
Guide to Using

TopRank

*What-If Analysis Add-In for
Microsoft Excel*

**Version 5.7
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Welcome

Welcome to TopRank, the ultimate What-If tool for spreadsheets from Palisade Corporation. TopRank greatly enhances the standard What-If and data table capabilities found in your spreadsheet. In addition, you can easily step up to powerful risk analysis with its companion package, @RISK.

TopRank and What-If Analysis

TopRank helps you find out which spreadsheet value or variable affects your results the most — an automated What-If or sensitivity analysis. You also can have TopRank automatically try any number of values for a variable — a data table — and tell you the results calculated at each value. TopRank also tries all possible combinations of values for a set of variables (a Multi-Way What-If analysis), giving you the results calculated for each combination.

Running a What-If or sensitivity analysis is a key component of making any decision based on a spreadsheet. This analysis identifies which variables affect your results the most. This shows you those factors you should be most concerned with as you 1) gather more data and refine your model and 2) manage and implement the situation described by the model.

TopRank is a spreadsheet add-in for Microsoft Excel. It can be used with any pre-existing or new spreadsheet. To set up your What-If analyses, TopRank adds new custom “Vary” functions to the spreadsheet function set. These functions specify how the values in your spreadsheet can be varied in a What-If analysis; for example, +10% and -10%, +1000 and -500, or according to a table of values you’ve entered.

TopRank can also run a fully automatic What-If analysis. It uses powerful auditing technology to find all possible values in your spreadsheet which could affect your results. It can then change all these possible values automatically and find out which is most significant in determining your results.

TopRank Applications

TopRank applications are the same as spreadsheet applications. If you can build your model in a spreadsheet, you can use TopRank to analyze it. Businesses use TopRank to identify the critical factors – price, up front investment amount, sales volume or overhead – that most affect the success of their new product. Engineers use TopRank to show them the individual product components whose quality most affects final product production rates. A loan officer can have TopRank quickly run his model at all possible interest rate, loan principle amount, and down payment combinations and review results for each possible combination. Whether your application is in business, science, engineering, accounting or other field, TopRank can work for you to identify the critical variables which affect your results.

Modeling Features

As an add-in to Microsoft Excel, TopRank links directly to Excel to add What-If analysis capabilities. The TopRank system provides all the necessary tools for conducting a What-If analysis on any spreadsheet model. And TopRank works in a style you are familiar with – Excel style menus and functions.

What-If analysis and Data Tables are functions that can be performed directly in your spreadsheet, but only in a manual, unstructured format. Simply changing a cell value in your spreadsheet and calculating a new result is a basic What-If analysis. And a Data Table which gives a result for each combination of two values can also be built in your spreadsheet. TopRank, however, performs these tasks automatically and analyzes their results for you. It instantly performs What-Ifs on all possible values in your spreadsheet which could affect your result, instead of requiring you to individually change values and recalculate. It then tells you what spreadsheet value is most significant in determining your result.

Multi-Way What-If Analysis

TopRank also runs data table combinations automatically, without requiring you to set up tables in your spreadsheet. Combine more than two variables in its Multi-Way What-If analysis – you can generate combinations of any number of variables – and rank your combinations by their affect on your results. You can perform these sophisticated and automated analyses quickly, as TopRank keeps track of all the values and combinations it tries, and their results, separate from your spreadsheet. By taking an automated approach, TopRank gives you What-If and Multi-Way What-If results almost instantly. Even the least experienced modeler can get powerful analysis results.

TopRank Functions

TopRank defines variations in spreadsheet values using functions. To do this, TopRank has added a set of new functions to the Excel function set, each of which specifies a type of variation for your values. These functions include:

- **Vary** and **AutoVary** functions which, during a What-If analysis, change a spreadsheet value across a + and - range you define.
- **VaryTable** functions which, during a What-If analysis, substitute each of a table of values for a spreadsheet value.

TopRank uses functions to change spreadsheet values during a What-If analysis and keeps track of the results calculated for each value change. These results are then ranked by the amount of change from the original expected results. Then functions which caused the greatest change are identified as the most critical to the model.

TopRank Industrial also includes 35 probability distribution functions found in @RISK. These functions can be used along with Vary functions to describe variation in spreadsheet values.

How are TopRank Functions Entered?

TopRank functions are entered wherever you want to try different values in a What-If analysis. The functions can be added to any number of cells in a spreadsheet and can include arguments which are cell references and expressions — providing extreme flexibility in defining variation in value in spreadsheet models.

In addition to adding Vary functions yourself, TopRank can automatically enter Vary functions for you. Use this powerful feature to quickly analyze your spreadsheets without manually identifying values to vary and typing in functions.

Automated What-ifs

When automatically entering Vary functions, TopRank traces back through your spreadsheet and finds all possible values which could affect the result cell you identify. As it finds a possible value, it substitutes in an “AutoVary” function with the default variation parameters (such as +10% and -10%) you’ve selected. With a set of AutoVary functions inserted, TopRank can then run its What-If analysis and rank the values which could affect your results by their importance.

With TopRank, you can step through your Vary and AutoVary functions and change the variation each function specifies. As a default you can use a -10% and +10% variation, but for a certain value you may feel that a -20% and +30% change is possible. You can also select to not have a value varied — as in some cases a spreadsheet value is fixed and could never be changed.

**Running a
What-If Analysis**

During its analysis TopRank individually changes values for each Vary function and recalculates your spreadsheet using each new value. Each time it recalculates, it collects the new value calculated in each result cell. This process of changing values and recalculating is repeated for each Vary and VaryTable function. The number of recalculations performed depends on the number of Vary functions entered, the number of steps (i.e., values across the min-max range) you want TopRank to try for each function, the number of VaryTable functions entered, and the values in each table used.

**TopRank
Results**

TopRank ranks all varied values by their impact on each result cell or output you've selected. Impact is defined as the amount of change in the output value that was calculated when the input value was changed. If, for example, the result of your spreadsheet model was 100 prior to changing values, and the result was 150 when an input changed, there is a +50% change in results caused by changing the input.

TopRank results can be viewed graphically in a Tornado, Spider or Sensitivity graph. These graphs summarize your results to easily show the most important inputs for your results.

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Introduction

This introduction describes the contents of the TopRank package and shows how to install TopRank and attach it to your copy of Microsoft Excel.

Checking Your Package

Your TopRank package should contain:

- *The TopRank User's Manual (this book) with:*
- Preface and Getting Started
- Overview of What-If Analysis
- Overview of TopRank
- TopRank Modeling Techniques
- TopRank Command Reference
- TopRank Function Reference
- Technical Appendices

The TopRank CD including:

- TopRank System Files
- TopRank Example Files
- TopRank Tutorial

The TopRank Licensing Agreement and User Registration Card

If your package is not complete, please call your dealer or supplier or contact Palisade Corporation directly at (607) 277-8000.

About This Version

This version of TopRank can be installed with Microsoft Excel 2000 or higher.

Working with your Operating Environment

This User's Guide assumes that you have a general knowledge of the Windows operating system and Excel. In particular:

- You are familiar with your computer and using the mouse.
- You are familiar with terms such as icons, click, double-click, menu, window, command and object.
- You understand basic concepts such as directory structures and file naming.

If You Need Help

Technical support is provided free of charge for all registered users of TopRank with a current maintenance plan, or is available on a per incident charge. To ensure that you are a registered user of TopRank, **please register online at www.palisade.com/support/register.asp.**

If you contact us by telephone, please have your serial number and User's Guide ready. We can offer better technical support if you are in front of your computer and ready to work.

Before Calling

Before contacting technical support, please review the following checklist:

- *Have you referred to the on-line help?*
- *Have you checked this User's Guide and reviewed the on-line multimedia tutorial?*
- *Have you read the README file? It contains current information on TopRank that may not be included in the manual.*
- *Can you duplicate the problem consistently? Can you duplicate the problem on a different computer or with a different model?*
- *Have you looked at our site on the World Wide Web? It can be found at <http://www.palisade.com>. Our Web site also contains the latest FAQ (a searchable database of tech support questions and answers) and TopRank patches in our Technical Support section. We recommend visiting our Web site regularly for all the latest information on TopRank and other Palisade software.*

Contacting Palisade

Palisade Corporation welcomes your questions, comments or suggestions regarding TopRank. Contact our technical support staff using any of the following methods:

- *Email us at support@palisade.com*
- *Telephone us at (607) 277-8000 any weekday from 9:00 AM to 5:00 PM, EST. Follow the prompt to reach Technical Support*
- *Fax us at (607) 277-8001.*
- *Mail us a letter to:*

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If you want to contact Palisade Europe:

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- *Fax us at +44 1895 425051 (UK).*
- *Mail us a letter to:*

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Middlesex
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United Kingdom**

If you want to contact Palisade Asia-Pacific:

- *Email us at support@palisade.com.au*
- *Telephone us at + 61 2 9252 5922 (AU).*
- *Fax us at + 61 2 9252 2820 (AU).*
- *Mail us a letter to:*

**Palisade Asia-Pacific Pty Limited
Suite 404, Level 4
20 Loftus Street
Sydney NSW 2000
Australia**

Regardless of how you contact us, please include the product name, exact version and serial number. The exact version can be found by selecting the Help About command on the TopRank menu in Excel.

Student Versions

Telephone support is not available with the student version of TopRank. If you need help, we recommend the following alternatives:

- *Consult with your professor or teaching assistant.*
- *Log-on to <http://www.palisade.com> for answers to frequently asked questions.*
- *Contact our technical support department via e-mail or fax.*

TopRank System Requirements

System requirements for TopRank 5.0 for Microsoft Excel for Windows include:

- *Pentium PC or faster with a hard disk.*
- *Microsoft Windows 2000 SP4, Windows XP or higher.*
- *Microsoft Excel 2000 or higher.*

Installation Instructions

General Installation Instructions

The Setup program copies the TopRank system files into a directory you specify on your hard disk. To run the Setup program in Windows 2000 or higher:

- 1) *Insert the TopRank CD-ROM in your CD-ROM drive*
- 2) *Click the Start button, click Settings and then click Control Panel*
- 3) *Double-click the Add/Remove Programs icon*
- 4) *On the Install/Uninstall tab, click the Install button*
- 5) *Follow the Setup instructions on the screen*

If you encounter problems while installing *TopRank*, verify that there is adequate space on the drive to which you're trying to install. After you've freed up adequate space, try rerunning the installation.

Removing TopRank from Your Computer

If you wish to remove TopRank from your computer, use the Control Panel's Add/Remove Programs utility and select the entry for TopRank.

The DecisionTools Suite

TopRank for Excel is a member of the DecisionTools Suite, a set of products for risk and decision analysis described in **Appendix A: Using TopRank With Other DecisionTools**. The default installation procedure of TopRank puts TopRank in a subdirectory of a main "Program Files\Palisade" directory. This is quite similar to how Excel is often installed into a subdirectory of a "Microsoft Office" directory.

One subdirectory of the Program Files\Palisade directory will be the TopRank directory (by default called TOPRANK5). This directory contains the program files plus example models and other files necessary for TopRank to run. Another subdirectory of Program Files\Palisade is the SYSTEM directory which contains files which are needed by every program in the DecisionTools Suite, including common help files and program libraries.

