The Beginner's Guide to Taxable Portfolio Optimization

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Overview

- Taxable portfolio optimization methodology
- Guidelines for sensible inputs
- Troubleshooting "unintuitive" answers
- "Tricks" for special cases
- Its not black magic, its using common sense

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Optimization Objective Function

● Investor objective is to maximize risk- adjusted returns net of costs:

$$U = \alpha - ((\sigma_s^2 / RAP_s) - (\sigma_u^2 / RAP_u)) - ((C + T) * A)$$

Return   Risk Component   Implementation Cost

  – Most commercial portfolio optimizers uses the objective function described in Levy and Markowitz (1979).

  – Portfolio return variance is the proper measure of risk because the difference between the arithmetic average rate of return and the geometric average rate of return is proportional to the variance (see Messmore, 1995)

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Objective Function Explained

- $U = \alpha - (\sigma_s^2 / RAP_s) - (\sigma_u^2 / RAP_u) - ((C + T) * A)$

  - α **= the "certainty equivalent" expected portfolio return**
  - σ_s^2 = portfolio variance risk due to common factors (correlation across securities)
  - σ_u^2 = portfolio variance risk due to stock specific risks
  - **RAP = risk tolerance**
  - C = transaction costs for the optimization
  - T = capital gain taxes for the optimization
  - **A = amortization constant**

  Items in **bold** are what user's have responsibility to set sensibly

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Constraints

- Any optimization can be run with a variety of constraints
- Constraint misuse is the largest contributor to failed optimizations
- Class I constraints are those that are linear combinations of security weights:
  - Position limits
  - Industry and sector limits
  - Factor Exposure or Penalty File Variables
- Class II constraints are other constraints such as:
  - Maximum number of assets
  - Maximum turnover
  - Minimum trade sizes
  - Maximum realized capital gain

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Constraint Feasibility

- If there are conflicts among the constraints, the portfolio optimization is called "infeasible"
- Our system will try to find a reasonable solution to infeasible problems but this does not mean that you can always get an intuitive result
- Consider the portfolio construction:
  - Max number of assets equal to 20
  - Maximum weight in a position is 4%
  - Sometimes conflicts are very subtle and hard to notice

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Optimization in Steps

- First, the optimizer attempts to find a portfolio that meets all Class I constraints, if one exists
  - Next it will find the feasible portfolio that has the least turnover from the initial portfolio. This is the real starting point of the process
- Once a feasible portfolio is found, the main optimization occurs.
  - Our goal is to adjust the security weights to maximize the objective function, given your input settings
- Violations of Class II constraints are checked when maximum utility is achieved
- If there are any violations of Class II constraints that can be fixed, the optimizer will adjust the security weights to fix them
- You're done

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Stopping Criteria

- The optimization process normally stops when the maximum of the objective function is reached within a certain level of "precision"
- Constraint conflicts can cause the process to stop prematurely
  - Imagine a concentrated portfolio where sector constraints require 65% two way turnover to be feasible. If you set a turnover constraint below 65% you won't get the fully correct answer. It can't be done.
  - Same concentrated portfolio but where almost all the positions have embedded capital gains. If you set a "Max Realized Capital Gain constraint" equal to something small (say zero), its not possible and the process will stop prematurely

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Constraint Priority

- If there are conflicts among the constraints, the optimizer will try to come up with a reasonable compromise
  - Class I constraints have priority over Class II constraints that are not "stopping criteria"
  - Within Class I constraints, position sizes are higher than grouping constraints, that are in turn higher than factor/penalty constraints
  - There is no specific priority among Class II constraints, so the optimizer tries to find the best compromise based on the objective function inputs
  - Constraints on stopping criteria can cause premature termination and unintuitive results
  - Class II constraints can be violated if they drive the portfolio very far away from the unconstrained optimal state

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"Pilot Error" Issues

- Most support issues related to optimizations are setups that are either mathematically impossible (infeasible) or economically irrational, or both.
  - The Northfield optimizer basic system has been in use by hundreds of institutions since 1989
  - The tax functionality was added in 1996, and has also been used by hundreds of institutions for tens of thousands of portfolios
  - If you get a weird answer, its probably not a bug in the system
- Review the "Messages" tab output report after every run
  - Any unusual aspects of the problem will result in warning messages in this report

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Feasible but Economically Irrational

- Users are responsible for setting reasonable inputs for three aspects of the problem
  - Certainty equivalent expected returns (CEER), consider both expectations and probability of being correct
  - RAP, the investor's willingness to exchange variance risk and return.
    - This can be subdivided into common factor risks and stock specific risks.
  - Amortization constant, defining the horizon over which costs (trading costs and taxes) that occur at a moment in time are spread into costs per unit time (i.e. reduction in return)

