Financial Modelling (BEAM046) Term 1, 2022/3

Week 2 Tutorial Case: Portfolio Optimization

Introduction

You are an analyst in a US fund management company that specializes in global equity investment. The company is considering launching a new fund, the 'G7 Equity Fund', which will invest in a broad selection of large stocks in the equity markets of the G7 countries (US, UK, Japan, Germany, France, Canada and Italy). Your manager has asked you to establish the efficient frontier for these markets. As a proxy for the investment in each market, you decide to use the aggregate equity return index for each market.

A. The data

The adjusted close prices for the seven indices are provided in the file named "Week 2 Tutorial Case Worksheet" on the ELE course page. Ignore exchange rate fluctuations (you could assume that the currency risk is perfectly hedged). Use the return index data to compute monthly simple returns. These calculations have already been completed in the template.

B. Estimating the inputs to the optimization

Use the return data to compute the covariance matrix for the seven markets.

A significant problem with applying portfolio optimization in practice is that sample estimates of expected returns are very noisy, and hence not reliable. The fund company has, using another approach, estimated the following expected monthly returns for the G7 markets:

US	0.48%
UK	0.39%
Japan	0.55%
Germany	0.51%
France	0.43%
Canada	0.45%
Italy	0.42%

These values have already been entered in the template.

C. Computing the efficient set with short sales

1. Compute the mean return for each market. Compute the covariance matrix for the seven markets using the matrix expression from the lecture notes; remember to first select the output area, and to press Control+Shift+Enter to enter the formula. Note that the formula for the covariance matrix uses the mean return, not the expected return.

2. Initialise the weights of the two portfolios P1 and P2 to any arbitrary values and calculate the sums of the weights. Compute the expected returns (using the expected returns, not the mean returns) and the variances of P1 and P2, and covariance between them.

3. Use Solver to find the global minimum variance portfolio (P1) and the portfolio that has an expected return equal to the highest expected return of the individual assets (P2).

4. Create the super-portfolio of P1 and P2. Initialise the weight in P1 to any value. Set the weight in P2 so that the weights automatically sum to 100%. Compute the mean, variance and standard deviation of the super-portfolio (for these, you can just use the standard formulas for a 2-asset portfolio)

5. Set up two 1-way data tables, one for the standard deviation, sharing the same input range. Specify an input range that goes from the global minimum variance portfolio, P1 (i.e. a weight of 100% in P1) to a portfolio that lies above P2, i.e. which is long in P2 and short in P1 (e.g. a weight of -50% in P1). Set the table headers to be references to the super-portfolio standard deviation and expected return, respectively. Select the whole data table, including input range and table headers. Go to the 'Data' tab, 'What-if Analysis', 'Data Table', and set the column input cell to the weight in P1. Press 'OK'.

D. Computing the efficient set without short sales

1. The calculations for the mean return and the covariance matrix are automatically copied over from the previous sheet. Initialise the weights of the portfolio P to any arbitrary values and calculate their sum. Calculate the expected return and variance of P.

2. Use Solver to find the global minimum variance portfolio. Initialise the target expected return to the expected return of the global minimum variance portfolio.

3. Assign names to the cell ranges that contain the portfolio weights, the sum of the portfolio weights, the portfolio expected return, the portfolio variance, the target portfolio return and the output area. In the 'Developer' tab, choose 'Macros', select the 'NoShortSales' macro and press 'Run'. The VBA program will start at the expected return of the global minimum variance portfolio and go up to the highest expected return of the individual assets in 40 steps, in each case calculating the minimum variance portfolio and reporting its standard deviation and expected return in the table.

Note: In order to estimate the efficient set with a short selling constraint, you will need to use Visual Basic. This is what you should do:

1. Close other Excel files, if you have them open.
2. Enable the 'Developer' tab in the menu (go to 'File/Options/Customize Ribbon' and check the Developer box).
3. Go to the 'Developer' tab.
4. Select Visual Basic Editor.
5. Go to the 'Insert' tab and choose 'Module'.
6. Copy and paste the code from the VBA program file on the course website.
7. Correct any formatting errors that may highlighted in red.
8. Using the Names manager in Excel, give the appropriate ranges in your spreadsheet names that match those used in the VBA program.
9. Amend the starting value and the increment for the target expected return. To do this, manually implement Solver to identify the GMVP and use the expected return of this portfolio as the starting value. Identify the individual stock that has the highest expected return (this will be the ending value for the target expected return). Divide the difference between the starting value and the ending value by 39, and use this as the increment.
10. Go to 'Tools/References' and check 'Solver' box.
11. Go to Excel; Go to the Developer tab; Choose 'Macros'; Select the 'NoShortSales' macro and press 'Run'.