Setting Up the TopRank Icons or Shortcuts

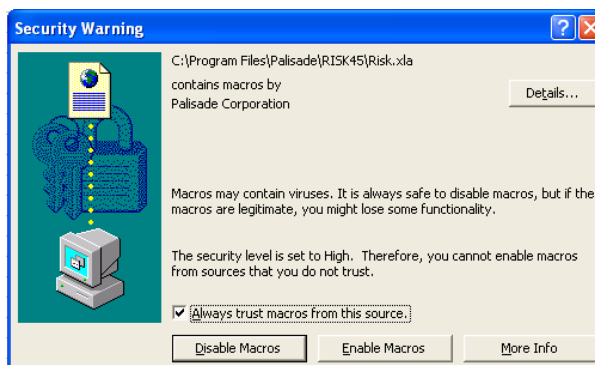
The TopRank setup program automatically creates a TopRank command in the Programs menu of the Taskbar. However, if problems are encountered during Setup, or if you wish to do this manually another time, follow these directions.

- 1) *Click the Start button, and then point to Settings.*
- 2) *Click Taskbar, and then click the Start Menu Programs tab.*
- 3) *Click Add, and then click Browse.*
- 4) *Locate the file TOPRANK.EXE and double click it.*
- 5) *Click Next, and then double-click the menu on which you want the program to appear.*
- 6) *Type the name "TopRank", and then click Finish.*

Macro Security Warning Message on Startup

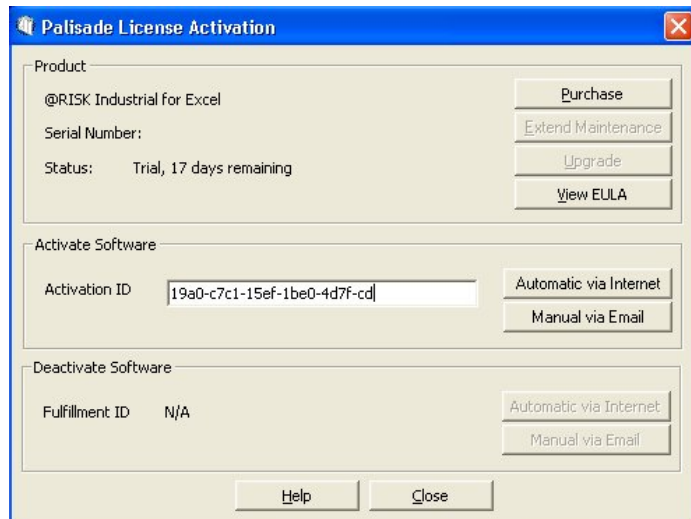
Microsoft Office provides several security settings (under **Tools>Macro>Security**) to keep unwanted or malicious macros from being run in Office applications. A warning message appears each time you attempt to load a file with macros, unless you use the lowest security setting. To keep this message from appearing every time you run a Palisade add-in, Palisade digitally signs their add-in files. Thus, once you have specified **Palisade Corporation** as a trusted source, you can open any Palisade add-in without warning messages. To do this:

- Click **Always trust macros from this source** when a Security Warning dialog (such as the one below) is displayed when starting TopRank.



Software Activation

Activation is a one-time license verification process that is required in order for your TopRank software to run as a fully licensed product. An **activation code** is on your printed/emailed invoice and may resemble a dash separated sequence like "19a0-c7c1-15ef-1be0-4d7f-cd". If you enter your Activation code during installation, then your software is activated the first time the software is run and no further user action is required. If you wish to activate your software after installation, select the TopRank Help menu License Activation command and enter your activation code in the displayed **Palisade License Activation** dialog box.



Frequently Asked Questions

1) What if my software is not activated?

If you do not enter an activation code during installation or you are installing a trial version, your software will run as a trial version with time and/or number of uses limitations and must be activated with an activation code in order to run as a fully licensed product.

2) How long can I use the product before I have to activate it?

Software that is not activated may be run for fifteen days. All of the product's features are present, but the License Activation dialog will appear each time the program is launched to remind you to activate and to indicate the time remaining. If the 15 day trial period expires, the software will require activation in order to run.

3) How do I check my activation status?

The License Activation dialog box is viewed through the TopRank Help menu License Activation command. Activated software shows a status of **Activated** and trial version software shows a status of **Not Activated**. If the software is not activated, the remaining time that the software is allowed to run is displayed.

4) How do I activate my software?

If you do not have an activation code you may obtain one by clicking the Purchase button in the License Activation dialog. An online purchase will be immediately given an activation code and an optional link to download the installer should reinstallation become necessary. To purchase by phone call the local Palisade office given in the **Contacting Palisade** section of this chapter.

Activation may be done over the Internet or via email:

- **Activation if you have Internet Access**

In the Palisade License Activation dialog box, type or paste the activation code and press "Automatic via Internet". A success message should appear after a few seconds and the License Activation dialog box will reflect the software's activated status.

- **Activation if you do not have Internet Access**

Automated activation by email requires a few steps:

1. **Click "Manual via Email"** to display the request.xml file which you may save to disk or copy to the Windows clipboard. (It is recommended you note the location on your computer of the request.xml file.)
2. **Copy or attach the XML file** to an email and send it to *activation@palisade.com*. You should receive an automatic response to the return address in your email shortly.
3. **Save the response.xml attachment** in the response email to your hard drive.
4. **Click on the Process button** that is now in the Palisade License Activation dialog box and navigate to the response.xml file. Select the file and click OK.

A success message should appear and the License Activation dialog will reflect the software's activated status.

5) How do I transfer my software license to another machine?

Transfer of a license, or **rehosting**, may be performed through the Palisade License Activation dialog box as a two step procedure: *deactivation* on the first machine and *activation* on the second machine. A typical use of rehosting is to transfer your copy of TopRank from your office PC to your laptop. To rehost a license from *Machine1* to *Machine2*, make sure both machines have the software installed and are connected to the Internet during the deactivation/activation rehosting.

1. On *Machine1*, click deactivate **Automatic via Internet** in the License Activation dialog. Wait for the success message.
2. On *Machine2*, click activate **Automatic via Internet**. Wait for the success message.

If the machines do not have Internet access then you may follow the similar instructions above for rehosting by the automated email process.

6) I have Internet Access but I am still unable to Activate/Deactivate automatically.

Your firewall must be set to allow TCP access to the licensing server. For single user (non network installations) this is
<http://service.palisade.com:8888> (TCP port 8888 on
<http://service.palisade.com>).

On-line Tutorial

In the on-line tutorial, TopRank experts guide you through sample models in movie format. This tutorial is a multi-media presentation on the main features of TopRank.

The tutorial can be run by selecting the TopRank **Help Menu Getting Started Tutorial** command.

Using TopRank

To use TopRank in a normal Excel session:

- 1) Click the TopRank icon in the Windows Start Programs Palisade DecisionTools group.
- 2) Use the Excel Open command to open the example spreadsheet FACTORY.XLS. The default location for the examples is C:\PROGRAM FILES\PALISADE\TOPRANK5\EXAMPLES.
- 3) Click the Add AutoVary Functions icon, the second one on the toolbar.
- 4) Click the Model Window icon on the TopRank Toolbar – the one on the Toolbar with the red and blue arrow. The Model Window list, listing the Vary functions in the FACTORY worksheet along with your output cells is displayed.
- 5) Click the Run What-if Analysis icon – the one with the red tornado graph. You've just started a what-if analysis for the FACTORY worksheet. The what-if analysis is underway. When it is complete, your what-if analysis results will be displayed.

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Introduction

Have you ever wondered which factors matter most in your decision? If so, you need What-If or sensitivity analysis, which measures the impact on results of changing an uncertain variable across its possible values. Change an assumption you've made in your model and see how it affects results. This is a simple What-If analysis, and it is a familiar activity to many.

What is What-If?

What-If analysis can be used for almost any type of model and is often done with a spreadsheet on a PC. A business person, for example, might use a spreadsheet to combine the uncertain variables *sales price*, *sales volume*, *production costs* and *investment amount* to calculate the results they're interested in — *profits*. By individually varying each uncertain variable, they can see how changes affect profits. And by ranking the impacts of each variable on profits, the What-If analysis shows which is most important.

Better Decisions With What-If Analysis

By examining the impact of reasonable changes in base-case assumptions, What-If analysis determines which variables have little impact on outcomes and which are significant. This perspective on what's important can help structure the decision under consideration. You can concentrate your attention on those critical factors and how changes in them affects the results of your decision.

What-If analysis is a critical component of the decision modeling process. Typically, first, the spreadsheet model is built. Then, What-If analysis identifies the critical components of the model. Additional data is then gathered on these critical variables and the model is refined. Ultimately, a decision is made using a robust model in which all important issues are identified.

What-If Analysis and Planning

What-If analysis also aids in planning operations and contingencies. Once a decision has been made to “go” based on your model, your What-If analysis has already identified what affects outcomes the most and what's insignificant. This helps you plan by showing where you should prepare the most to guard against changes, and where you don't need to worry if changes occur.

Perhaps, for example, your What-If analysis identified labor costs as the critical factor affecting the profitability of a new assembly plant. Because of your What-If analysis results, you'll spend more time insuring that there's a solid, long-term labor contract in place.

What-If Analysis and the Computer

The spreadsheet was revolutionary in bringing the benefits of What-If modeling to a broad spectrum of users. A simple What-If analysis can be accomplished with any spreadsheet model by changing a value and recalculating. Instantly you see the effect of the change on your results — a single What-If calculation. Usually, a couple more What-Ifs are tried manually — maybe a best case and a worst case — and the results are noted and reported.

More ambitious spreadsheet users often run a set of What-Ifs, each on different input values, manually tracking their effects on results. They then compare the impacts on results from each change and identify the most critical variables in their model.

Automated What-Ifs with TopRank

TopRank brings an automated and rigorous approach to What-If analysis on spreadsheets. Instead of requiring you to manually change a set of input values, TopRank automatically changes any or all inputs in your spreadsheet, tracks all results calculated, and ranks them according to their impacts. TopRank also graphs your results for easy presentation.

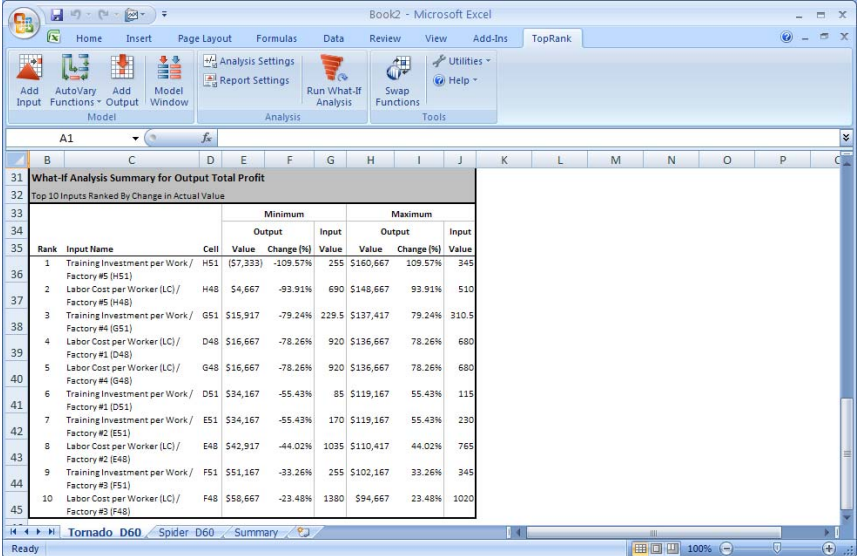
TopRank greatly speeds What-If modeling and provides a thorough analysis of a greater number of input values. Instead of being limited to a manual testing of five or ten What-If calculations, TopRank can quickly process hundreds or thousands of What-If calculations.

