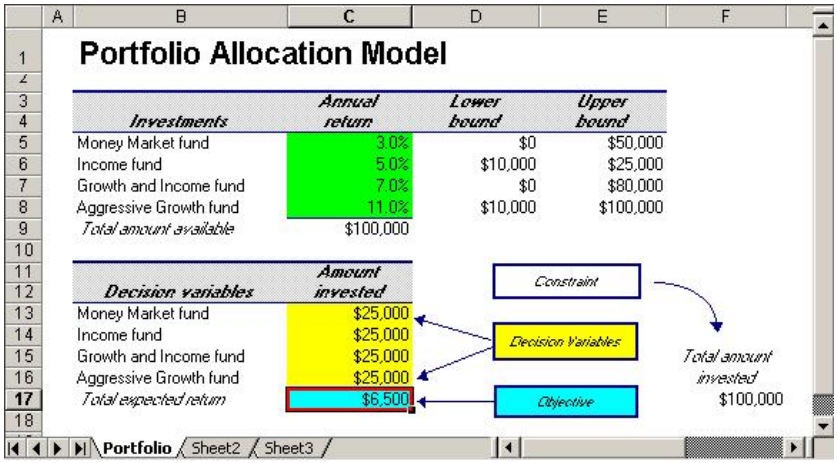
# One-Minute Spotlight

## OptQuest: Efficient Frontier

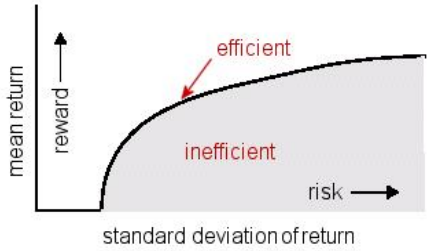
OptQuest, available with Crystal Ball Professional and Premium Editions, is a Crystal Ball add-in tool that searches for optimal solutions given the uncertainties in your Crystal Ball spreadsheet models (see Spotlight #14 for a walkthrough of this program).

OptQuest includes several advanced features, one of which is its ability to automatically perform an Efficient Frontier Analysis. This type of analysis is especially useful for finding optimal portfolios of investments or assets. This spotlight uses a simple portfolio example (shown below) to provide a basic overview of OptQuest's Efficient Frontier function.




### What Is an Efficient Frontier?

If you were to examine all the combinations of investment strategies for a given set of assets, you would notice that each potential portfolio has its own specific mean return and standard deviation of return. Plotting the means on one axis and the standard deviations on another axis, you can create a graph like this:




Points on or under the curve (in the gray area) represent the possible combinations of investments. Points above the curve (in the white area) are unobtainable combinations given the particular set of available assets.

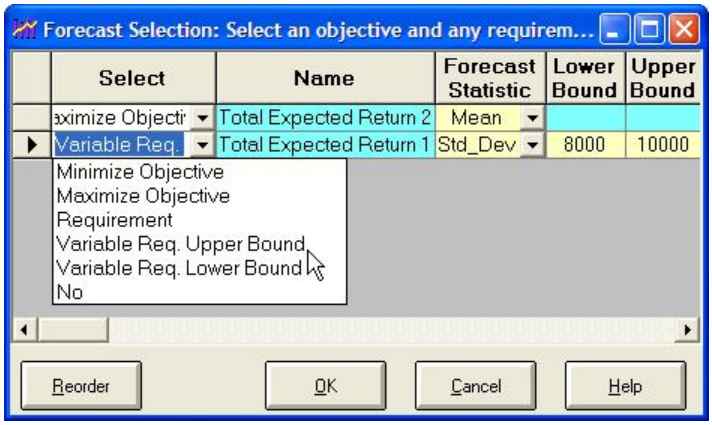
# One-Minute Spotlight

The curve itself represents portfolios where you cannot obtain higher mean returns without generating higher standard deviations, or lower standard deviations without generating lower mean returns. The portfolios that lie directly on the curve are called "efficient," and the curve itself is often called the "efficient frontier." Portfolios that lie below the curve are called "inefficient," meaning that better portfolios exist with higher returns, lower standard deviations, or both.

