Project Report: Transaction Cost-Aware Portfolio Optimization with Survival Constraints

Narek Mesropyan

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Methodology: Implementation of Lobo, Fazel, and Boyd (2002) Iterative Heuristic for Fixed Transaction Costs
Code Repository: GitHub

1 Problem Setup

Tested on 5 major technology equities (AAPL, MSFT, GOOGL, AMZN, TSLA) using 1-year historical returns from Yahoo Finance (March 2025–2026). **Stress test:** GOOGL expected return artificially boosted to 50% annualized.

2 Methodology

Baseline (Naive Mean-Variance)

Standard optimizer ignoring frictions produces corner solution:

Ticker	Naive Weight	Rationale
AAPL	0.00%	
MSFT	0.00%	
GOOGL	**100.00%**	$\mu_{\text{GOOGL}} = 50\% \gg$ others
AMZN	0.00%	
TSLA	0.00%	

Survival Optimizer (Iterative Heuristic)

Implements Section 3.4 of Lobo et al. (2002). Fixed costs approximated via reweighted ℓ_1 norm:

$$\max_w \ \mu^T w - \alpha\|w - w_0\|_1 - \sum_i \frac{\beta}{|\text{trade}_i^{(k-1)}| + \delta}|\text{trade}_i|$$

Parameters: $\alpha = 0.001$ (slippage), $\beta = 0.0005$ (fixed fee), $\delta = 10^{-5}$, 10 iterations.

Survival Constraints (SOCP):

1. Budget: $\sum_i w_i = 1$
2. No-shorting: $w_i \geq 0$
3. Position limit: $w_i \leq 0.40$
4. Volatility cap: $w^T \Sigma w \leq 0.05^2$

3 Results

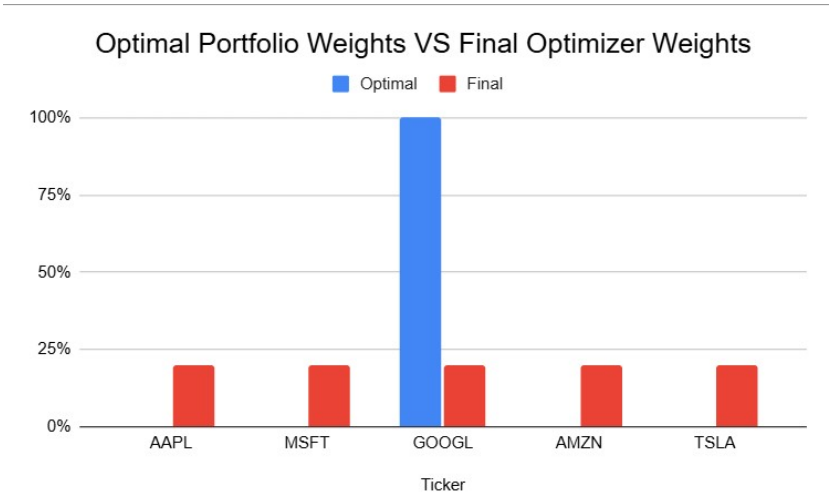

Figure 1: Naive vs. Survival-Optimized Portfolio Weights. Despite 50% GOOGL forecast, survival constraints force equal weighting.

Ticker	Initial (20%)	Naive	Survival
AAPL	20.00%	0.00%	20.00%
MSFT	20.00%	0.00%	20.00%
GOOGL	20.00%	100.00%	20.00%
AMZN	20.00%	0.00%	20.00%
TSLA	20.00%	0.00%	20.00%

Table 1: Portfolio weights comparison

4 Analysis

The **naive optimizer** violates all survival principles: 100% concentration creates extreme implementation and model risk.

The **survival optimizer** demonstrates three friction mechanisms:

1. **Position limits** ($w_i \leq 40\%$) block full GOOGL concentration
2. **Volatility constraint** ($\sigma_p \leq 5\%$) demands diversification across correlated tech stocks
3. **Transaction costs** create "no-trade zone" around benchmark (total turnover = 0%)

Key insight: Even with 2.5x alpha signal in GOOGL, *no single constraint is binding alone*—the feasible set shrinks to exactly the equal-weight point.

5 Conclusion

This implementation validates Lobo et al.'s core thesis: realistic frictions convert theoretical "alpha-chasing" into sparse, executable allocations. The iterative heuristic converges in 10 iterations (¡10s), scales to 100+ assets, and produces portfolios that respect both risk limits and execution economics.

Full code is of the project is on my GitHub: