One-Minute Spotlight

OptQuest: Finding the Best Solutions under Uncertain Conditions
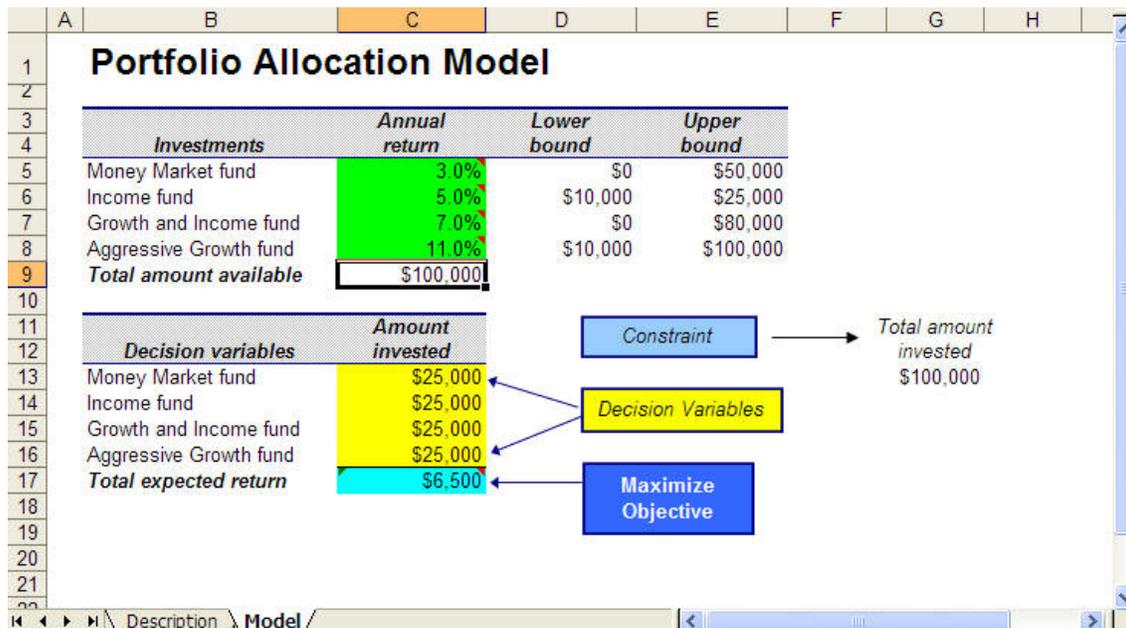
What is OptQuest?

OptQuest is an optimization tool that runs with Crystal Ball. As an add-in to Crystal Ball, OptQuest enhances simulation models by automatically searching for and finding optimal solutions.

For example, if you were a supply chain manager, you could use Crystal Ball to simulate uncertain demand and the likelihood of running short on stock (given specific inventory levels). For the same problem, OptQuest could help you to identify adequate inventory levels, reduce your holding costs, and optimize your potential profit, while still accounting for the uncertainty of demand.

You can also use OptQuest for portfolio analysis, where you determine an investment strategy that optimizes profit while taking into consideration the uncertainty around the annual returns of each asset. Other applications for optimization include workforce planning of employees, configuration of machines for production scheduling, the location of facilities for distribution, and tolerances in manufacturing design.

What Are You Trying to Optimize?

Before using OptQuest, you first need to create your Crystal Ball model. Once you feel that the model is a valid representation of your problem, system, or process, you then need to use Crystal Ball to define the decision variables. Decision variables are variables in your model that you have control over, such as how much rent to charge or how much money to invest in a mutual fund (see below).

