

# One-Minute Spotlight

## The Crystal Ball Charts: Sensitivity

As you become more proficient at building spreadsheet models, you will want to know how much a given assumption affects your result. In other words, you want to determine the sensitivity of the forecast to each assumption. The sensitivity chart gives you with ability to quickly and easily judge the influence each assumption cell has on a particular forecast cell.

A net present value (NPV) analysis model is shown below. After 2000 trials, Crystal Ball reports only a 32.93% probability of achieving or exceeding the deterministic NPV of \$344,796. You'd like to know which of the twelve assumptions has the greatest effect on this NPV forecast. Do they all have an equal impact, or do specific assumptions drive the variation of the forecast results?

The sensitivity chart can help you to answer these critical questions.

|                         | Year 0       | Year 1           | Year 2      | Year 3      | Year 4      | Year 5      |
|-------------------------|--------------|------------------|-------------|-------------|-------------|-------------|
| Cost/Package            |              | \$6.00           | \$6.05      | \$6.10      | \$6.15      | \$6.20      |
| # Sold                  |              | 902,000          | 967,000     | 1,132,000   | 1,297,000   | 1,462,000   |
| <b>Gross Revenues</b>   |              | \$4,812,000      | \$5,850,350 | \$6,905,200 | \$7,976,550 | \$9,064,000 |
| Cost of Revenues        |              | \$2,646,600      | \$3,217,693 | \$3,797,860 | \$4,387,103 | \$4,985,000 |
| <b>Gross Income</b>     |              | \$2,165,400      | \$2,632,658 | \$3,107,340 | \$3,589,448 | \$4,078,000 |
| Operating Costs         |              | \$324,810        | \$394,899   | \$466,101   | \$538,417   | \$611,000   |
| Net Income Before Taxes |              | \$1,840,590      | \$2,237,759 | \$2,641,239 | \$3,051,030 | \$3,467,000 |
| Taxes                   |              | \$588,989        | \$716,083   | \$845,196   | \$976,330   | \$1,109,000 |
| Initial Investment      | -\$3,400,000 |                  |             |             |             |             |
| <b>Net Income</b>       | -\$3,400,000 | \$1,251,601      | \$1,521,676 | \$1,796,043 | \$2,074,701 | \$2,357,000 |
| <b>NPV Project 1</b>    |              | <b>\$344,796</b> |             |             |             |             |
| <b>IRR Project 1</b>    |              | <b>15%</b>       |             |             |             |             |
| <b>Assumptions</b>      |              |                  |             |             |             |             |
| Taxes                   |              | 32%              |             |             |             |             |
| Discount Rate           |              | 10%              |             |             |             |             |
| Cost of Revenues %      |              | 55%              |             |             |             |             |
| Operating Cost %        |              | 15%              |             |             |             |             |

## How Does Sensitivity Analysis Work?

Crystal Ball calculates sensitivity by computing rank correlation coefficients between every assumption and every forecast while the simulation is running. Correlation coefficients provide a meaningful measure of the degree to which assumptions and forecasts change together.

The sensitivity chart ranks the assumptions from the most important down to the least important in the model. If an assumption and a forecast have a high correlation coefficient, it means that the assumption has a significant impact on the forecast (through both its uncertainty and its model

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sensitivity). Positive coefficients indicate that an increase in the assumption is associated with an increase in the forecast. Negative coefficients imply the opposite situation. The larger the absolute value of the correlation coefficient, the greater the sensitivity.

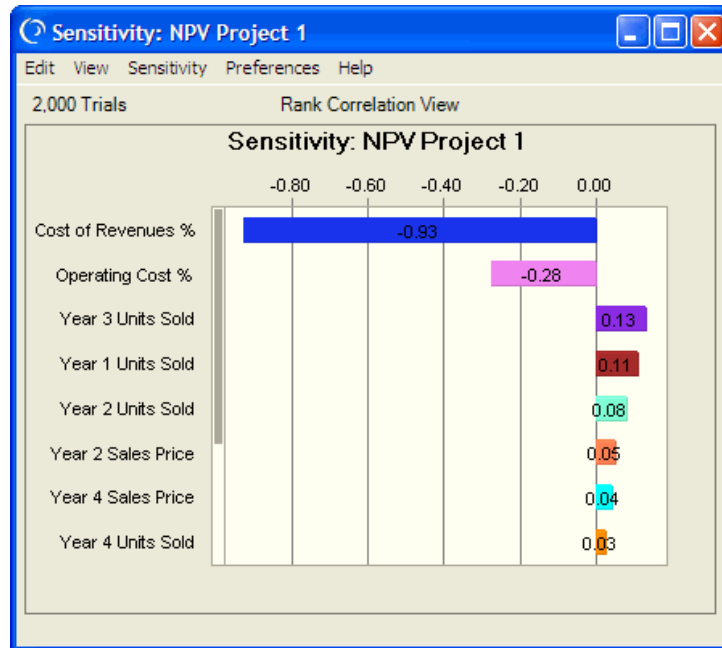
## Creating the Sensitivity Chart

When you run a simulation, you need to make sure that the "Store assumption values for analysis" setting in Run Preferences (this is the default setting). After the simulation has been stopped, you can create a sensitivity chart by either selecting the Open Sensitivity Chart option from the Run menu or by clicking the sensitivity chart toolbar button (outlined in red, below).