Running a What-If Analysis

A What-If analysis is an iterative process. One by one, each spreadsheet variable (in TopRank, called an **input**) is changed to a new possible value and the spreadsheet is recalculated. A new result is generated and recorded, the input is reset to its original value and the next input is changed. At the end of the analysis, a set of data is created, containing various possible input values and the results associated with each.

Results from What-If Analyses

The results of a What-If analysis include **tables** ranking inputs by their effects on results and **graphs** which summarize those rankings. A typical ranking as produced by TopRank shows the most important inputs at the top of the list, with the maximum and minimum output value caused by each input shown.



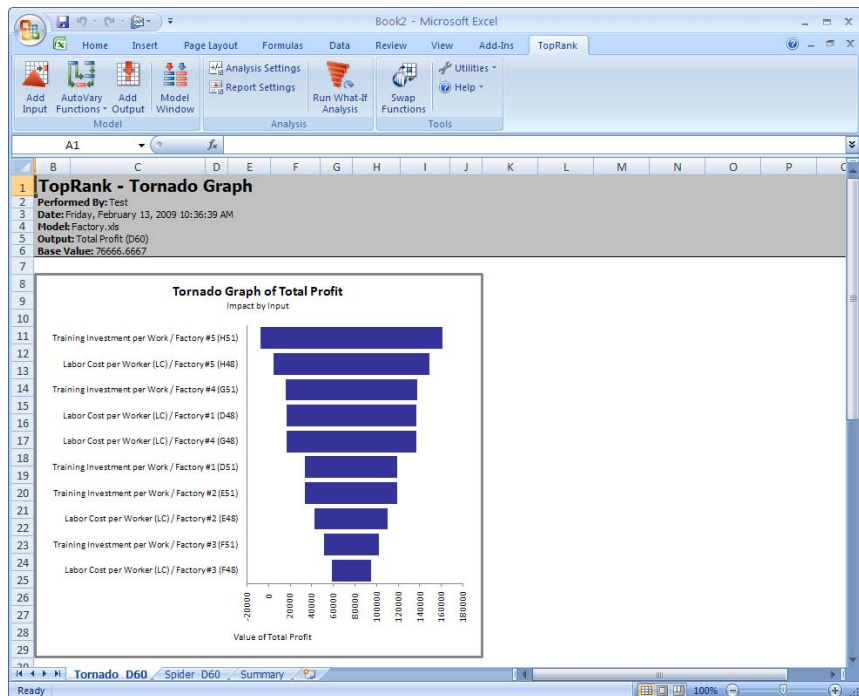
What-If Analysis Summary for Output Total Profit								
Top 10 Inputs Ranked By Change in Actual Value								
Rank	Input Name	Cell	Minimum		Maximum			
			Output Value	Change (%)	Output Value	Output Value	Change (%)	
1	Training Investment per Work / Factory #5 (H51)	H51	\$7,333	-109.57%	255	\$160,667	109.57%	345
2	Labor Cost per Worker (LC) / Factory #5 (H48)	H48	\$4,667	-93.91%	690	\$148,667	93.91%	510
3	Training Investment per Work / Factory #4 (G51)	G51	\$15,917	-79.24%	229.5	\$137,417	79.24%	310.5
4	Labor Cost per Worker (LC) / Factory #1 (D48)	D48	\$16,667	-78.26%	920	\$136,667	78.26%	680
5	Labor Cost per Worker (LC) / Factory #4 (G48)	G48	\$16,667	-78.26%	920	\$136,667	78.26%	680
6	Training Investment per Work / Factory #1 (D51)	D51	\$34,167	-55.43%	85	\$119,167	55.43%	115
7	Training Investment per Work / Factory #2 (E51)	E51	\$34,167	-55.43%	170	\$119,167	55.43%	230
8	Labor Cost per Worker (LC) / Factory #2 (E48)	E48	\$42,917	-44.02%	1035	\$110,417	44.02%	765
9	Training Investment per Work / Factory #3 (F51)	F51	\$51,167	-33.26%	255	\$102,167	33.26%	345
10	Labor Cost per Worker (LC) / Factory #3 (F48)	F48	\$58,667	-23.48%	1380	\$94,667	23.48%	1020

Graphs of What-If Results

Graphs are also important for both displaying the relative ranking of one input versus another (using a tornado graph and a spider graph) or displaying the impact of an individual input on results (a sensitivity graph).

Tornado Graphs

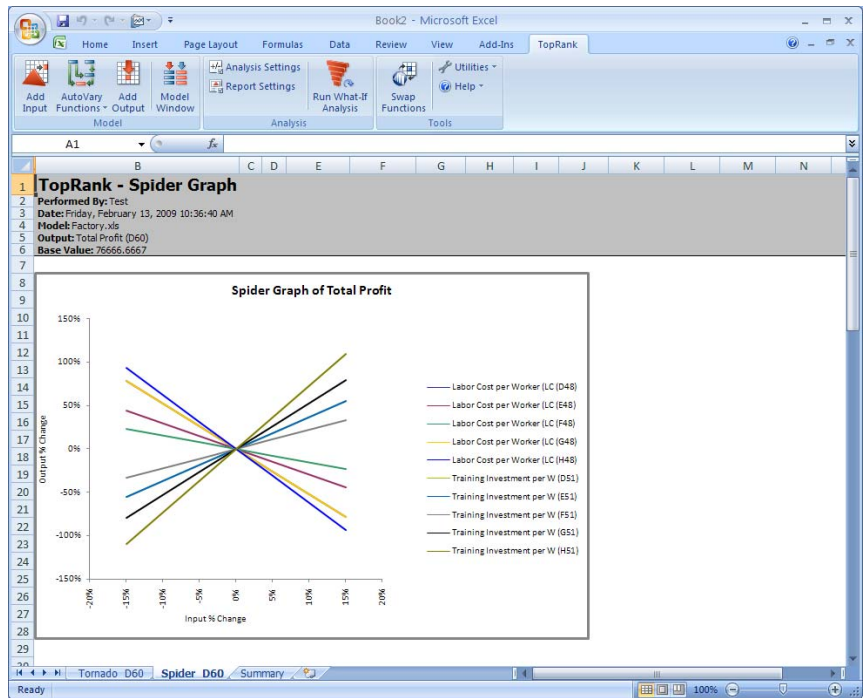
A tornado graph compares the effects of all inputs on results. For each input (listed on the Y-Axis), the length of the bar drawn indicates the amount of change the input caused on results. As the input with largest effects (and longest bar) is shown at the top and those with less impact below, the graph often takes the shape of a tornado.



The tornado graph brings attention to the inputs that require further attention (those plotted on the top of the graph). The tornado summarizes the impact of an almost unlimited number of inputs in a neat, simple graph.

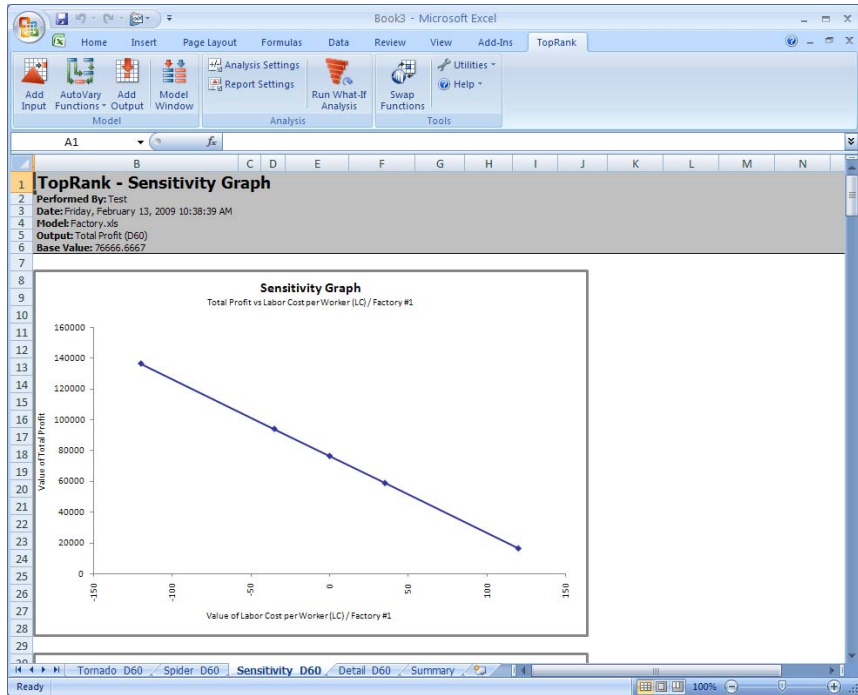
Spider Graphs

A spider graph also compares the effects of multiple inputs on results. For each input, the percentage change in its value from the base case is plotted on the X-Axis and the percentage change in results is plotted on the Y-Axis. As inputs have different impacts on results, the graph often resembles a spider.



Sensitivity Graphs

The effects of an individual input on results can be plotted with a standard line graph. The value of the selected input is plotted on the X-Axis and the value of results is plotted on the Y-Axis. This simple X-Y plot clearly illustrates how results change in conjunction with changes in the underlying input. The graph also shows if changes are constant or linear, or if results start to change more dramatically with increases in input value.



Multi-Way What-If Analysis

There are many cases when you may want to see the impacts of combinations of changes in two or more inputs on results. This is called a **Multi-Way What-If analysis**. Multi-Way What-If analyses vary inputs at the same time and calculate the effect of each combination of input values on results.

Changing More Than One Input

Multi-Way What-If analyses deal with the problem that inputs, in real life, do not vary one at a time as is assumed by the standard one-way What-If. At the same time, one input can differ positively from what was expected, while a second can differ negatively. Inputs can also vary jointly, as a rise in one (such as rainfall) often is accompanied by a rise in a second (such as crop yield).

As with the standard one-way What-If analysis, spreadsheet users often conduct Multi-Way What-If analyses manually. Each of several inputs can be changed to their maximum possible value at the same time, calculating an **optimistic scenario** for results. Conversely, the inputs then can be changed to their minimum possible values, creating a **pessimistic scenario**.

Calculating more than a small number of Multi-Way combinations manually with a spreadsheet becomes very cumbersome. TopRank automates Multi-Way What-If analyses, trying all possible combinations of inputs you select, tracking results calculated at each combination, and ranking them according to their impact on results.

Critical Combinations

A Multi-Way What-If analysis can include **1) a varying number of total inputs** and **2) a varying number inputs used in each combination**. For example, you might have four inputs – *price, sales volume, production costs, and investment* – and you want to see the impacts of every combination of two inputs on your result, *profit*. Your analysis might tell you that *price and sales volume* varying together are the most significant combination affecting your result – *profit*.

Multi-Way What-If Analysis Results

As with one-way What-If analyses, Multi-Way What-If analysis results can be displayed in tables and graphs. A table lists the combinations of inputs that were tested and the corresponding result that was calculated.