One-Minute Spotlight

In the spreadsheet below, you have four decisions to make regarding how much you want to invest in each of four funds (C13-C16). These variables are all in your control. In Cell C13, the decision variable describes the range of investment dollars, from $0 to $50,000.
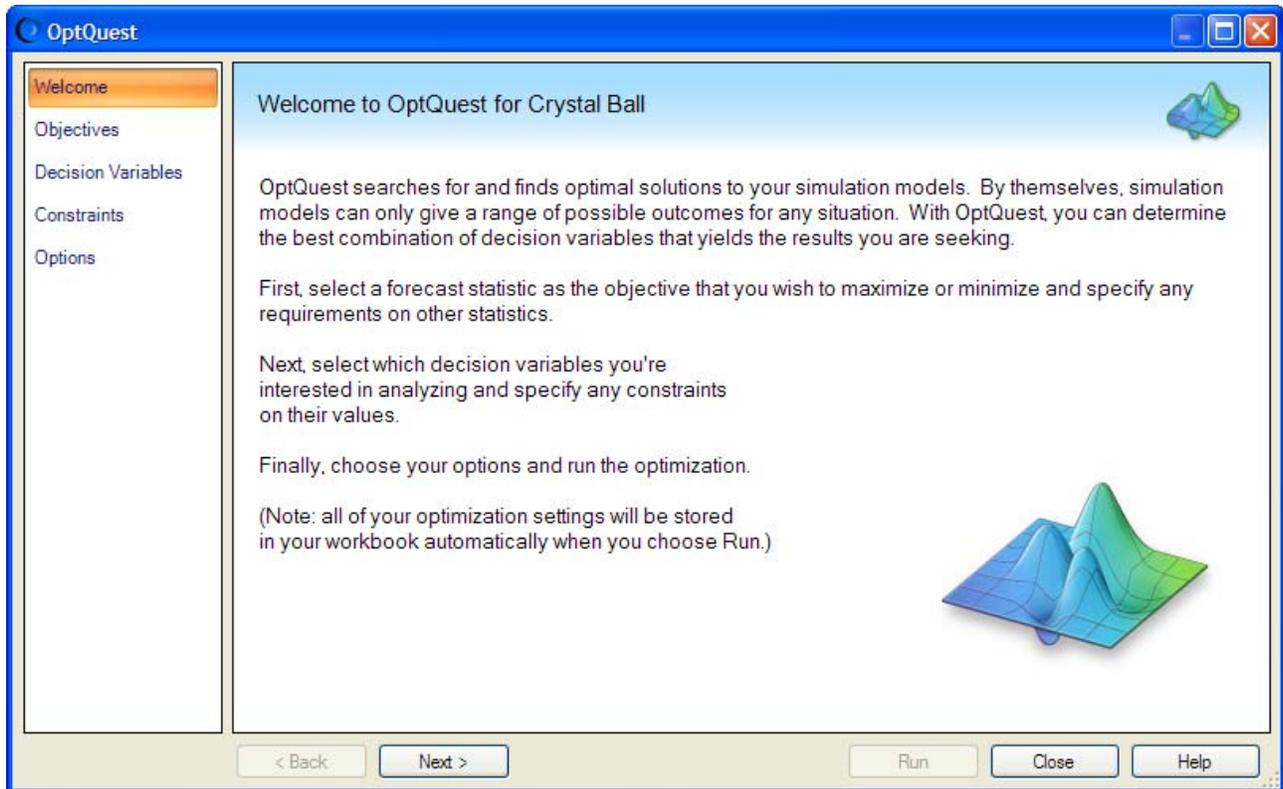

After defining all the decision variables, you can start OptQuest through the Run menu or toolbar.

The OptQuest Wizard

The OptQuest wizard program helps you through the setup process. The Welcome screen describes what OptQuest does and the steps to set up and run an optimization.

One-Minute Spotlight

You first select your objectives (e.g., maximize the revenue of the portfolio). You first select the forecast you want to optimize (e.g., minimize construction costs, maximize profits).

You can also set a requirement, which is a restriction on a forecast statistic such as the mean or standard deviation. For example, you could set a requirement to ensure that in any acceptable solution, the standard deviation would be less than $8000 (reduce your risk). OptQuest will ignore any solution that does not comply with your requirement.

Next, you can review and update the decision variables in your model. Following that, you have the option to set a constraint on your decision variables. A constraint restricts the decision variables to specific combinations of values.

