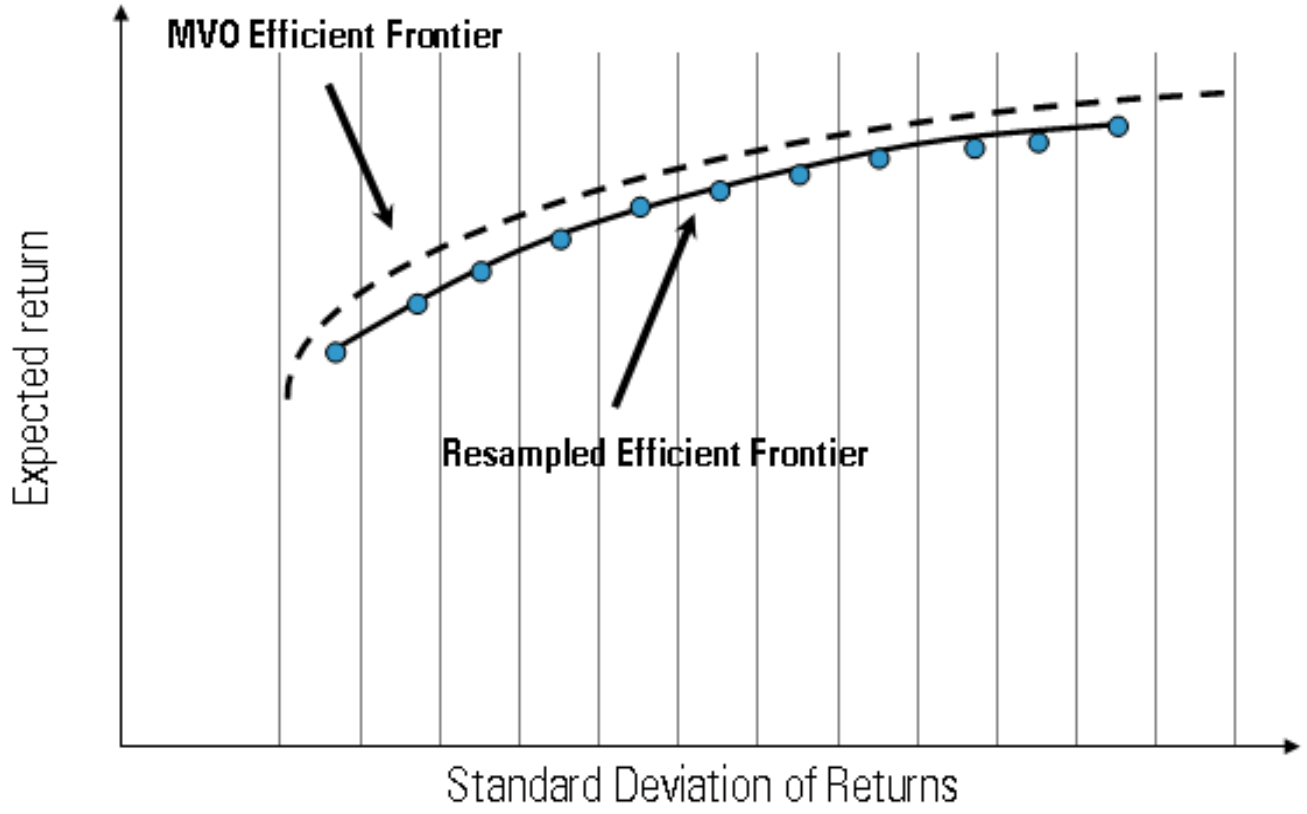


Methodology

- With in each bin, the asset allocations are averaged to determine the average asset allocation of that bin