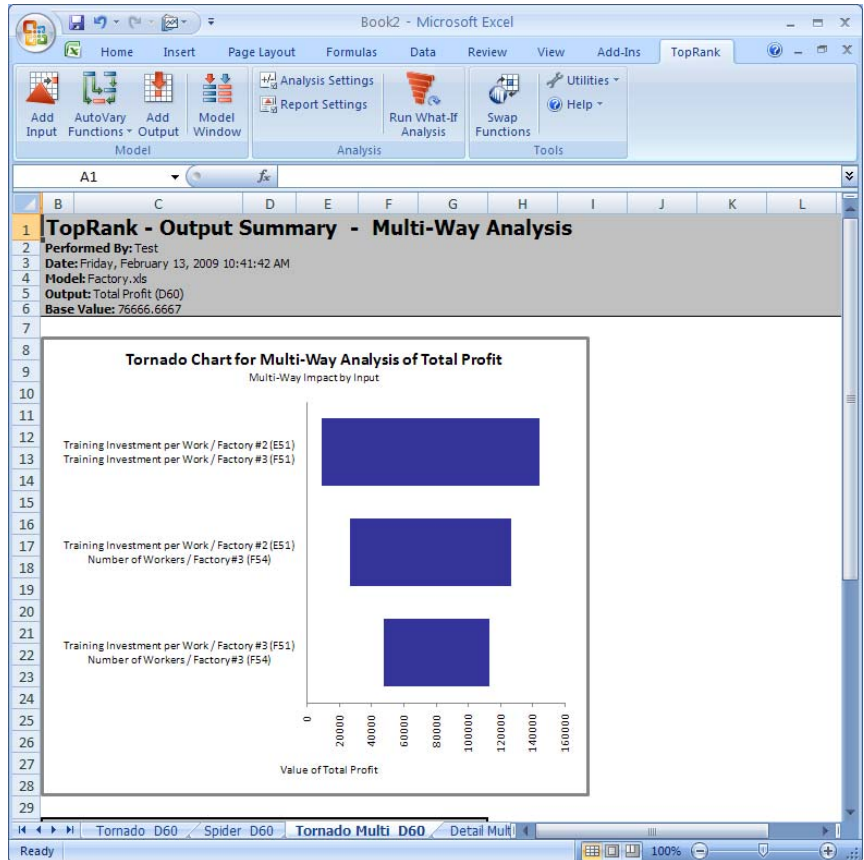
TopRank - Output Detail - Multi-Way Analysis
 Performed By: Test
 Date: Friday, February 13, 2009 10:41:42 AM
 Model: Factory.xls
 Output: Total Profit (D60)
 Base Value: 76666.6667

What-If Analysis Multi-Way Analysis Output Detail
 Inputs and Outputs

Rank	Output Variation				Input Variation			
	Total Profit D60		Training Investment per Work / Factory #2 E51		Investment per Work / Factory #3 F51		Number of Workers / Factory #3 F54	
	Value	Change (%)	Value	Change (%)	Value	Change (%)	Value	Change (%)
1	\$8,667	-88.70%	170	-15.00%	255	-15.00%	100	0.00%
2	\$144,667	88.70%	230	15.00%	345	15.00%	100	0.00%
3	\$26,667	-65.22%	170	-15.00%	300	0.00%	85	-15.00%
4	\$126,667	65.22%	230	15.00%	300	0.00%	115	15.00%
5	\$113,492	48.03%	200	0.00%	345	15.00%	115	15.00%
6	\$41,667	-45.65%	170	-15.00%	300	0.00%	115	15.00%
7	\$111,667	45.65%	230	15.00%	300	0.00%	85	-15.00%
8	\$47,492	-38.05%	200	0.00%	255	-15.00%	85	-15.00%
9	\$54,842	-28.47%	200	0.00%	255	-15.00%	115	15.00%
10	\$59,667	-22.17%	170	-15.00%	345	15.00%	100	0.00%
11	\$93,667	22.17%	230	15.00%	255	-15.00%	100	0.00%
12	\$90,842	18.49%	200	0.00%	345	15.00%	85	-15.00%

Multi-Way Tornado Graph in TopRank

The combinations that have the most impact on results can be displayed with a tornado graph, just as are one-way What-If analysis results. When a tornado graph is used with Multi-Way results, each bar represents the changes in results caused by a combination of two or more inputs.



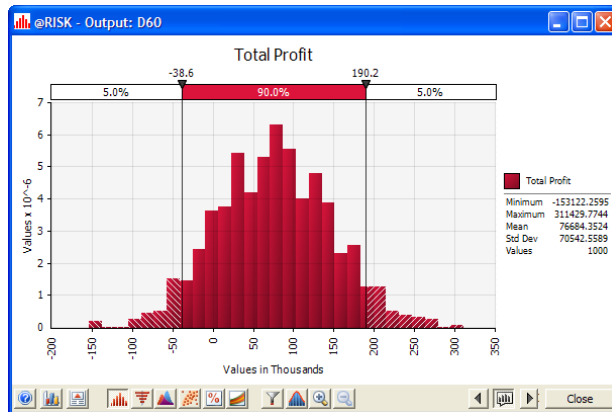
What-If Analysis and Risk Analysis

What-If analysis is often the first analysis performed on a spreadsheet. Its results then lead to a further refinement of the model, additional analyses and ultimately, a final decision based on the best model possible. Risk analysis, a powerful analytical technique available using TopRank's companion product, @RISK, is often the next analysis performed on a spreadsheet after a What-If analysis.

Moving from What-If to Simulation

What-If analyses initially identify what's important in your model. You can then focus on these important components to better estimate what their values could be. Usually, however, there are several or more of these important uncertain components, and, in reality, they could all vary at the same time. To analyze an uncertain model such as this you need risk analysis or Monte Carlo simulation. Risk analysis varies all uncertain inputs simultaneously – just as they do in real life – and builds a range and distribution of the possible results that could occur.

With risk analysis, inputs are described with a probability distribution – such as normal, lognormal, beta or binomial. This is a much more detailed description of the uncertainty present in an input's value than a simple + or - percentage variation. A probability distribution shows both the range of values possible for an input and the likelihood of occurrence of any value in the range. Simulation combines these input distributions to generate both a range of possible results from your model and the likelihood of any result occurring.

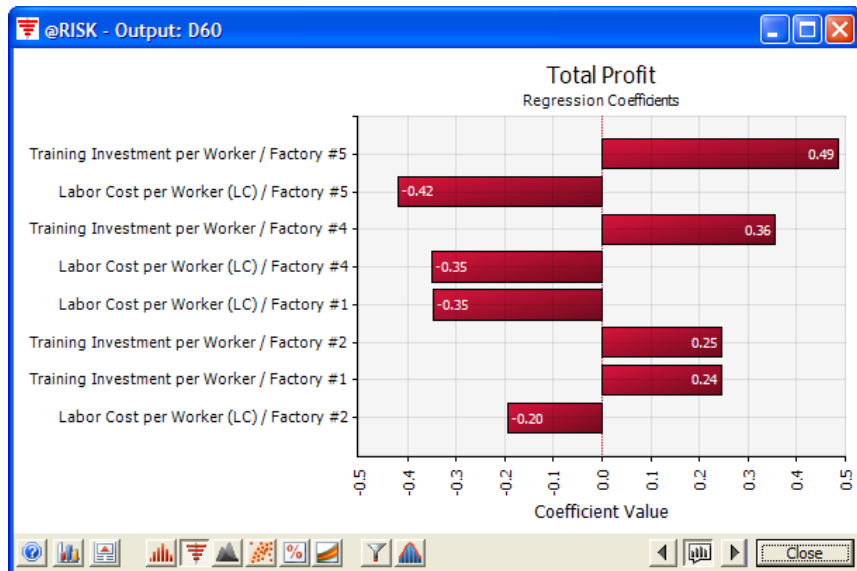


Using What-If Definitions in a Risk Analysis

The simple + and - change which defines the inputs to a What-If analysis can be refined to create the probability distributions needed in a risk analysis. TopRank's What-If inputs automatically can be directly used in a risk analysis using @RISK.

Sensitivity Analysis Using Risk Analysis

Sensitivity analysis can be conducted on the data generated by a risk analysis to identify the most critical inputs which affect results. This is often accomplished using correlation and/or regression analysis of the data sets generated by the simulation. This is a robust and highly refined form of sensitivity analysis as it uses as its basis the simulation data where all inputs were changed simultaneously. In many cases it may just affirm the results of your initial What-If analysis, but there are times when there may be a difference in the results. Assuming the simulation model is properly specified, the sensitivity analysis results from the simulation are the ones you should use.



Sensitivities to Probabilities in a Risk Analysis

A What-If analysis can also be performed on the probabilities used in a risk analysis. In this form of What-If analysis, probabilities or input distribution parameters are changed by simulation. One simulation is executed with one set of probabilities, then a second is executed on the same model with different probabilities and so on. The results of each simulation are then compared to identify the impact of changing probabilities.

@RISK has the capability to run multiple simulations, one after another, and change values by simulation. It then automatically compares results from each of the multiple simulations. TopRank also can run multiple What-If analyses, one after another, and change input variations by run. You can then compare the results from each What-If analysis and see how changes in assumptions affect your results.

Sensitivity Analyses in @RISK vs. TopRank

TopRank

For a simple What-If calculation, TopRank determines how a single input affects the output by only changing the value of the input. The values of all other inputs in the model remain constant. This method is called single variable sensitivity analysis.

The advantages of a TopRank sensitivity analysis is that it is quick and easy. TopRank can automate the whole process of finding and defining inputs, and it only needs to run a few iterations to get meaningful results. And, TopRank gives you answers in an easy to understand format. The spider graph tells exactly how much a given % change in an input affects the output.

The disadvantage of a TopRank sensitivity analysis is that it does not take the variability of other inputs into account. The Multi-Way sensitivity analysis can compensate for this weakness to an extent, but does not always find cross-correlation between input variables.

@RISK

In an @RISK simulation, the value of each input changes simultaneously. Data is collected for both the inputs and the output, and the sensitivity is calculated using a rank order correlation coefficient or via linear regression.

The disadvantages of an @RISK sensitivity analysis is that it requires a large number of iterations and you must use uncertainty distributions in your model. And, while the results tell you which variables have the greatest effect, they do not tell you how much a given % change in an input affects the output.

The advantage of an @RISK sensitivity analysis is that it does not require an extra set of calculations if you are going to run an @RISK simulation anyway. And, any cross-correlation between inputs is always reported in the results.

We recommend using TopRank and @RISK in most instances. TopRank is quick and easy, and present results in an easy-to-interpret form. Use TopRank before using @RISK to save time and effort.

Why What-If First?

Risk analysis is a more robust and comprehensive analytical technique when compared with What-If analysis as it varies all inputs simultaneously. It also accounts more explicitly for interrelationships among inputs in the results it generates. And with its own form of sensitivity analysis, it identifies the most important inputs which affect your results. But, even with all this, why is What-If analysis so popular and why should it still be used in conjunction with risk analysis?

- **It's Easy.** There's no doubt about it – a What-If analysis is easy. From the simple, manual What-If performed by most every spreadsheet user to the automated, extensive What-If processing of TopRank, a What-If analysis can be performed quickly and easily. Describing your inputs in terms of a possible + and - change is easier and more understandable for many when compared with the probability distributions required by risk analysis
- **It Saves Time for a Subsequent Risk Analysis.** Quickly identifying the most critical inputs with What-If analysis saves time when developing a risk analysis model. You can then concentrate your efforts in defining probability distributions to those most important inputs. Describing the range and shape of a probability distribution can be time-consuming and it's easier if you can focus on a more limited set of inputs.
- **Its Results Are Understandable and Accessible to All.** Decision makers are all comfortable with the concept of a What-If analysis. "What's most important" and "what happens if this factor increases in value" are common questions asked during the decision making process. Some decision makers, however, have trouble with the concepts of probabilities, simulation and distributions of possible outcomes. They're naively afraid of the "black box" that has executed their simulation and don't trust the results of the more complex technique.
- **For Some Analyses, There's Just Not Enough Time for Risk Analysis.** Many decision makers deal with reams and reams of models – some more critical, some less. They just don't have the time to build a simulation model for all cases. A quick What-If, however, gives them needed information in little time for those less important decisions.

