2025

Endurance Investors Optimization Modelling

MGMT 573 – Case 4 – Group 6

NAMES: ANDREW ABELLO, ELIKPLIM AMPOFO, RUPALI KAKADIA AND OWEN MAHIN

Introduction

Endurance Investors is a private asset management firm whose partners developed different funds to meet the demands of an expanding client base. Recently, to meet the needs of a small but growing list of wealthy private clients, Endurance introduced a blue-chip fund called the Endurance Private Client Fund (EPCF). It is a portfolio comprising five blue-chip stocks, namely Boeing, Exxon, General Motors, McDonald's, Procter & Gamble, and the S&P 500 Index fund. The main goal is to optimize the portfolio by maximizing expected returns while keeping risk (standard deviation) below 13%, with additional constraints like no single asset exceeding 30% of the portfolio. Brian Johson the portfolio manager, has a task to revise the portfolio weights for the new quarter. However, the existing model doesn't account for transaction costs (0.5% of transaction value) and recent changes in asset performance data. Additionally, Brian wants to limit changes in portfolio weights to ±15% from the previous quarter to maintain client confidence.

The case has two parts: Part I involves optimizing without considering transaction costs and weight change constraints, while Part II incorporates these real-world factors. Tasks include using Solver in Excel to find optimal weights, analyzing shadow prices, constructing efficient frontiers, and comparing results between the two parts.

Part 1

This problem is solved using a nonlinear method.

a. Expected annual return ignoring the 2 policy restraints is 13.28%.
b. Optimal portfolio weights for the next quarter are provided in table 1

Table 1

Asset	**Boeing**	**Exxon**	**General Motors**	**McDonald's**	**Proctor &Gamble**	**S&P500**
Asset tracker	BA	XON	GM	MCD	PG	SP
Fraction of portfolio	0.1	0	0	0.3	0.3	0.3

Total portfolio weight = 0.1 + 0.3 + 0.3 + 0.3 = 1

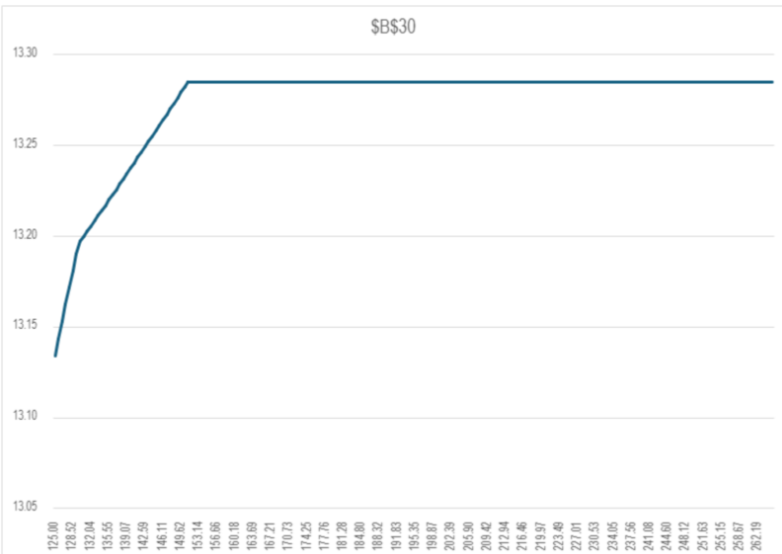
Expected Return (%)	13.28
Variance	150.9176783
Risk (Standard Deviation)	12.28
Objective (Max return)	13.28

c. Shadow price on the following constraint:

Name	Final Value	Lagrange Multiplier
Upper bound on Portfolio variance	169	0.014510076

Sensitivity = LaGrange muliplier * 2Standard Deviation
= 0.377261976
Interpretation: For every one percent increase in variance, the expected return will increase by 0.377%

d.
The efficient frontier for the portfolio. It is the set of portfolios with the highest return for a given level of standard deviation. All other portfolios below are dominated.



Part 2

e. The expected annual return subject to the 2 policy restraints is 12.77%.
f. Optimal portfolio weights for the next quarter are provided in table 3

Asset	**Boeing**	**Exxon**	**General Motors**	**McDonald's**	**Proctor & Gamble**	**S&P500**
Asset tracker	BA	XON	GM	MCD	PG	SP
Fraction of portfolio	0.185897497	0.01	0.06	0.24	0.24	0.264102503

Expected Return (%)	13.09
Variance	168.9999994
Risk (Standard Deviation)	13.00

Objective (Max return) including transaction costs.	12.77

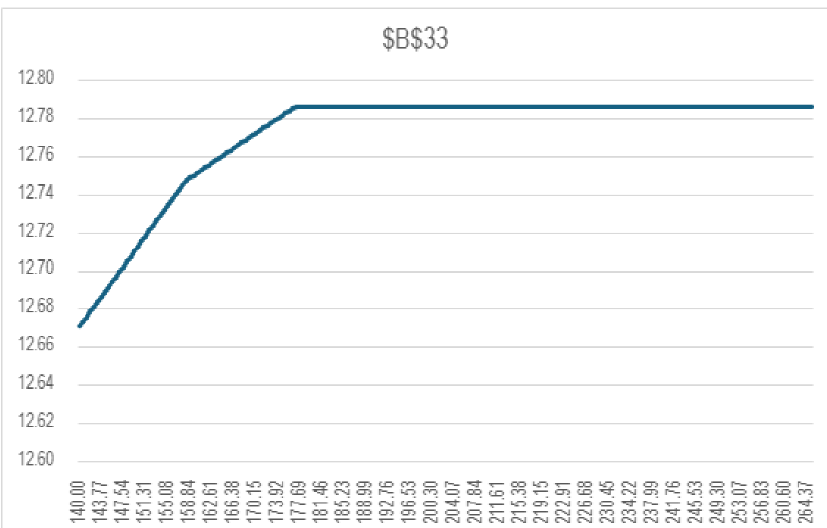
g. Shadow price on the following constraint:

Name	Final Value	Lagrange Multiplier
Upper bound on Portfolio variance	169	0.015432793

Sensitivity = lagrange muliplier * 2*Standard Deviation
=0.015432793*2*13 = 0.401252618

Interpretation: For every one percent increase in variance, the expected return will increase by 0.401%

h. The efficient frontier for the portfolio. The optimal expected annual return 12.77 is the highest return you can get for a given standard deviation.



i. The efficient frontier in part I reaches its peak at a higher expected return of 13.28% and then starts plateauing whereas the efficient frontier in part II reaches its peak at a lower expected return of 12.77% and then the returns are constant for higher standard deviations. This is because in part II, you can't make big changes to the portfolio because transaction costs are tied to it and you are being penalized if for large changes. So, since the part I is more flexible, it can have a higher expected return than part II.

j. Based on the model, we would recommend Endurance Investors to opt for the portfolio weights in Part II because it penalizes the expected returns for large changes in weights and is a more realistic model as transaction costs are included. Such a model will induce more trust from clients because it considers potential risks which the first one does not.

Assumptions/Predictions:

Limitations of the Portfolio Optimization Model in the Case:

- Simplified Risk Measurement:

Risk is measured solely by standard deviation, ignoring tail risks (e.g., black swan events), liquidity risk, and sector-specific risks. This may underestimate true portfolio risk.

- Transaction Cost Simplifications:

Transaction costs are modeled as a flat 0.5% rate, ignoring complexities like market impact costs, fixed fees, or varying broker rates. Large trades could artificially inflate costs.

- No Dynamic Rebalancing:

The model optimizes for a single period, ignoring the need for continuous rebalancing to maintain target weights as markets fluctuate.

Conclusion:
The two model consider cases of with and without transactions costs. While both approaches have their pros and cons, we recommend Endurance Investors to opt for the second approach with transaction costs. While the model provides a structured framework for portfolio optimization, its real-world effectiveness is limited by its reliance on idealized assumptions, and simplified cost/risk structures. Practical implementation would require adjustments to account for dynamic markets, behavioral factors, and operational constraints.

Appendix

Solution Structure Part I

Variables x_i : Proportion of money invested in stock i

Parameters : σ_{ij} : Covariance of stock i with stock j

μ_i : Expected return of stock i

Objective Maximize : $\sum_{i=1}^{6} \mu_i x_i$

Expected Returns

Constraints

→ Max Variance : $\sum_{i=1}^{6} \sum_{j=1}^{6} \sigma_i x_i x_j \le 169$

→ Max Hold of a fund : Each $x_i \le 0.3$

→ Sum of all portfolio weights = 100%.

$$\sum_{i=1}^{6} x_i = 1$$

→ Non Negativity All $x_i \ge 0$.

Part II . Solution Structure .

- Same variables and parameters as Part I .

→ Transaction cost = 15% .

Variable: Cost variable : C_i = Transaction cost for stock i .

→ Objective : Maximize Expected Return

$$\sum_{i=1}^{6} \mu_i x_i - \sum_{i=1}^{6} C_i \times 0.15$$

→ Constraints :- (Including all constraints from Part I)

- Change in weight ($\pm$ 15%).

Plus 15 : $$\sum_{i=1}^{6} x_i - \text{current weight}(i) \leq 0.15 .$$

Minus 15 . $$\sum_{i=1}^{6} \text{current weight}(i) - x(i) \leq 0.15 .$$

- Transaction cost Constraint .

$$\sum_{i=1}^{6} C_i \geq x_i - \text{current weight}(i)$$

$$\sum_{i=1}^{6} C_i \geq \text{current weight}(i) - x_i$$