FINAL PROJECT GUIDELINES V2

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Final Project Data Sets

- 20 small-cap weekly returns 1997-2010 (see slide 6)
- 145 stocks monthly returns, 6 scores, risk-free rate
  - "stocks145scores6.csv"
  - Monthly returns 1990 through 2014 (25 years)
  - Spread across market-cap groups and sectors
  - 6 scores: ROE, BP, PM12M1M, SIZE, ANNVOL1M, EP
- 145 stocks plus bonds, T-bills and other
  - "stocks145bonds7.csv"
  - 1, 2, 5, 7, 10, 20, 30 year bonds, 30 and 90 day T-bills
  - CPI, MKT, SP500

Project Goals and Methods

- Design the most attractive portfolio you can to attract investors. Do so by experimenting with a number of alternative portfolios using different optimization strategies, i.e,., different constraints, concentration penalties, mean-variance vs expected shortfall, GMV versus maximum Sharpe ratio portfolios, etc.
- Create a performance report using table. Performance based on specifications to be provided. Will be used to rank you as a portfolio manager.
- Out of sample back-test to create performance report
- Training window length and rebalancing frequency choices
- For mean-variance try using covariance matrix estimators based on: (1) a fundamental factor model, (2) a statistical factor model, (3) an RMT eigenvalue-shrinkage method.
- Consider using pre-selection methods to reduce number of stocks, particularly
- Your final portfolio should include some fraction of a sub-portfolio of bond indexes

Custom Performance Report

Create a custom performance report function using the function **`table.Performance`** (in the mpo package) that contains the following PerformanceAnalytics package functions (with default arguments unless otherwise indicated):

- **`Return.cumulative`**
- **`maxDrawdown`**
- **`SharpeRatio.annualized`** (with **`geometric = F`**)
- **`Return.annualized`** (with **`geometric = F`**)
- **`StdDev.annualized`**
- **`SharpeRatio`**
- **`SortinoRatio`**
- **`SharpeRatio`** (with **`FUN = "ES"`**, and result will be STARR ratio with p = .95)
- **`ES(aka ETL)`** (with **`method = "historical"`**)

NOTE: The last four measures above are on a monthly returns basis.

Additional Performance Information

In addition to the table of values that your custom report described on the previous slides will provide, you need to include the following performance information in your Final Project Report:

- Beta relative to the market (MKT), using time series of risk-free rate to compute excess returns. Write your own function.
- Normalized STARR ratio for monthly returns. Will provide useful comparison with SharpeRatio and SortinoRatio with monthly returns on previous slide. Write your own function based on slide 32 of "LS3 Performance Analysis.pdf".
- Time series plots of turnover and diversification, and average values of those, for your back-tested portfolio. See TO and DIV functions "LS3 Performance Analysis.pdf" and in code provided during the quarter.
- Graphical results produced by **`charts.PerformanceSummary`**

Project Part 1: Getting Started

For this first well-defined part of your project you will use the **`smallcapW`** weekly returns of 20 small-cap stocks from 1997 through 2010 contained in the **`mpo`** package. You will use the following scripts in the Final Project folder, along with modifications of these scripts:

`BTgmvLoBoxWeekly104.R`

`BTQuLoBox104Lambda20.R`

Both of these compute out-of-sample back-tests using a two-year rolling window with weekly rebalancing. The argument training_period = 104 sets the initial rolling window at the beginning of the time series of returns.

The first scripts global minimum variance portfolios with a long-only and a [0, .2] box constraint, and compares the results with the market return.

The second script computes a maximum quadratic utility portfolio under the same constraints with a risk aversion parameter value lamdba = 20.

Project Part 1 (continued)

1. Read the script **`BTgmvLoBoxWeekly104.R`** carefully to make sure you understand what it is doing, and run it. Use the custom performance report that you create as described on slide 4 to report the results of running the script (NOTE: I hope to improve the custom report capability so that measures on slide 5 are also available, stay tuned).
2. See if you can quickly get any significant improvement in the above results by replacing the box constraint with a short box constraint. Only report your results if you can get such an improvement.
3. See if you can get any significant improvement in the results in (1) by replacing the box constraint with a concentration penalty for some choice of concentration risk aversion parameter (**`concentration_aversion)`**, see code and examples in Ch. 2.13 of S&M). Report the best results you can obtain using this concentration risk penalty approach.

Project Part 1 (continued)

4. Read the script **`BTQuLoBox104Lambda20.R`** carefully to make sure you understand what it is doing, and run it. Try several alternative choices of lambda. How large does lambda have to be to give results similar to 1 on the previous slide. What is the best choice of lambda (on an overall portfolio performance base). How does this best choice compare with the results from 1, 2 and 3 ("not as good", "as good", "better")

5. Now modify the code in 1 on the previous slide to compute a global minimum expected shortfall with the long-only and box constraint of 1. You must replace "**`quadprog`**" with "**`glpk`**" in your code, and have the following two lines in your portfolio specification object:

```
p = .9  # Also try .8 and .95
pspec.gmesLo = add.objective(pspec.lo,
    type="risk",name="ES",arguments=list(p=p))
```

   Can you get a better result with global minimum expected shortfall than with global minimum variance? If so, report the result.

Project Part 2 (to be revised tomorrow)

There are several different portfolio construction strategies that you will potentially evaluate in your search for a "best" portfolio to try and market to investors, and I will describe these subsequently in the next version of this document and in lecture. But meanwhile, here is where to start with out-of-sample back-tests:

- Use only the 145 stocks in the file "stocks145score6.csv", i.e., no factor model, and try to find a best portfolio, as reflected by the overall set of performance measures on the last two slides, with emphasis on the first three in slide 3 and the **`charts.PerformanceSummary`** results.

  You should be evaluating both Mean-Variance and Mean-ES methods for the following portfolios under long-only and some box constraints, and optionally concentration penalties:

  - Global Minimum Risk Portfolios, i.e., GMV and GMES
  - Maximum Sharpe ration and Maximum STARR ratio portfolios
  - Optionally an "intermediate portfolio" between the above two types, with possibilities to be discussed in lecture and Canvas discussions