Conclusions

What-If analysis is a powerful technique that has gained great popularity with the advent of the spreadsheet and the personal computer. Whether in its one-way or Multi-Way form, What-If analysis can provide important guidance for refining a model and implementing a decision. It shows you what's important and where to focus — important guidance for any decision maker. And it also provides a stepping stone to the powerful technique of risk analysis or Monte Carlo simulation.

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Introduction

TopRank is a spreadsheet add-in for Microsoft Excel. It can be used for What-If analysis on any pre-existing or new spreadsheet. To set up your What-If analyses, TopRank adds new custom “Vary” functions to the spreadsheet function set. These functions specify how the values in your spreadsheet can be varied in a What-If analysis; for example, +10% and -10%, +1000 and -500, or according to a table of values you’ve entered.

TopRank can also run a fully automatic What-If analysis. It uses powerful auditing technology to find all possible values in your spreadsheet which could affect your results. It can then change all these possible values automatically and find out which is most significant in determining your results.

Definition of Terms

Before getting into the details of What-If analysis with TopRank, you should understand some of the special terms used in this chapter:

- An **input** is a constant value used in a cell or formula in your spreadsheet model that affects your results
- An **output** is a cell on which you want to run a **What-If** analysis that contains the result of spreadsheet calculations
- The **base case** of an input is the number you entered in the spreadsheet when you first designed the model (usually the most likely value)
- The **minimum change** is the possible downside or negative change you think an input can reasonably have
- The **maximum change** is the possible upside or positive change you think an input can reasonably have
- **Steps** are the number of values across an input’s minimum-maximum range to be used in a **What-If** analysis
- **Distribution** is a probability distribution type which shows the likelihood of a value in an input’s minimum-maximum range occurring (e.g. a normal distribution)
- **What-If Table** is a table of values to be substituted for an input in a **What-If** analysis

- **Vary** and **VaryTable** are functions used by TopRank to describe the base case, minimum change, maximum change, steps, distribution and **What-If** table for an input
- **Multi-Way What-If** analysis varies two or more inputs at the same time and reports results for all combinations of inputs
- **VaryMulti** and **VaryMultiTable** are functions used by TopRank to identify inputs which are to be included in a Multi-Way **What-If** analysis

What is What-If Analysis?

TopRank can conduct one-way and Multi-Way What-If analyses on any spreadsheet model. TopRank performs these analyses by 1) adding a new set of functions to the spreadsheet function set and 2) providing capabilities to conduct What-If analyses on spreadsheets and calculate and graph the results of these analyses.

One-Way What-If Analysis

One-Way What-If analysis studies the effect of changes in individual input variables on the output values of a spreadsheet. Each input is changed individually while holding all others at their base case value. In TopRank, a one-way What-If analysis is conducted on all input variables identified using **Vary** functions. A Vary function is a custom function added to the Excel spreadsheet function set by TopRank.

Defining a What-If Input

Inputs to be changed in a one-way What-If analysis can be identified individually by the user or automatically by TopRank. At a minimum, each variable is defined by three values – its base value (the one originally present in the spreadsheet), its possible downside (negative) change, and its possible upside (positive) change. Negative and positive change is typically entered as a percentage, such as -10% or +20%. As an option, you can also enter an actual change (such as -1000 or +950) or an actual minimum and maximum (such as 100 or 200).

Vary Functions

In TopRank, base, minimum change, and maximum change for an input are entered in Vary functions, such as:

- **RiskVary(100,-10,+10)**, indicating a base case of 100 and a possible -10% and +10% change
- **RiskVary(50,-45,+10)**, indicating an expected value of 50 and a possible -45% and +10% change

During a normal spreadsheet calculations, Vary functions return their base case or expected value. For the functions shown above, the values returned are 100 and 50. These are also the values entered in the cell before the Vary function was added. By returning their expected value, Vary functions do not affect the normal results of your spreadsheet (when TopRank is not in use).

As with standard spreadsheet functions, Vary functions can be used by themselves in a cell or as part of a formula. Multiple Vary functions can be present in a cell and Vary functions can be arguments to other functions.

VaryTable Functions

If there is a table of possible values you want to try for an input, the **VaryTable** function is used. With **VaryTable** you simply enter a base value and a reference to the location in the spreadsheet that contains your table of values. Alternatively, you can also enter the table of values directly in the function itself. Typical **VaryTable** functions are:

- **RiskVaryTable(100,G1:G50)**, where 50 values located in the range G1:G50 are successively returned by the **VaryTable** function during the What-If analysis and new output values calculated for each
- **RiskVaryTable(50,{40,42.5,48,52,58})**, where five different values – 40 through 58 – are successively returned by the **VaryTable** function during the What-If analysis and new output values calculated for each

Letting TopRank Define What-If Variables

Vary and **VaryTable** functions can be entered directly in your spreadsheet by you, just as are any standard spreadsheet functions. **TopRank**, however, also includes a powerful automatic mode where **Vary** functions are automatically inserted in your spreadsheet for all input variables which could affect each output you select.

As an option, **TopRank** can automatically search your spreadsheet for all values in cells and formulas which could affect your output's value. These values are numeric constants – such as 1000, 10.5 or 99 – entered in the spreadsheet cells and formulas that combine to calculate an output. **TopRank** identifies inputs either when you start an analysis or when you add an output.

Identifying Inputs in Formulas

Inputs can be found in the formulas and values which are entered into spreadsheet cells. Through the use of cell references, formulas use the results of calculations in other cells, with subsequent formulas referencing those intermediate cells. Ultimately this chain of formulas leads to a result calculated in an output cell. Within this “tree” of formulas, any value – either alone in a cell, such as 100, or embedded in a formula, such as the 1.1 value in the formula = (1.1 * A2) + A3 – is a possible input variable which could affect the output. This is because only values – not cell references – can be changed in a **TopRank** What-If analysis (i.e., you can't change cell references without changing the structure of the model).

When **TopRank** automatically identifies inputs for you, it finds all possible values in cells and formulas which could be changed to affect the output selected. To do this, **TopRank** searches through the formulas in the spreadsheet, tracing back from the output cell through the dependent cells and formulas. In each identified formula, it finds input

values based on identification criteria you specify. For example, you can have TopRank find any possible input value, anywhere in a cell's formula or functions, or cause it to restrict its search to only values which are by themselves in a cell's formula. This keeps the list of identified inputs more manageable when desired.

After TopRank has identified inputs you, of course, can remove them from your inputs list or lock them, so they won't be changed in an analysis. You can do this if a value was identified by TopRank as a possible input, but, given your knowledge of the model, it could never be changed – it's a fixed value and changing it is nonsensical.

AutoVary Functions

When TopRank defines inputs for you, it automatically inserts an **AutoVary** function for each constant it finds that could affect your output. These AutoVary functions use a default +/- variation that you select – such as -20% and +20%. For example, TopRank can enter:

- **AutoVary(50,-10,+10)**, indicating an expected value of 50 and a possible -10% and +10% change. This is the equivalent to the function **Vary(50,-10,+10)**; the “Auto” just identifies it as a function automatically entered by TopRank

By using this automatic mode you can quickly analyze a spreadsheet prior to making more detailed Vary function entries. In as little as two mouse clicks you've generated valuable What-If results. In addition, with the automatic mode important What-If results can be gathered by users who have little or no training in analytical techniques.

At any time, AutoVary functions can be removed from your spreadsheet by TopRank, restoring it to its original condition.

Note: An AutoVary function is simply a Vary function that was automatically added to your spreadsheet by TopRank.

Steps and Distribution

The number of values tried for each input and their magnitude is given by the **#Steps** and **distribution** setting for each Vary function. These entries further customize the values used for each input during your What-If analyses.

Number of Steps for Vary Functions

A differing number of possible values can be returned for each Vary function. For each value returned, TopRank recalculates the worksheet and stores a new possible result. The number of values returned is given by the **#Steps** argument to the Vary function or a default number of steps.

In the function's simplest form – such as **Vary(100,-10,+10)** – there is no entry in the function for the **#Steps**. In this case TopRank uses the default **#Steps**. A typical default is four or five steps. With four steps TopRank calculates the spreadsheet at the minimum possible value for the Vary function, the maximum possible value, and two values equally spaced in between. If you enter a **#Steps** value in the Vary function, such as **Vary(100,-10,+10,,8)**, TopRank overrides the default **#Steps** and, in this case, returns eight different values for the Vary function.

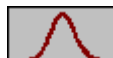
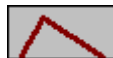
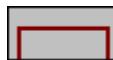
If a table of values is entered using the VaryTable function, such as **VaryTable(100,G1:G100)**, TopRank calculates spreadsheet results for each of the values entered in the table, whether ten, one hundred or thousands of values.

Distribution Across a Vary Function's Range

The actual values returned by TopRank for each step for each Vary function depend on the Distribution argument to the Vary function or the default distribution setting. The distribution selected describes how values are distributed across the minimum-maximum range of the function. For example, if the Uniform distribution is selected – such as **Vary(100,-10,+10,,,“Uniform”)** – any value in the minimum-maximum range described by the Vary function is equally likely to occur.

Four distribution types are available with TopRank. They are:

- **Uniform**
- **Triangular**
- **Tri1090**
- **Normal**

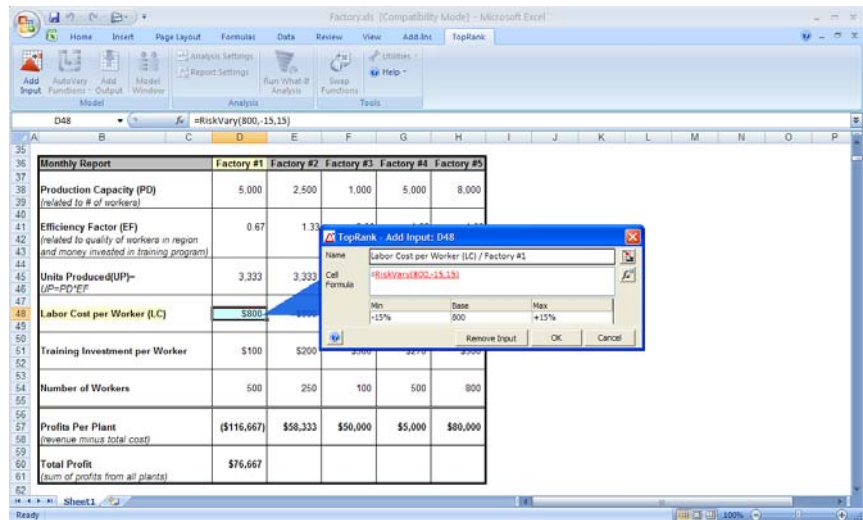


Percentile Values

TopRank steps across the min-max range defined by the Vary function by using a distribution's percentiles. Any probability distribution can be divided into 100 segments of equal probability. At the 20th segment or percentile there is a 20% chance of a lower value and a 80% chance of a higher value occurring. TopRank always returns the 0% percentile (minimum) and the 100% percentile (maximum) – a minimum of two steps for each Vary function (except for unbounded distributions such as the Normal, where TopRank returns the 5% and 95% percentile instead). Additional steps are spread equally on a percentile basis across the min-max range. If you ask for five steps, for example, TopRank returns values for the minimum and maximum, plus the 25%, 50% and 75% percentiles – a total of five values returned, 5 recalculations and 5 new results generated.

