Management
UNIVERSITY OF TORONTO
SCARBOROUGH

MGEC72: FINANCIAL ECONOMICS

Assignment-2

Deadline (March 20)

Constructing Markowitz Efficient Frontiers[1]

Through this assignment you should learn how to construct mean-variance efficient portfolios. Although your application only includes the four stocks you included in your portfolio, the method you learn here can be generalized to allow real world optimal asset allocation.

Steps

1. You have already calculated arithmetic and geometric averages, as well as the standard deviations of the returns of your four selected stocks.

2. Calculate the covariance matrix of the returns. (all the variances and covariances)

   Hint: Should not calculate these individually. Rather use Excel's COVARIANCE function in the Tools (Data Analysis) to calculate both variances and covariances. The diagonal elements of this matrix are the variances you have already calculated for each stock. The small differences you observe is due to the fact that Excel calculates the standard deviation as a sample statistic (i.e. by dividing by n-1, where n is the sample size), whereas it calculates the covariance as a population statistic (i.e. by dividing by n)

3. To calculate the mean-variance efficient portfolio you need the expected returns in addition to the variance-covariance matrix you calculated in part (2). Use the historical monthly geometric average returns as calculated in part (1) as estimates.

4. Find the mean-variance efficient frontier by minimizing the risk for given returns. Graph the efficient frontier and discuss the results.

   Hint 1: Excel is equipped with a program called Solver. Solver provides a numerical

[1] **Note: The assignment is a group work. Any use of work done by other groups, either from this term or the previous terms will be considered as plagiarism and will be dealt with accordingly.**

solution to constrained optimizations. Here, you will use Solver to adjust the portfolio weights in order to minimize the variance of the portfolio, given the constraints that (i) the expected return should be "say 1%" and (ii) that the portfolio weights add up to unity. Note that the resulting variance and the required rate of return together constitute a point on the mean-variance efficient frontier. Hence, the whole frontier could be traced out by repeating the process using many different values for the expected return.

Hint 2: To run Solver, click on the Tools menu and select Solver (if you encounter problems loading the Solver, refer to the on-line help index entry "Installing add-ins" or "Installing Solver"). Solver cannot be used on protected sheets.
(TOOLS/PROTECTION/UNPROTECT SHEET, to unprotect)

Hint 3: Follow the provided example step by step. It is not a bad idea to replicate the example to make sure your program is running as it should.

5. Repeat the previous step but with a short selling constraint – limiting the portfolio weights to non-negative values.

   Hint: Similar to the previous steps, but add a constraint in the Solver module that the weights must be positive.

   Note: The chart of the mean-standard deviation frontier is automatically updated to show both frontiers.

6. Find the CAL for both cases. Graph the CAL and discuss the results.

   Hint: Use the yield on the one-month Canadian treasury bill for your risk free. Remembers all the quoted rates are annualized so you need to convert the yields to one-month return.

You are now a portfolio manager!

Good luck,