For example, if you can only invest $50,000 in a group of portfolio assets (your decision variables), a constraint will ensure that the investment sum from all of the assets will never exceed $50,000. OptQuest will never run an optimization on a solution that does not satisfy your constraint, so you can think of it as an input filter that reduces the number of solutions OptQuest needs to run.

Finally, you can select from several setup options, the most important of which is how long you want OptQuest to run. You can also check the simulation run preferences.

The Optimization Process

At the basic level, OptQuest selects a value for each decision variable, enters those values into your spreadsheet, runs a Monte Carlo simulation on the spreadsheet, records the results, and repeats the process.

You could manually perform this sort of analysis, but as you increase the number of decision variables, the number of possible variable combinations becomes unwieldy.

On a more advanced level, OptQuest does a much better job at finding optimal solutions than is possible with manual calculations. OptQuest surpasses the limitations of genetic algorithm optimizers because it uses multiple, complimentary search methodologies, including advanced tabu search and scatter search, to help find the best global solutions.

While running solutions, OptQuest also checks for compliance with the constraints and requirements. In addition, OptQuest applies adaptive and neural network technologies to help it learn from past optimizations so it can achieve better results in less time.
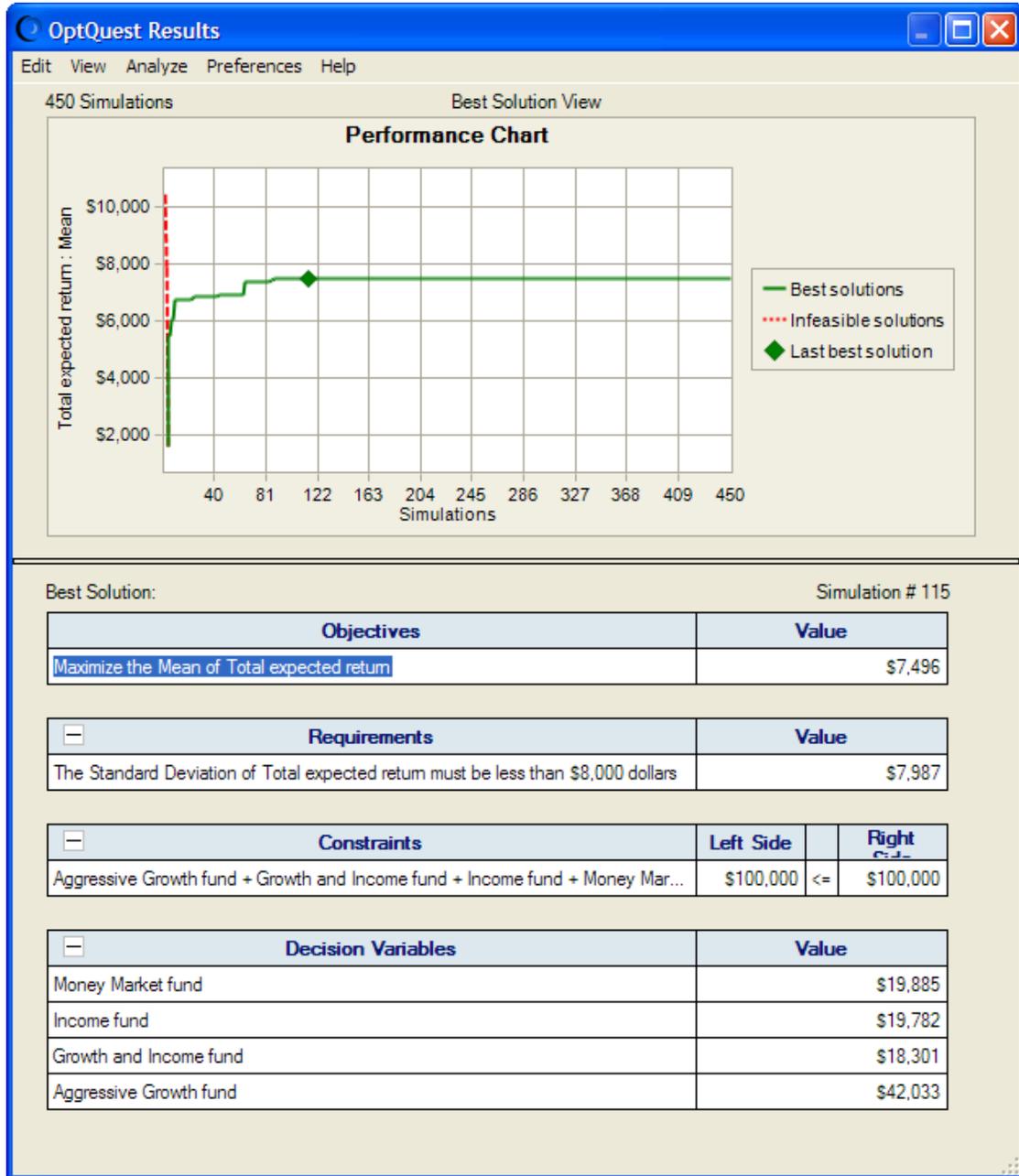
Informative Charts and Tables