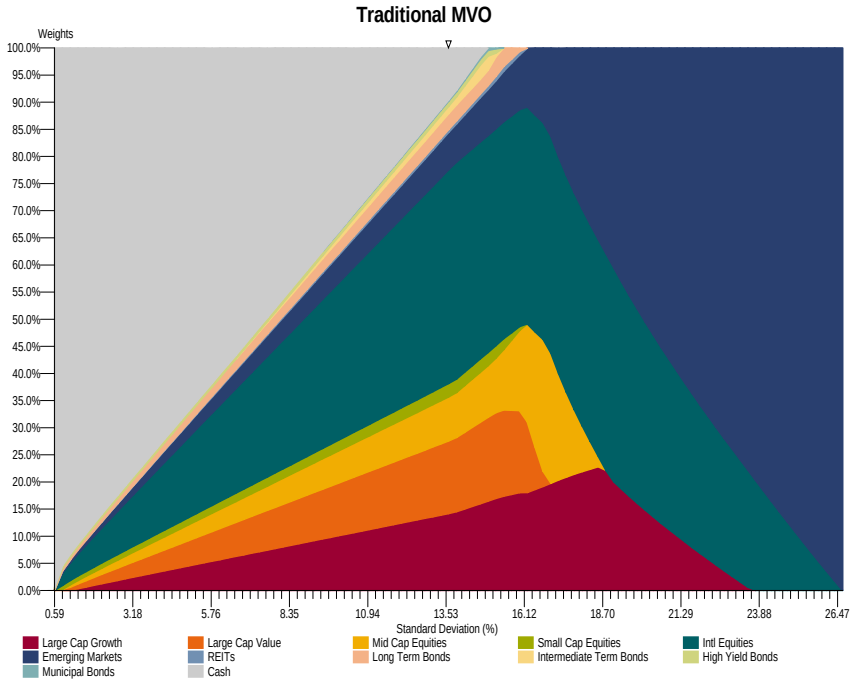
Methodology

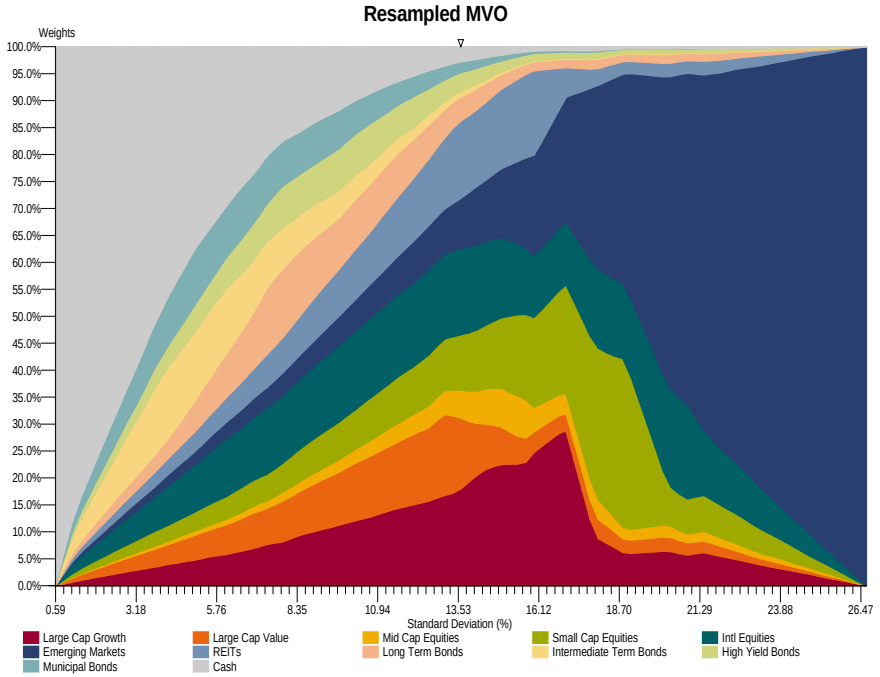
- The resampled frontier is created by connecting the average asset allocation of the bins