Adding Inputs by Cell

TopRank makes it easy to look at values in your spreadsheet and add, change, update or remove Vary and VaryTable functions associated with your inputs.



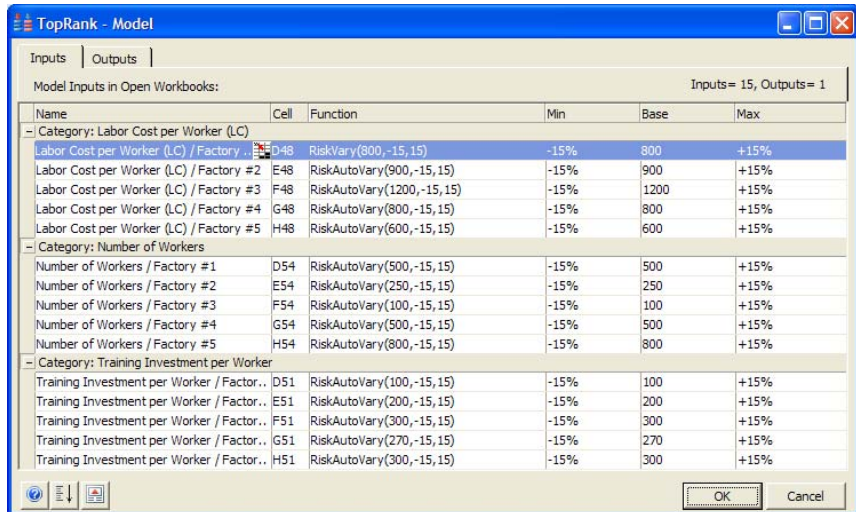
When the Add Input window is displayed, you can move to different cells in your worksheet and view their formulas. By clicking on values and functions in the formula displayed in the Add Input window (turning them "red"), you can add, edit or remove Vary functions by either:

- **Typing** directly in the formula, or
- Using the **Min-Base-Max** table below the formula to change parameters for a Vary function.

When adding inputs, TopRank generates and inserts in the spreadsheet formula the necessary Vary function to go with the parameters you've selected for an input. You can also easily remove those Vary functions you don't want.

Looking at All Inputs and Outputs in Open Workbooks

The **Model window** lists all selected output cells and all identified input Vary functions in your workbook(s). This table is displayed when Model Window icon (the icon with a red and blue arrow) is clicked.



TopRank - Model

Inputs | Outputs |

Model Inputs in Open Workbooks: Inputs= 15, Outputs= 1

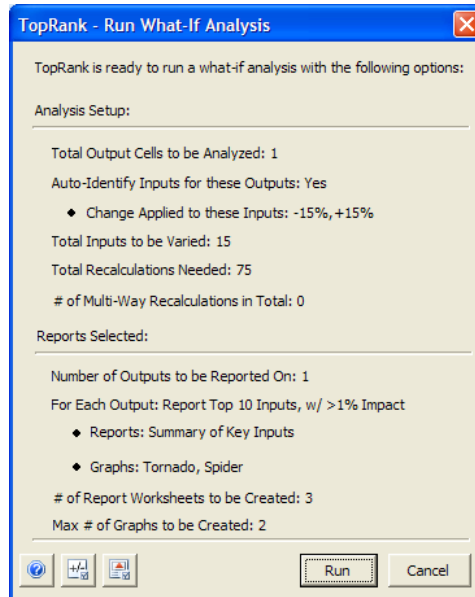
Name	Cell	Function	Min	Base	Max
- Category: Labor Cost per Worker (LC)					
Labor Cost per Worker (LC) / Factory #1	D48	RiskVary(800,-15,15)	-15%	800	+15%
Labor Cost per Worker (LC) / Factory #2	E48	RiskAutoVary(900,-15,15)	-15%	900	+15%
Labor Cost per Worker (LC) / Factory #3	F48	RiskAutoVary(1200,-15,15)	-15%	1200	+15%
Labor Cost per Worker (LC) / Factory #4	G48	RiskAutoVary(800,-15,15)	-15%	800	+15%
Labor Cost per Worker (LC) / Factory #5	H48	RiskAutoVary(600,-15,15)	-15%	600	+15%
- Category: Number of Workers					
Number of Workers / Factory #1	D54	RiskAutoVary(500,-15,15)	-15%	500	+15%
Number of Workers / Factory #2	E54	RiskAutoVary(250,-15,15)	-15%	250	+15%
Number of Workers / Factory #3	F54	RiskAutoVary(100,-15,15)	-15%	100	+15%
Number of Workers / Factory #4	G54	RiskAutoVary(500,-15,15)	-15%	500	+15%
Number of Workers / Factory #5	H54	RiskAutoVary(800,-15,15)	-15%	800	+15%
- Category: Training Investment per Worker					
Training Investment per Worker / Factor..	D51	RiskAutoVary(100,-15,15)	-15%	100	+15%
Training Investment per Worker / Factor..	E51	RiskAutoVary(200,-15,15)	-15%	200	+15%
Training Investment per Worker / Factor..	F51	RiskAutoVary(300,-15,15)	-15%	300	+15%
Training Investment per Worker / Factor..	G51	RiskAutoVary(270,-15,15)	-15%	270	+15%
Training Investment per Worker / Factor..	H51	RiskAutoVary(300,-15,15)	-15%	300	+15%

OK Cancel

The possible variation in value described by a Vary function can also be changed in the Model Window, just as in the Add Input window. Simply type in the new Min or Max value you want, or use the drop-downs to select a value from the list.

Running a What-If Analysis in TopRank

Clicking the Run What-If icon starts a what-if analysis. When starting, TopRank first locates all Vary functions in your spreadsheet. If you have selected to add AutoVary functions by automatically identifying inputs, TopRank will add them. Then, it displays a status screen describing the analysis you are about to run:



Following the Status dialog, TopRank runs the analysis. During the analysis, one by one, TopRank changes the values returned by each Vary function, recalculates the spreadsheet, and collects and stores the new output value. The values returned by each Vary function depend on the minimum/ maximum range you entered for the function, the number of steps and the distribution selected.

What-If Calculations

During What-If calculations, a new value is returned for each step of each Vary function. For each new value, a new result is calculated and collected from each selected output cell. Once all steps have been calculated, TopRank then returns the Vary function to its base value and begins changing the next entered Vary function. Once all Vary function have been changed, all are returned to their original base value and the ranking of results is performed.

Results from a What-If Analysis

The standard results of a one-way What-If analysis are a ranking of input variables by their impact on your outputs. Input variables are all Vary and VaryTable function that were changed by TopRank during the What-If analysis. Outputs are output cells identified by you prior to the analysis.

What-If Analysis Results for Two Outputs

The image shows two screenshots of an Excel spreadsheet. The top screenshot is titled 'What-If Analysis Summary for Output Profits Per Plant / Factory #1' and the bottom screenshot is titled 'What-If Analysis Summary for Output Profits Per Plant / Factory #2'. Both screenshots show a table with columns for Rank, Input Name, Cell, Value, Change (%), and Input/Output values for Minimum and Maximum scenarios.

Rank	Input Name	Cell	Minimum		Maximum		
			Value	Change (%)	Value	Change (%)	
1	Labor Cost per Worker (LC) / Factory #1 (D48)	D48	(\$176,667)	-51.43%	920	(\$56,667)	51.43%
2	Training Investment per Work / Factory #1 (D51)	D51	(\$159,167)	-36.43%	85	(\$74,167)	36.43%
3	Number of Workers / Factory #1 (D54)	D54	(\$134,167)	-15.00%	575	(\$99,167)	15.00%

Rank	Input Name	Cell	Minimum		Maximum		
			Value	Change (%)	Value	Change (%)	
1	Training Investment per Work / Factory #2 (E51)	E51	\$15,833	-72.86%	170	\$100,833	72.86%
2	Labor Cost per Worker (LC) / Factory #2 (E48)	E48	\$24,583	-57.86%	1035	\$92,083	57.86%
3	Number of Workers / Factory #2 (E54)	E54	\$49,583	-15.00%	212.5	\$67,083	15.00%

A different ranking is made for each output cell selected (since inputs have different effects on each of your output cells). A Vary function used for **Labor Cost for Factory 1**, for example, can have a major effect on an output **Profit for Factory 1** but no effect on an output **Profit for Factory 2**.

Ranking is done based on the amount of change from the output's base value that was caused by changing the input Vary function to a new value. The amount of change is measured as a percentage change. This is calculated using the formula:

$$\frac{(\text{New Calculated Output Value} - \text{Output Base Value})}{\text{Output Base Value}}$$

Graphical Results from a One-Way What-If Analysis

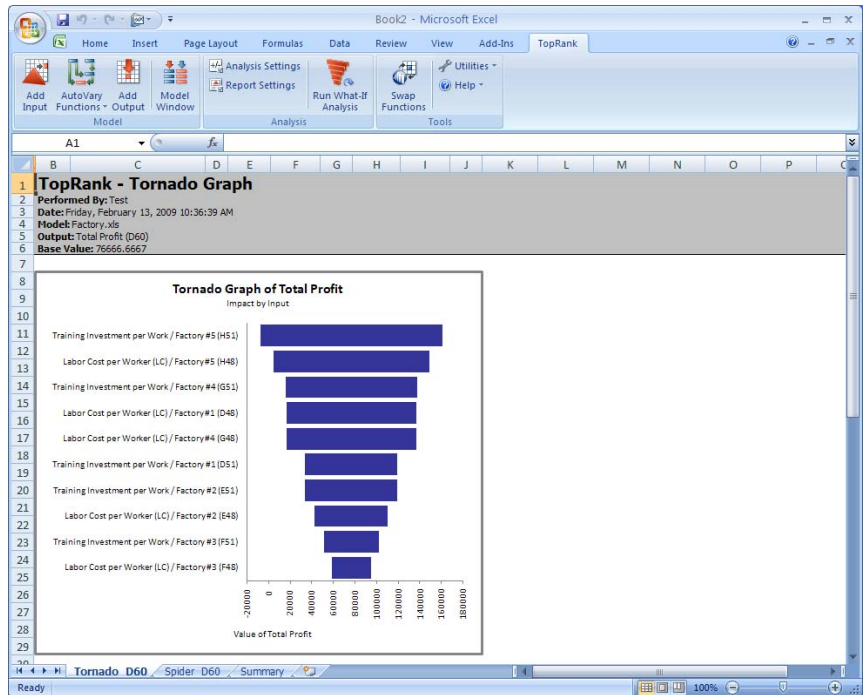
Three different types of graphs can be used to describe What-If analysis results. These are:

- Tornado graphs
- Spider graphs
- Sensitivity graphs

Each graph provides an easily accessible method to view different aspects of What-If analysis results.

