**Finding the Efficient Frontier**

**Instructions for Students**

**General Instructions**

The objective of this assignment is to graph the efficient frontier for eight assets using both constrained and unconstrained portfolios.

At the end of these instructions, you will find a list of five asset classes along with the symbols for a number of different ETFs which track indexes within each of those asset classes. You may select any of these ETFs, any individual stocks, or any other assets for which you have a ticker symbol.

The spreadsheet that accompanies these instructions will graph the efficient frontier for you after you have selected your eight assets, a risk-free rate, and a market risk premium. The “Returns” tab of the spreadsheet makes use of the StockHistory function in Excel 365. In order for the spreadsheet work for you, you must be using the Excel 365 version of Excel. StockHistory will list the most recent 61 monthly closing prices for each ticker symbol you enter, and the spreadsheet will then calculate the following: monthly returns, the annualized standard deviation of those returns, correlations and covariances with the other seven assets, a beta coefficient, and the expected return for each using the Capital Asset Pricing Model (CAPM).

The spreadsheet will then build a weighted variance/covariance matrix where you will use Solver to find the smallest possible standard deviation for the eight-asset portfolio with portfolio expected returns ranging from 2% to 13% (in increments of 1%). Additioally, Solver will calculate both the Minimum Variance Portfolio (MVP) and the Mean/Variance Efficient Portfolio MVE. The graph shows the location of each of the eight selected assets, the risk-free asset, the MVP, and the MVE.

This exercise also gives you the opportunity to place a no-shorting constraint on your portfolio which restricts the weights on each asset to be non-negative. Optionally, you can place additional constraints on your portfolio such as a maximum weight on one or more assets.

**Specific Instructions**

For this assignment, choose a risk-free rate that you believe reflects current market conditions. You should also choose a market risk-premium that you believe reflects current investor sentiment (how much extra expected return investors require to move from a risk-free asset to the riskiness of “the market”). Enter those values in celss G11 and G12 on the “Inputs” tab. Select any eight stocks, and then do the following:

Please do the following:

1. Enter the values you have chosen for the risk-free rate and the market risk-premium in cells G11 and G12
2. Enter the ticker symbols for the stocks and/or ETFs you have chosen in cells C15 – C22.
3. Study the expected returns and standard deviations of each asset you selected as well as the correlation matrix
4. Click the “Execute Solver” button on the first page and wait a minute while Solver finds the smallest possible standard deviation for portfolios with expected returns ranging from 2% to 13%, plus the MVP and MVE portfolios. These will all appear in the “Efficient Frontier” tab. Copy this graph. It is **Graph #1**.
5. Go back to the “Inputs” tab and place a check in the box for “Check here to exclude negative weights for all assets”. Optionally, you can also check in the box for “Check here for ALL weights to be less than x” and then Enter a Value for x for which you want all asset weights to be less than or equal to.
6. Click the “Execute Solver” button again and wait a minute while Solver finds the smallest possible standard deviation for portfolios with the constraints that you have just placed. Do not be surprised when the graph in the “Efficient Frontier” tab looks quite a bit different from the first graph. Copy this graph. It is **Graph #2**.
7. Compare the two graphs. One had no constraints while the other had some constraints. Which graph appears to offer investors the least portfolio risk (as measured by standard deviation) for a given expected return? Which graph seems to offer the greatest choice among portfolio expected returns? Why?
8. Choose a set of eight stocks and/or ETFs and their weights that you feel will give you the “best” portfolio if you are managing a hedge fund for a variety of individual and institutional investors. Feel free to define “best” however you want. Feel free to choose different assets from those you used above. There is no right or wrong set of choices for this step, but please explain **why** you decided to select this particular combination of assets and their weights for your hedge fund.
9. Please submit your two graphs along with your answers to the above questions.

**List of Some Possible ETFs You Can Use**

**Asset Class ETF**

Domestic Equity

Large-Cap Value VTV

Large-Cap Growth IWF

Mid-Cap Value DVY

Mid-Cap Growth IJK

Small-Cap Value VBR

Small-Cap Growth IWO

Financial XLF

Health XLV

Energy IYE

Technology VGT

Utilities IDU

Foreign Equity

China FXI

India INDA

Latin America EWZ

Europe VGK

Emerging Markets VWO

Fixed Income

Long-Term Bonds LQD

Intermediate Bonds BIV

Short-Term Bonds IGSB

TIPS TIP

Junk Bonds HYG

Real Estate

Domestic Real Estate VNQ

Global Real Estate IFGL

Commodities

Precious Metals IAU

Natural Resources VAW

Agricultural Commodities RJA