Assignment Week 4 - Efficient frontier [1]

1. Find the efficient frontier where short sales are allowed with and without risk less lending and borrowing.

   The following is given and does not change through question one of the assignment.

   - The risk free rate R_f is 2%
   - Asset 1 yearly expected return is 10% and the standard deviation is = 10%
   - Asset 2 yearly expected return is 20% and the standard deviation is = 20%

   For each of the following correlation coefficient between assets 1 and 2

   - $\rho = 1$;
   - $\rho = .5$;
   - $\rho = 0$;
   - $\rho = -1$;

   1.1 We will work our how to plot the efficient frontier **with** borrowing. For each choice of correlation coefficient you can follow the steps below.

   1.1.1. Assume it is **allowed** to borrow or lend money in the risk free rate. There is similar example in the class slides how to find an efficient portfolio.

   1.1.2. As you found the "optimal portfolio" the rest of the efficient frontier can be calculated by different choice of lending and borrowing.

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Use different colors for different valies of the correlation coefficient. Elaborate on your findings.

1.2 Work out the efficient frontier **without** borrowing. For each choice of correlation coefficient you can follow the steps below.

1.1.1. Find 2 efficient portfolios. The mean variance portfolio and an additional one.

1.1.2. Each efficient portfolio is a combination of two efficient portfolio. Find the full frontier by taking different combinations.

Elaborate on the different between the solution with and without a risk free borrowing available, as well as the effect of different values of the correlation coefficient. It is advisable to plot the following graphs to help you see the differences.

- One graph with the 4 different values of the correlation coefficient each frontier is calculated with a riskless asset.
- Second graph with the 4 different values of the correlation coefficient each frontier is calculated with a riskless asset.

2. Repeat the same experiment using financial data.

2.1. Collect data for Pepsi and Coca Cola (same period as in previous exercise).

2.2. Assume the risk free rate is 2% (or otherwise estimate it based on the USD 3m LIBOR rate from the British Banking Association webpage).

2.3. Estimate the yearly return, and covariance matrix of assets returns.

Calculate the efficient frontier with and without risk less lending and borrowing.

2.4. Add Microsoft to the portfolio

Add the new efficient frontier to the same graph.

Elaborate on your findings.