1. Consider three assets with the following mean return vector and dispersion (variance-covariance) matrix:

$$\boldsymbol{\mu} = \begin{bmatrix} 0.1 & 0.2 & 0.15 \end{bmatrix}$$

$$\Sigma = \begin{bmatrix} 0.005 & -0.010 & 0.004 \\ -0.010 & 0.040 & -0.002 \\ 0.004 & -0.002 & 0.023 \end{bmatrix}.$$

   (a) Construct and plot the Markowitz efficient frontier using the above data.

   (b) Tabulate the weights, return and risk of the portfolios for 10 different values on the efficient frontier.

   (c) For a 15 % risk, what is the maximum and minimum return and the corresponding portfolios ?

   (d) For a 18 % return, what is the minimum risk portfolio ?

   (e) Assuming the risk free return $\mu_{rf} = 10\%$, compute the market portfolio. Also determine and plot the Capital Market Line.

   (f) Find two portfolios (consisting of both risky and risk free assets) with the risk at $10\%$ and $25\%$.

2. Consider the same data given in Problem 1. Now, construct the minimum variance curve (and efficient frontier) and the feasible region (in the risk-return plot) assuming that short sales are not allowed. In the same plot, also indicate the minimum variance curves (there are three of those) if you consider any two out of three securities at a time. Also, in another graph, plot the weights corresponding to the minimum variance curve (and write the equation that these weights satisfy). *[Note: Look at Capinski for more information.]*

3. Obtain data (from online resources) of monthly prices for 10 stocks each with 60 data points all taken at the same duration. Put this data and it's details in a single Excel/CSV file. Using the data and assuming $5\%$ (*change this, if required*) risk free return:

   (a) Construct and plot the Markowitz efficient frontier.

   (b) Determine the market portfolio.

   (c) Determine and plot the Capital Market Line.

   (d) Determine and plot the Security Market Line for all the 10 stocks.

**[Note: In all our assignments and exams, the rates quoted are always annual/per period rates.]**