Results

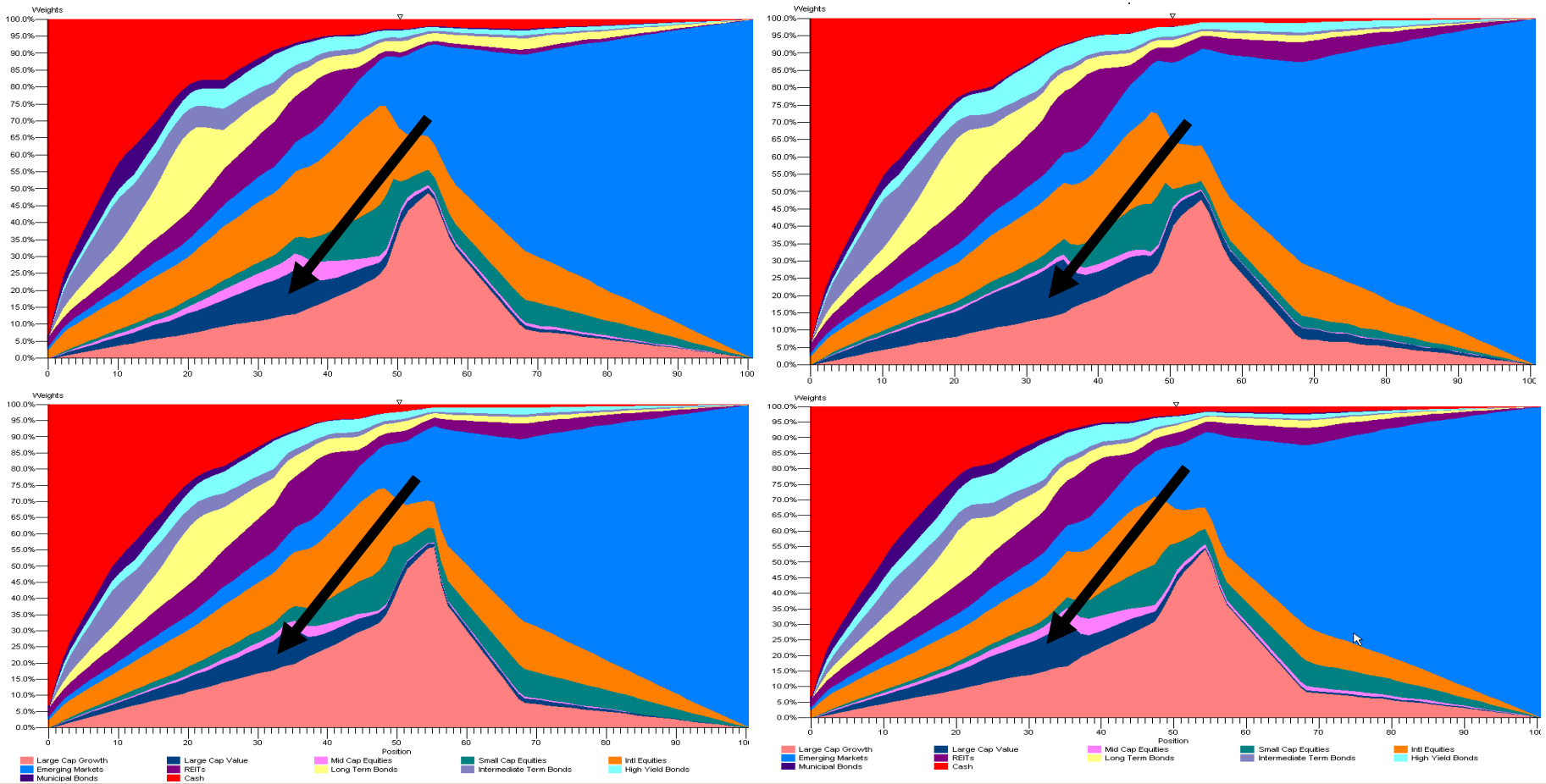
- Base Case vs. Resampled Case Optimization





Results

- Random Seed

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