As you run an optimization, you can view the Performance Chart window (shown below) to see the best current solution, how many solutions OptQuest has run, and how much time remains in your optimization. Each time OptQuest generates a new best result, it displays that result.

The Performance Chart window also shows you whether or not the current best solution meets the requirements and how it satisfies any constraints you may have set. In the example shown below, the 36th simulation of 1000 trials returned a mean Total expected return of $7,496. All of the $100,000 available for investment was used, and various amounts were invested into each of the funds.

One-Minute Spotlight

Using the Results

Once you have completed your optimization, OptQuest copies the best decision variable values back to your spreadsheet model. You can then view your model and the forecast chart for the optimal outcome. Optionally, you can use OptQuest's Solution Analysis feature to compare the optimal and suboptimal results for any useful trends in decision variable results.

One-Minute Spotlight

OptQuest Results

Edit   View   Analyze   Preferences   Help

11759 Total Solutions   Solution Analysis View   20 Displayed

Rank	Solution #	Objective — Maximize Mean Total expected return	Requirements — Standard Deviation < $8,000 Total expected return	Constraints — Aggressive Growth fund + Growth and In...			D — Mon
1	2972	$7,756	$7,998	$100,000	<=	$100,000	
2	2731	$7,751	$8,000	$99,726	<=	$100,000	
3	2621	$7,751	$8,000	$99,736	<=	$100,000	
4	2183	$7,751	$8,000	$99,719	<=	$100,000	
5	2050	$7,750	$7,999	$99,743	<=	$100,000	
6	1887	$7,750	$7,999	$99,764	<=	$100,000	
7	1571	$7,749	$7,996	$99,750	<=	$100,000	
8	1244	$7,744	$7,982	$100,000	<=	$100,000	
9	1179	$7,742	$7,986	$99,775	<=	$100,000	
10	898	$7,740	$7,995	$99,882	<=	$100,000	
11	109	$7,720	$7,947	$100,000	<=	$100,000	
12	85	$7,675	$7,949	$99,847	<=	$100,000	
13	84	$7,675	$7,950	$99,898	<=	$100,000	
14	63	$7,675	$7,951	$100,000	<=	$100,000	
15	20	$7,569	$7,866	$100,000	<=	$100,000	

Statistics:

Minimum		$1,601	$1,892	$20,000		$100,000	
Mean		$7,162	$7,412	$94,829		$100,000	
Maximum		$7,756	$8,000	$100,000		$100,000	
Std. Dev.		$1,451	$1,515	$18,234		$0	

Show the best
- ○ 15 solutions
- ○ 1 % of solutions
- ○ All feasible solutions (2166)
- ⦿ New best solutions (20)

Include
- ☑ Feasible solutions (2166)
- ☐ Infeasible solutions (9593)

You can also create reports from the optimization and extract the optimization data to a spreadsheet for additional analysis.

Not every problem requires optimization. For some questions, simulation alone can provide useful insights and solutions. But when your aim is to make better decisions and achieve an optimal forecast, the powerful combination of Crystal Ball and OptQuest can help you achieve your goal with speed and accuracy.

For more information or to contact us, browse to http://www.oracle.com/crystalball.

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