Tornado Graphs

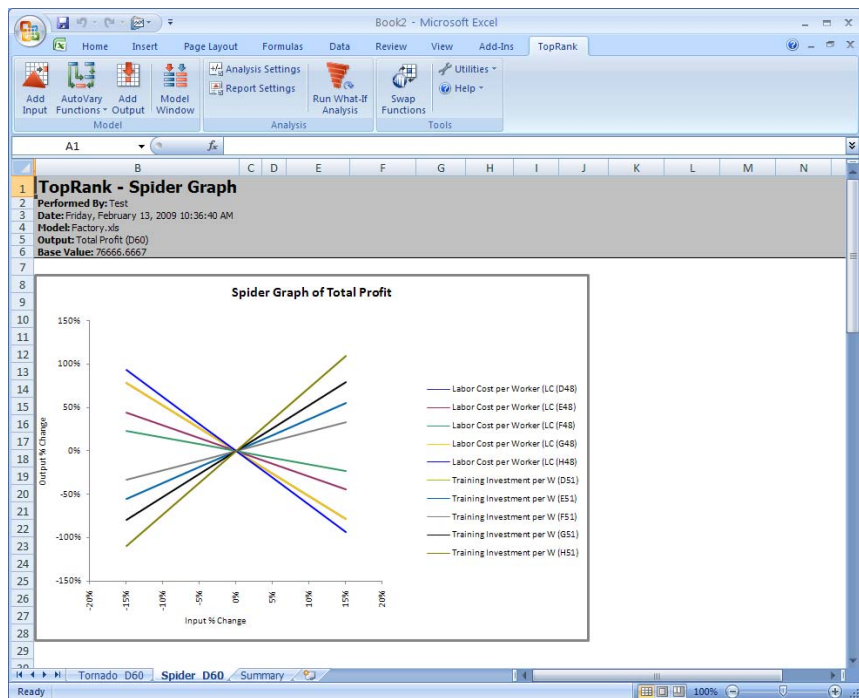
A tornado graph compares the effects of all input variables on a given output. The X-Axis is drawn in the units of % change in output value. For each variable (listed on the Y-Axis), a bar is drawn between the extreme values of the output as calculated using the lower and upper input values. The variable with the greatest range or longest bar (the difference between the maximum and minimum value) is plotted on the top of the graph, and the variables proceed down the Y-Axis with decreasing range.



The tornado graph brings attention to the variables that have the greatest effects on your output's value (those plotted on the top of the graph). The tornado graph can summarize the impact of an almost unlimited number of variables in a neat, simple graph.

Spider Graphs

A spider graph also compares the results for a single output as generated by multiple input variables. For each input variable, the percentage of the base case is plotted on the X-Axis and the percent change in output value calculated is plotted on the Y-Axis. The slope of each line depicts the relative change in the output per unit change in the input variable. The shape of the curve shows whether a linear or non-linear relationship exists between the input and the output.



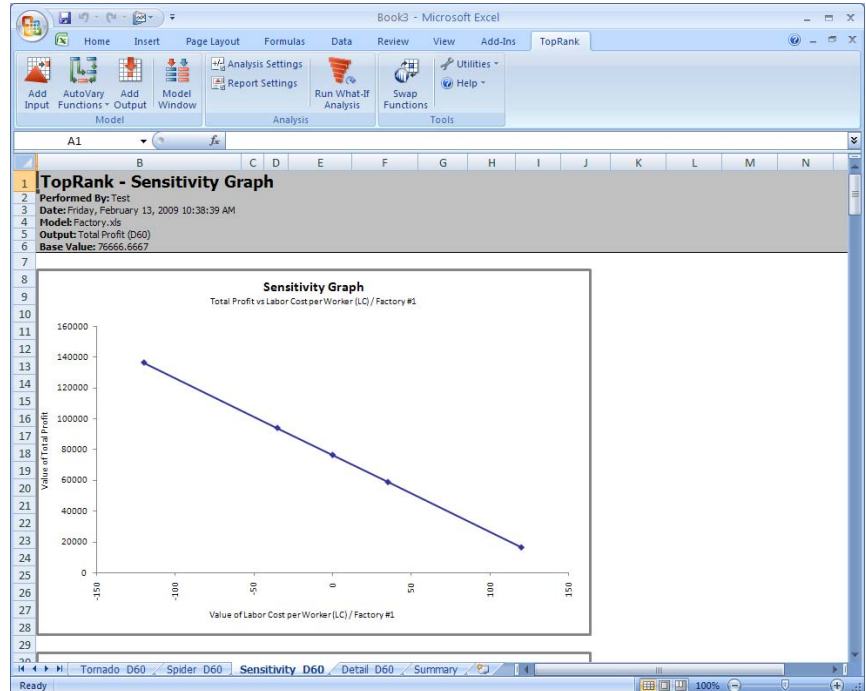
Spider graphs provide more information about the variables than tornado diagrams. For example, spider graphs show the reasonable limits of change caused by each input variable and the unit impact of these changes on the outcome. While tornado graphs may lead the decision maker to think that risk is proportional, the slope of spider graphs demonstrates any unproportional changes in outcomes.

The number of variables used in a spider graph should not exceed seven, but a limit of five is recommended to avoid clutter. If your What-If analysis contains a large number of input variables, it is a good

idea to plot them on a tornado graph first to determine which variables have the greatest impact. Then, use only these variables on your spider graph.

Sensitivity Graphs

The sensitivity or What-If graph is a simple diagram plotting input value used vs. output value calculated. The value of the selected input variable is plotted on the X-Axis and the calculated output value is plotted on the Y-Axis.



What is Multi-Way What-If Analysis?

A Multi-Way What-If analysis studies the impact of combinations of several inputs in a spreadsheet on results. In a Multi-Way What-If analysis, combinations of inputs are varied at the same time and the results calculated by each combination is tracked. Combinations are then ranked by their impact on each selected output.

TopRank Functions for Multi-Way What- If Analysis

Multi-Way What-If analysis is accomplished in TopRank using the “Multi” form of the Vary and VaryTable functions. **VaryMulti** and **VaryMultiTable** functions identify those inputs to be included in a Multi-Way What-If analysis. These functions are identical in form and arguments to standard Vary and VaryTable functions. They are included in the one-way What-If analysis that runs first in a TopRank analysis, prior to any Multi-Way What-If that is selected.

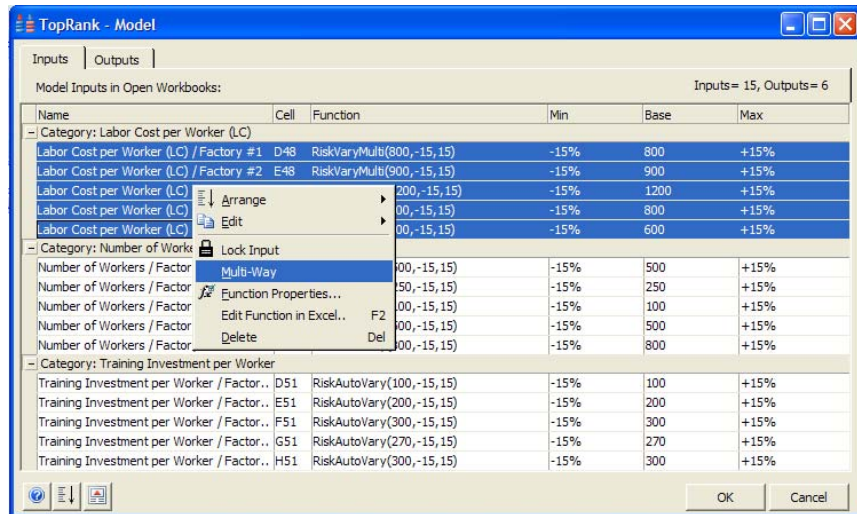
Group Size

All VaryMulti and VaryMultiTable functions are included in a Multi-Way What-If analysis. The number of these functions to be included in each combination tested is determined by the **Group Size** setting. For example, you might have four inputs defined using VaryMulti and VaryMultiTable functions — **price, sales volume, production costs, and investment** — and you want to see the impacts of every combination of two inputs on your result, **profit**. In this case, the Group Size is two. Your analysis might tell you that **price and sales volume** varying together are the most significant combination affecting your result — **profit**. Setting the Group Size to three might identify the combination of **price, sales volume and investment** as the most important three-way combination of inputs on results.

Defining Multi-Way What-If Inputs

Inputs for a Multi-Way What-If analysis can be defined by:

- Directly changing the selected Vary and VaryTable functions in your spreadsheet to their equivalent VaryMulti and VaryMultiTable forms, or,
- Highlighting the input Vary and VaryTable functions in the Model Window list, right-clicking and selecting 'Multi-Way'.



VaryMulti and VaryMultiTable functions take the same arguments as do Vary and VaryTable functions. The Multi option just instructs TopRank to run a second analysis (following the one-way What-If analysis) that tries all Multi-Way combinations using "Multi" functions in your model. VaryMulti and VaryMultiTable functions are also evaluated as standard Vary and VaryTable functions during the one-way What-If analysis. This provides both one-way and Multi-Way What-If results on the same inputs in a single run.

Running a Multi-Way What-If Analysis in TopRank

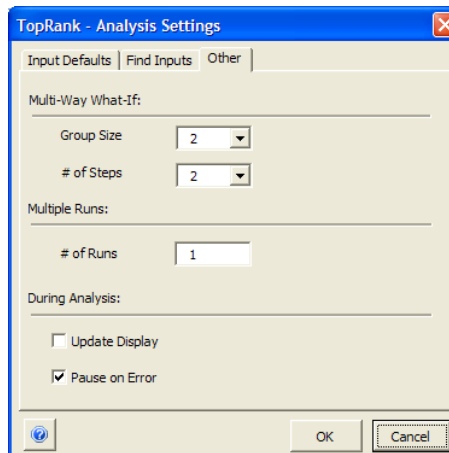
Multi-Way What-If analyses are executed by TopRank automatically once all one-way What-Ifs are completed. When executing a Multi-Way What-If, TopRank first identifies all VaryMulti and VaryMultiTable functions in your spreadsheet. Then, using the Group Size you've selected, TopRank tries all combinations of input values possible. As with a one-way What-If, TopRank recalculates your spreadsheet for each combination and collects the new output values generated. Once the Multi-Way What-If is completed, TopRank ranks all calculated combinations according to their impact on each output you've selected.

How Many Multi-Way Calculations Are Made?

The number of iterations or recalculations required during a Multi-Way What-If depends on:

- The number of **VaryMulti** and **VaryMultiTable** functions in your spreadsheet
- The **#Steps** entered in VaryMulti functions or number of values in the table for each VaryMultiTable function. If no #Steps is entered in a VaryMulti function, the default Multi-Way What-If # of Steps entered in the Other tab of the Analysis Settings dialog is used.
- The **Group Size** selected. In the Professional version, Group Size is limited to 2 or 3, and there is no Group Size limit in the Industrial version.

The selections for Group Size and default # of Steps used in a Multi-Way analysis are made in the TopRank Analysis Settings Dialog:



Testing All Combinations with a Data Table

The number of calculations required to complete a Multi-Way analysis grow exponentially with increases in each of these three parameters, so user beware! When a large number of VaryMulti and VaryMultiTable functions are present in your spreadsheet it is important to keep the Group Size small to rein in the total number of recalculations required.

There are certain analyses which require all possible combinations of inputs to be tried during a Multi-Way What-If analysis and all the results from all combinations to be reported. This is the equivalent to a data table or What-If table calculation in a spreadsheet. A traditional spreadsheet data table is a two-dimensional matrix filled with results calculated by substituting two lists of values (as listed across the top and down the side of the table) for two inputs in your spreadsheet. The matrix holds results for each two-way combination.

In TopRank, a data-table calculation can be performed using a Multi-Way What-If analysis. Simply set the Group Size equal to the number of Multi-Way inputs. Then, results are calculated for all possible combinations of input values. Unlike the spreadsheet, your Multi-Way data table calculation in TopRank can have any number of dimensions (i.e., inputs) and each input can have different number of possible values (i.e., steps).