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CEER & RAP
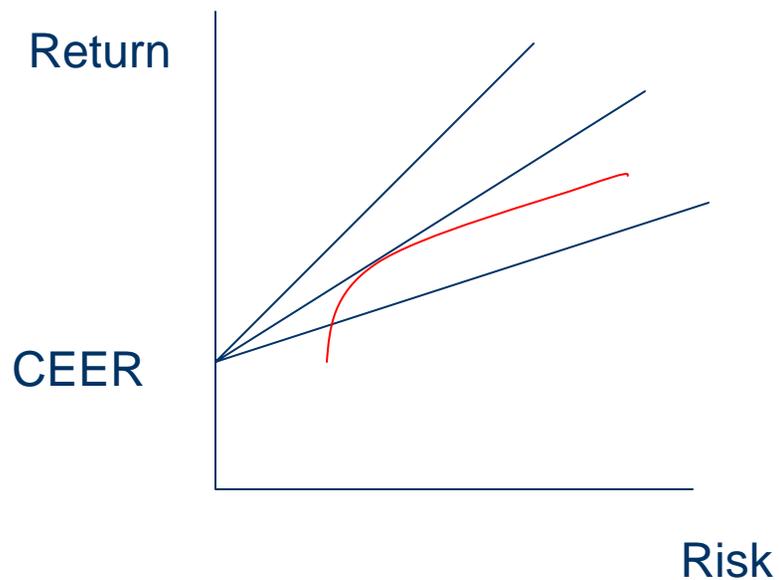
Return

Risk

CEER

Slope = 1/RAP

$CEER_1 = CEER_0 + Risk/RAP$

Where $CEER_0$ is risk free

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Expected Return Scaling

- Index portfolio, CEER = 0 => Risk minimization
- Active portfolio, scale benchmark-relative return expectations to reflect your probability of being correct
- Assume:
  - You believe IBM will outperform the market by 30% in the next six months. You don't know what IBM will do after that
  - You try to run your portfolios with 25% a year turnover
  - When you make predictions of stock relative performance, you get the sign right 55% of the time and get it wrong 45%
  - What's your CEER?
- There is a huge finance literature on alpha scaling that involves subtleties that are strategy dependent
  - Northfield will introduce an "automatic" alpha scaling tool to the optimization system

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Quantifying Risk Tolerance as RAP

- RAP is the investor's willingness to trade between risk and return
- Assuming CEER return scaling, rational values are in the range of 0 < RAP < 200
  - Zero would represent a totally risk averse investor (hide the money under the mattress)
  - 200 represents an investor that only cares about maximizing long term growth between now and the end of time
- Two good rules of thumb for high net worth investors
  - In absolute risk terms, RAP approximately 2 times investor's net worth as a percentage of total assets. This will vary over the investor life cycle
  - In benchmark relative terms, RAP approximately 6 times the desired tracking error
  - Note that these values are what are sensible for investors; they don't necessarily express an asset manager's desire to not get fired

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Cost Amortization Constants

- A good starting value for the amortization constant is the percentage expected annual "one way" turnover
- Adjust for:
  - Time value of money. Deferring costs is more valuable when rates of return are high
  - Possibility of stepped up basis at death. If you're 99 years old, you don't want to pay any capital gains now
  - The incremental tax on short term gains over long term gains is always spread over the "remaining time to long term status"
- Later in 2007, Northfield will introduce a change in the amortization constant process that corrects for the traditional Markowitz assumption that the future is one long period.
  - Performance measurement services and the IRS don't agree

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Concentrated Positions

- Set the optimizer "non linear transaction cost" function "ON"
  - This makes the optimizer do transactions in small bites that better diversify concentrated positions, rather than a few big trades
- Carefully consider any constraints on maximum tracking error (risk), or maximum realized capital gain
  - Its very easy to be so risk averse that you spend so much in taxes that its crazy
  - Its also very easy to say "optimize the portfolio subject to a max capital gain of X". Clients often do this without understanding the real economic tradeoffs that are implied.

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"Stupid Optimizer Tricks"

- **Negative tax rates are not allowed**
  - To realize gains, adjust the position cost basis so gains become losses and losses become gains.

- **High net worth investors usually care about both absolute risk and benchmark relative risk**
  - You can express both by mixing cash into the benchmark. If the client is twice as worried about absolute risk and return, make the benchmark 2/3 cash and 1/3 your regular benchmark index

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"Stupid Optimizer Tricks" cont.

- If you use CEER values, you can adjust them to reflect taxes on dividends.
  - Assume a stock that has an expected benchmark relative return of zero on a pretax basis, but a dividend yield that is 2% greater than the benchmark. The after tax expected return is negative.

- The opportunity for tax loss harvesting is enhanced when you have a higher degree of cross-sectional dispersion of returns within portfolios
  - There is a "tax alpha" for stocks that is positively related to volatility

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Getting Help

- Always review your "Messages" tab report with respect to the mathematical feasibility and economic reasonableness of your case

- Almost all the conceptual issues are in : : <u>Investment Management for Taxable Private Investors</u> by Wilcox, Horvitz and diBartolomeo. Published by CFA Research Institute

- Northfield Optimizer Online HELP is very extensive

- Northfield's website, <u>www.northinfo.com</u> has a large set of searchable research papers, newsletters and conference presentations with related content

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