## Two Ways to View Sensitivity

When you first open the sensitivity chart, the assumptions are listed on the left side, starting with the assumption with the highest sensitivity. In this case, Cost of Revenues has a sensitivity of (93)%.



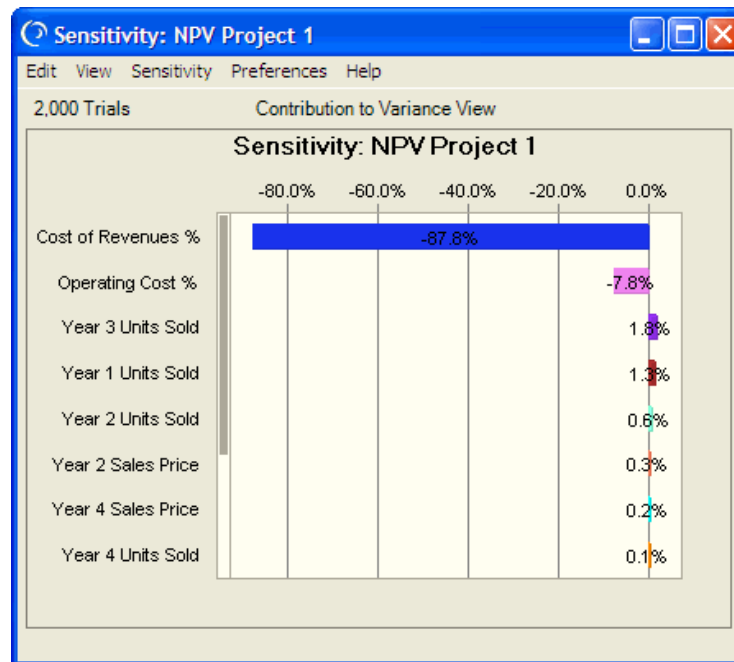
The target forecast that you are analyzing is listed above the chart. You can change the target forecast in the Sensitivity menu.



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In the View menu (or by right-clicking the chart), you can also switch the view from Rank Correlation to Contribution to Variance, shown below. In this view, Crystal Ball displays the sensitivity information as the percent of forecast variance due to each assumption.

Some people prefer this setting because they find that percentage values are easier to interpret and explain than correlation coefficients. Note that this view still shows opposing bars where the rank correlation coefficients are negative.

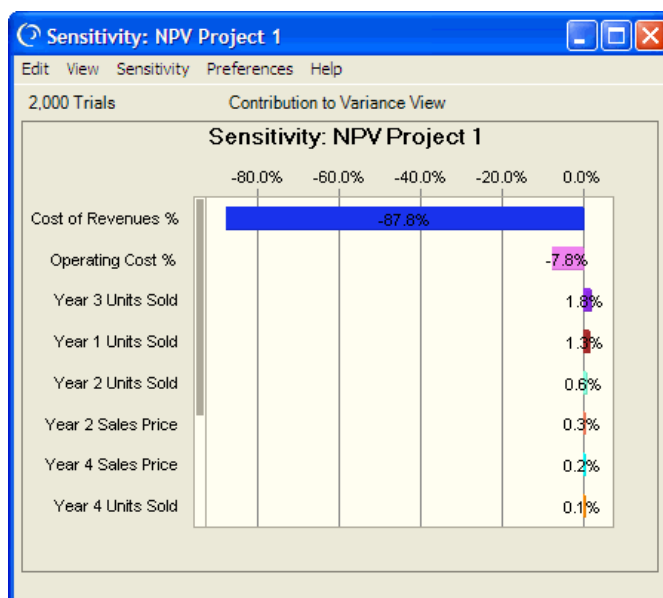


### Interpreting the Sensitivity Chart Results

While sensitivity analysis is an important method for determining the key factors that drive the uncertainty in a forecast, you must combine the results with your knowledge of the structure of the model.

In this example, the Cost of Revenues assumption has the greatest impact on the NPV. Armed with this evidence, you can explain that the most uncertainty is associated with Cost of Revenues. This might mean that the company's top priority should be getting costs lowered. The remaining eight assumptions (not all shown) have much less of an impact on the NPV.

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Is this the result you expected? One of the benefits of sensitivity analysis is that it can help you to reassess the validity of your model. If you did not expect to see the results shown above, then you have the opportunity to recheck the logic of your model and the parameters of your assumptions. For example, a single, dominant assumption can sometimes indicate a mathematical or typographical error that has artificially inflated the impact of an assumption.

### The Pros and Cons of Sensitivity Analysis

The sensitivity chart feature has several limitations you should be aware of when correlated assumptions or non-monotonic (nonlinear) relationships are present in your model. These limitations are detailed in the interpretation chapter of the *Crystal Ball User Manual*.

In summary, the sensitivity chart feature provides three key benefits:

- You can find out which assumptions are influencing your forecasts the most, reducing the amount of time needed to refine estimates.
- You can find out which assumptions are influencing your forecasts the least so you can ignore or discard them altogether.
- As a result, you can construct more realistic spreadsheet models and greatly increase the accuracy of your results because you will know how all of your assumptions affect your model.

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