OptQuest can create an efficient frontier by determining an optimal reward for multiple levels of risk that you define.

**Variable Requirements**

To use the Efficient Frontier function, you must define a variable requirement in the Forecast Selection dialog (shown below). Variable requirements let you define a range of values for a requirement (instead of a single point). OptQuest runs one full optimization for each value in the range, starting with the most limiting requirement. This lets you see the effects of tightening or loosening a requirement.




In this portfolio example, you want to maximize the Total expected return (the objective) on an investment of $100,000, but you also want to limit your exposure. You can use the Variable Requirement Upper Bound to limit your risk by putting an upper bound on the standard deviation of the forecast.

As shown above, you set a Variable Requirement Upper Bound to search for ten optimal portfolios starting with an upper standard deviation limit of $8000 and increasing until the tenth optimization, which limits the forecast to an upper standard deviation bound of $10,000.

**Running an Efficient Frontier**

# One-Minute Spotlight

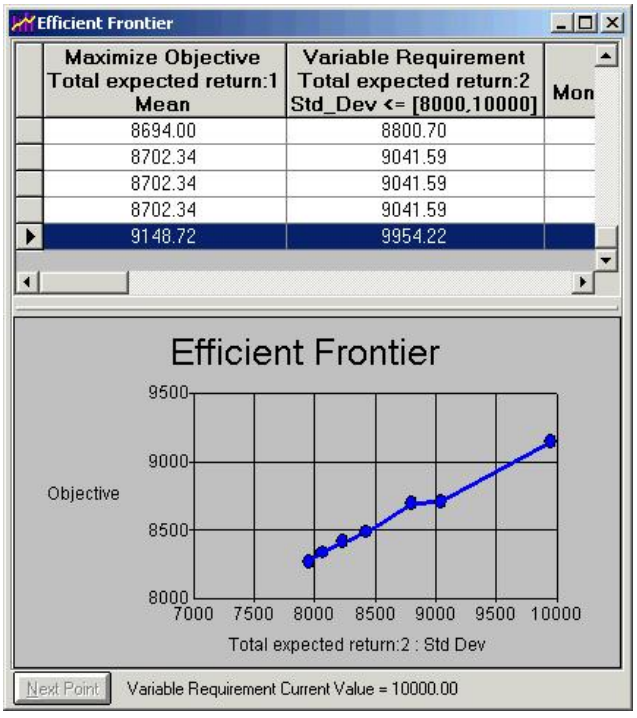
When you run OptQuest, it begins its first optimization using the initial requirement point (the most restrictive end of the range). In this example, that first point is $8000, so OptQuest rejects all solutions where the standard deviation is greater than or equal to $8000.

OptQuest searches for an optimal solution until there is no significant improvement between best solutions or until it reaches a maximum number of simulations. OptQuest then begins an optimization on the second requirement point, which in this example is a higher standard deviation limit close to $8200 (greater risk, but hopefully greater reward).

Because OptQuest has already evaluated and stored many solutions from the first optimization, succeeding optimizations take less time. OptQuest runs the successive requirement points for approximately half the time of the initial requirement point. However, be aware that efficient frontiers do take more time to run than regular optimizations. Optimizations that use variable requirements take significantly longer to run because they are running an optimization for each point in the variable requirement range.

**Analyzing the Efficient Frontier Chart**

At any time, you can view the progress in the Efficient Frontier window. This window is only available if you have defined a variable requirement. Open this window by selecting View > Efficient Frontier, by clicking on the Efficient Frontier icon, or by clicking on the Frontier button in the Performance Graph window.



# One-Minute Spotlight

Once OptQuest has completed the Efficient Frontier analysis, you can review the results for each of the optimal portfolios that define the efficient curve (in this example, there are ten portfolios). The best solutions are listed in the table at the top of the window, and that chart shows you the final curve. Your final investment strategy will depend on which results mean the most to you and on how much exposure you deem reasonable.

**Final Note:** When running an Efficient Frontier, we suggest that you let OptQuest determine when to complete the multiple optimizations. If you wish to circumvent OptQuest's calculations, the Next Point button (grayed out above) forces OptQuest to start optimizing for the next requirement point.

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