**1.** In this homework you are asked to select 20 stocks quoted at the IMKB from any newspaper. Record 31 days of closing prices (end-of-trading day values) of the twenty assets, from December 20, 2004 to January 31, 2005. Calculate the daily return for each stock $s = 1, \ldots, 20$ using

$$return(s, d) = value(s, d) - value(s, d - 1), \ d = 1, \ldots, 30.$$

Then compute the mean return using the formula:

$$mean(s) = \frac{\sum_{d=1}^{30} return(s, d)}{30}$$

for $s = 1, \ldots, 20$, and the deviations

$$dev(s, d) = return(s, d) - mean(s),$$

for $s = 1, \ldots, 20$ and $d = 1, \ldots, 30$. Using the above quantities, compute the variance/covariance matrix entries:

$$cov(s, t) = \frac{\sum_{d=1}^{30} dev(s, d)dev(t, d)}{29},$$

for $s, t = 1, \ldots, 20$. Notice that since the matrix is symmetric you may compute only the upper triangular part and the diagonal (or, the diagonal and the lower triangular part).
    Now, the questions:

**a** Run the Markowitz mean-variance portfolio model on this data, choosing a suitable number of target returns starting from the mean return of the assets to the maximum return. Plot the efficient frontier.

**b** Do the same analysis after incorporating the riskless asset (e.g., one month treasury bill, or one-month bank deposit).

**c** Select your own efficient portfolio from part a or part b, and test your portfolio against the realized stock values during the month of February 2005. In other words, starting from February 1 until February 28, find the daily value of your portfolio, compute the daily return of your portfolio along with its mean and standard deviation. Plot the daily returns versus the number of working days (where IMKB was open for trading).

The group that achieves the highest mean return portfolio will get the title "most greedy". The group that achieves the smallest standard deviation of return will get the title "most prudent". The groups that achieve a negative return will fail the course (OK, just kidding!). **Hint**: In this homework you may have to find out how to up-load data into XPRESS-MP. Please keep your data for future homeworks after you hand this one in.