Problem 1
Please access your data in R as follows:

```r
a <- read.csv("http://www.stat.ucla.edu/~nchristo/statistics_c183_c283/FIRST_LAST.csv", sep=",", header=TRUE)
```

1. Convert the adjusted close prices into return for the 15 stocks and the S&P500.
2. Find the composition of the minimum risk portfolio using these stocks. Assume short sales are allowed.
3. Trace out the efficient frontier.
4. Place the 15 stocks on the plot expected return against standard deviation and add the minimum risk portfolio on the efficient frontier.
5. Use an appropriate R function to find the composition of the optimal portfolio, its expected return and standard deviation, and place it on the plot of part (3). Add the capital allocation line on the plot.

Problem 2
Assume the following inputs:

- \( S_0 = \$48 \), \( E = \$50 \), \( R_f = 0.05 \), \( \sigma = 0.30 \), Days to expiration = 73.

1. Simulate 10000 paths of the stock to find the price of this European call option. (Assume daily intervals.)
2. Use the binomial option pricing model to find the price of this European call option assuming a 30-step binomial tree.
3. Use the Black-Scholes-Merton option pricing model to find the price of this European call option.

Problem 3
Assume you have a multivariate normal distribution \( Y \sim \mathcal{N}_{15}(\mu, \Sigma) \), where \( \mu \) and \( \Sigma \) are the mean and variance covariance matrix respectively of the 15 stocks from problem 1. Use the method of spectral decomposition to obtain one random sample from this distribution.

Problem 4
The stop-loss strategy is an interesting hedging scheme. Suppose you just sold the call option that you computed in problem 2. This hedging procedure works as follows: Buy the stock as soon as its price rises above \( E \) and selling it as soon as its price fall below \( E \). Use the same data as in problem 2 to compute the cost of this strategy using one simulated path of the stock. Please note that you observe the stock price at the end of each daily interval, therefore any buying or selling of stocks will occur at the end of the day. Here is an example: