

# CFRM 543 Final Project

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## 1 Introduction

This project aims to both familiarize one with financial modeling packages in R and to use those tools to develop a portfolio that is appealing to investors. The report is divided into two sections.

In the first section, the goal is to achieve superior gains by modifying two given scripts. The first script works with a global minimum variance portfolio, while the second script uses a maximum quadratic utility portfolio with a risk aversion parameter. We modify the scripts by changing some of the parameters such as the box constraints, lambda value, risk measure (i.e. volatility versus ES). Importantly, in addition to summary plots, the results are reported using a custom performance report that outputs the following:

- Cumulative Return
- Maximum Drawdown
- Annulaized Sharpe Ratio
- Annualized Mean Return
- Annualized Mean Volatility
- Monthly Sharpe Ratio
- Monthly Sortino Ratio
- Monthly Expected Shortfall
- Stable Risk-Adjusted Return Risk Ratio (STARR)

In the second portion of this report, we look at 145 stocks and try to find the best portfolio. This is done as in the first section, and both the minimum variance portfolio and the maximum utility portfolio are estimated using the new data.

## 2 Analysis of Small Cap Weekly Returns

### 2.1 Global Minimum Variance Portfolio

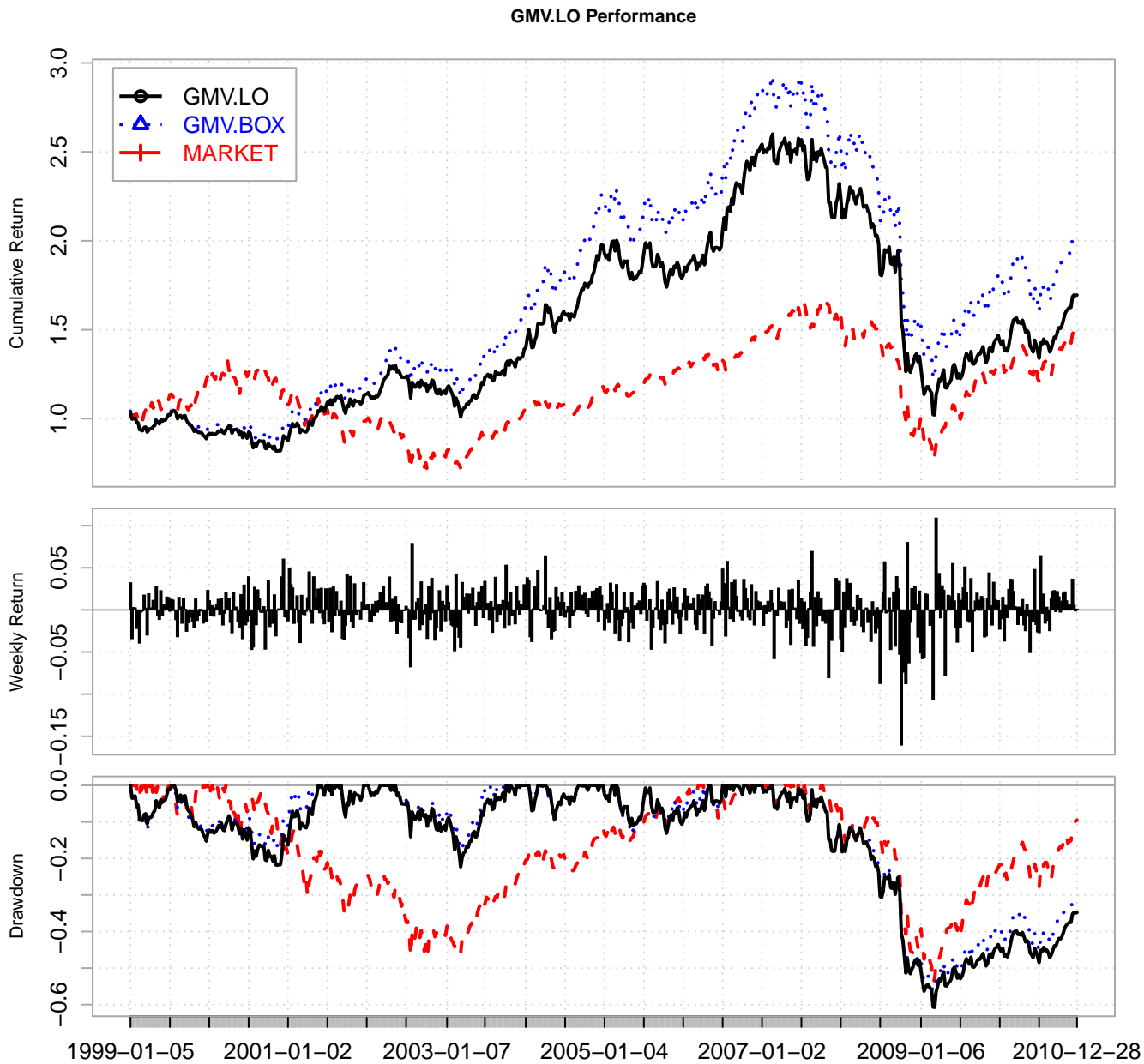
The data for this analysis is provided in the mpo package. The initial script is as follows:

```
library(mpo)
library(PortfolioAnalytics)
library(ROI)
library(ROI.plugin.quadprog)
library(ROI.plugin.glpk)
library(lattice)

returns = smallcapW
MARKET = returns[, "Weekvwretd"]
returns = smallcapW[, 1:20]

funds = colnames(returns)
pspec = portfolio.spec(assets=funds)
pspec.fi = add.constraint(pspec, type="full_investment")
pspec.lo = add.constraint(pspec.fi, type="long_only")
pspec.gmvLo = add.objective(pspec.lo, type="risk", name="var")
pspec.box = add.constraint(pspec.fi, type="box", min=0, max=.2)
pspec.gmvBox = add.objective(pspec.box, type="risk", name="var")
```

Notice that several different portfolios are produced. We will first compare the performance of the two GMV portfolios here with that of the market, then see if the constraints can be changed to improve performance.



The initial result is that the GMV portfolio with a box constraint produces the greatest result. This can be confirmed with the following table of performance statistics. Note that the cumulative return is much greater for the box return portfolio, as well as the Sharpe Ratio. For both GMV portfolios, the Sharpe Ratio is greater than that of the market.

	GMV.LO	GMV.BOX	MARKET
ES	-0.0595000	-0.0582000	-0.0612000
maxDrawdown	0.6074000	0.5824000	0.5436000
Return.annualized	0.0448000	0.0617000	0.0352000
Return.cumulative	0.6951000	1.0554000	0.5162000
SortinoRatio	0.0637000	0.0819000	0.0532000
StdDev.annualized	0.1842000	0.1833000	0.1946000
SharpeRatio.annualized	0.2432886	0.3364853	0.1807692
SharpeRatio	0.0459141	0.0581146	0.0382322
STARR	0.0153273	0.0202155	0.0137029