Results from a Multi-Way What-If Analysis

The standard results of a Multi-Way What-If analysis are a ranking of combinations of inputs by their impact on results. Inputs are all VaryMulti and VaryMultiTable functions that were changed by TopRank during the Multi-Way What-If analysis. Outputs are all output cells identified by you prior to the analysis. The number of inputs used in each combination is given by the Group Size setting you selected prior to the analysis.

Multi-Way What-If Results

TopRank - Output Detail - Multi-Way Analysis

Performed By: Test
 Date: Friday, February 13, 2009 11:00:33 AM
 Model: Factory.xls
 Output: Profits Per Plant / Factory #1 (D57)
 Base Value: -136566.6667

What-If Analysis Multi-Way Analysis Output Detail

Inputs and Outputs

Rank	Output Variation				Input Variation							
	Value	Change (%)	Value	Change (%)	Value	Change (%)	Value	Change (%)				
1	(\$56,667)	\$1.43%	680	-15.00%	765	-15.00%	1200	0.00%	800	0.00%	600	0.00%
2	(\$56,667)	\$1.43%	680	-15.00%	1035	15.00%	1200	0.00%	800	0.00%	600	0.00%
3	(\$56,667)	\$1.43%	680	-15.00%	900	0.00%	1020	-15.00%	800	0.00%	600	0.00%
4	(\$56,667)	\$1.43%	680	-15.00%	900	0.00%	1380	15.00%	800	0.00%	600	0.00%
5	(\$56,667)	\$1.43%	680	-15.00%	900	0.00%	1200	0.00%	680	-15.00%	600	0.00%
6	(\$56,667)	\$1.43%	680	-15.00%	900	0.00%	1200	0.00%	920	15.00%	600	0.00%
7	(\$56,667)	\$1.43%	680	-15.00%	900	0.00%	1200	0.00%	800	0.00%	\$10	-15.00%
8	(\$56,667)	\$1.43%	680	-15.00%	900	0.00%	1200	0.00%	800	0.00%	680	15.00%
9	(\$176,667)	-\$1.43%	920	15.00%	765	-15.00%	1200	0.00%	800	0.00%	600	0.00%
10	(\$176,667)	-\$1.43%	920	15.00%	1035	15.00%	1200	0.00%	800	0.00%	600	0.00%
11	(\$176,667)	-\$1.43%	920	15.00%	900	0.00%	1020	-15.00%	800	0.00%	600	0.00%
12	(\$176,667)	-\$1.43%	920	15.00%	900	0.00%	1380	15.00%	800	0.00%	600	0.00%
13	(\$176,667)	-\$1.43%	920	15.00%	900	0.00%	1200	0.00%	680	-15.00%	600	0.00%
14	(\$176,667)	-\$1.43%	920	15.00%	900	0.00%	1200	0.00%	920	15.00%	600	0.00%

What-If Analysis Summary for Output Total Profit

Top 10 Inputs Ranked by Change in Actual Value

Rank	Multi-Way Name	Output Variation			
		Value	Change (%)	Value	Change (%)
1	Labor Cost per Worker (L2) / Factory #1 (D48) Labor Cost per Worker (L2) / Factory #5 (H48)	(\$55,333)	-172.17%	\$208,667	-172.17%
2	Labor Cost per Worker (L2) / Factory #1 (D48) Labor Cost per Worker (L2) / Factory #5 (H48)	(\$55,333)	-172.17%	\$208,667	-172.17%
3	Labor Cost per Worker (L2) / Factory #1 (D48) Labor Cost per Worker (L2) / Factory #5 (H48)	(\$43,333)	-156.52%	\$196,667	-156.52%
4	Labor Cost per Worker (L2) / Factory #2 (E48) Labor Cost per Worker (L2) / Factory #5 (H48)	(\$29,083)	-137.93%	\$182,417	-137.93%
5	Labor Cost per Worker (L2) / Factory #1 (D48) Labor Cost per Worker (L2) / Factory #2 (E48)	(\$17,083)	-122.28%	\$170,417	-122.28%
6	Labor Cost per Worker (L2) / Factory #2 (E48) Labor Cost per Worker (L2) / Factory #1 (D48)	(\$17,083)	-122.28%	\$170,417	-122.28%

Multi-Way What-If results include:

- A list of combinations of inputs, ranked by their impact on results, and
- A grid which details the results generated and input values used in each combination.

The grid of data detailing the values for each combination can be placed in your spreadsheet for further analysis. A spreadsheet Pivot Table for

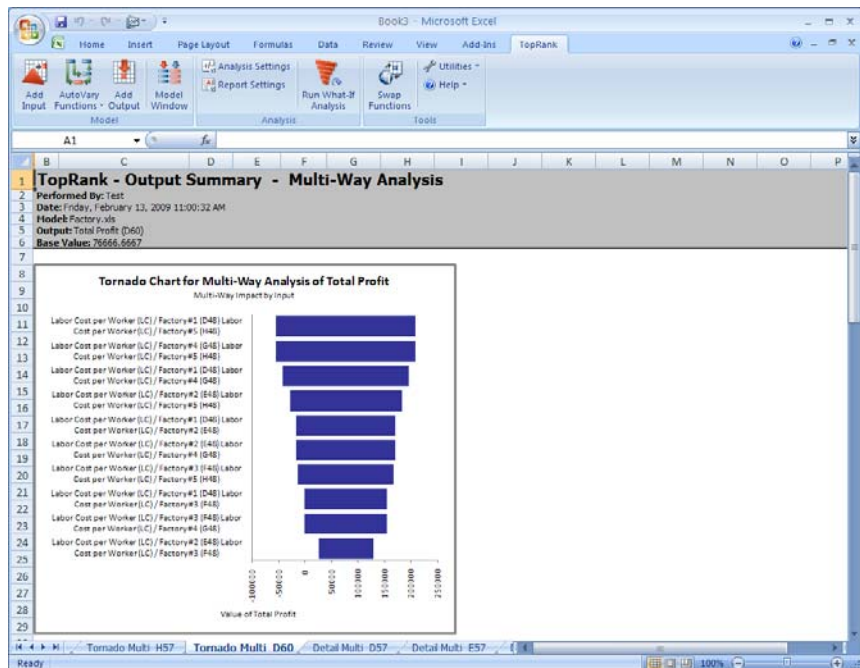
example, is often effective for viewing the multi-dimensional data sets generated by a Multi-Way What-If analysis.

Ranking of Multi-Way What-If results is done based on the amount of change from the output's base value that was caused by the combination of input values used. The amount of change is measured as a percentage change. This is calculated using the formula:

$$\frac{(New\ Calculated\ Output\ Value - Output\ Base\ Value)}{Output\ Base\ Value}$$

Graphical Results from a Multi-Way What-If Analysis

A tornado graph can be used to quickly describe the results of a Multi-Way What-If analysis. As with a tornado graph created with a one-way What-If analysis, each bar in the Tornado represents the swing in results caused by changes in input values. For a Multi-Way tornado, each bar represents the minimum and maximum changes caused by a combination of a set of inputs.



The number of inputs used in each combination is given by the Group Size setting. If you have specified that your Group Size equals the number of Multi-Way inputs, no Tornado graph is available.

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Modeling Critical Factors in Profitability

One of the most frequently asked questions when studying a production process is “What factors should I concentrate in order to maximize my profit?”. The traditional way of answering this question is to go into a spreadsheet, identify all possible factors that can influence results, and vary each input factor manually to determine which variation of input brings most dramatic change to the output after recalculation.

With TopRank, the identification and variation of input factors take place automatically. Once you’ve identified your output cell, TopRank both identifies the inputs which could affect your results, and varies them – all automatically.

Example Model: FACTORY.XLS

To see this in action with Excel with TopRank, first load the example worksheet **FACTORY.XLS**. Then:

- 1) Select cell D60 and identify this cell as an output by pressing the Add Output icon (the icon with a single arrow).
- 2) Press the What-If icon to begin the sensitivity analysis.
- 3) Once you’ve reviewed your initial What-If results, try a new analysis under different assumptions:
- 4) Click the Analysis Settings icon and change the range that inputs could vary. In this example, inputs can vary from -15% to +15%.
- 5) Press the What-If icon to begin the new What-If analysis.

Adjusting the Model with the Lock Command

Suppose you discover that one input in your model can’t be changed, i.e., Labor Cost in Plant 1, and you want TopRank to exclude the input in its sensitivity analysis. You can do this telling TopRank to lock the value of this input:

- 1) Bring up the Model Window list by pressing the Model Window icon.
- 2) Highlight the input you wish to lock, right click and select the Lock Input command
- 3) Press the What-If icon to begin the new What-If analysis. The locked inputs are not varied in the analysis.

Further Analysis of the Model using @RISK

TopRank serves as a first step in an analytical process by determining which variables in the model are more important. You can decide which variables should be carefully specified with probability distributions prior to running an @RISK simulation.

In this example, TopRank identifies Training Investment in Plant 5 as the most critical factor in improving the total revenue. The detailed report from the Result window also shows that a 15% increase in the Training Investment in Plant 5 increases the total revenue by 110%. The second and third important factors are Labor Cost in Plant 5 and Training Investment in Plant 4. When this model is simulated in @RISK, probability distributions should be applied to these top factors to describe their range of possible values and the probabilities of different values occurring.

Using the VaryTable Function

Often in the real world, inputs in a model only vary among several possible values. For example, the size of men's shoes can only take on full and half size values between five and fifteen (that is, unless you're Shaquille O'Neal with size 18's!). In this case, the built-in AutoVary function is not appropriate because the value it returns can be any value across a range. For example, an AutoVary function could return a value of 7.65 for the shoe size.

To address this aspect of modeling, TopRank provides a VaryTable function to enable you to specify a list or table of values among which the input varies.

Example Model: VARYTABLE.XLS

To learn more about the VaryTable function, first open the worksheet VARYTABLE.XLS. Then, watch how the VaryTable function can be used with a table or a list of values.

Defining a Table of Values

To define a table of values in TopRank:

- 1) Find the locations of cells that contain the table of values. In our example VARYTABLE, the locations are cells B43:B54.
- 2) Move to the cell – D29 – that contains the VaryTable function, i.e., RiskVaryTable(most likely value, location of the table) in Excel. In our example, the function reads **RiskVaryTable(480,B43:B54)**.
- 3) During a What-If analysis TopRank recalculates the spreadsheet using each of the values in the range B43:B54 – a total of 12 values and 12 recalculations.

Defining a List of Values

If your values are not listed in a table in the spreadsheet, TopRank allows a list of possible values in the function itself. To change the VaryTable function in D29 from a reference to a list of values:

- Type: =RiskVaryTable(480, {200, 400, 550, 100, 800, 900, 650, 350, 570, 225, 450, 570})

If a VaryTable function is involved in a sensitivity analysis, TopRank shows the effect of every value in the table on the output. In this example, TopRank's Detail Result window shows the effect that every value in the Shipping Cost table has on the Total Profit. A Shipping Cost of \$100 for car Model A increases the Total Profit by 30% while a Shipping Cost of \$900 decreases the Total Profit by 32%.

Multi-Way What-If Analysis

Individual inputs that do not seem critical in a model may become important once they are varied collectively with other factors. Therefore, an analyst is often interested in knowing how combinations of factors affect the output, instead of just knowing each individual factor's effect on the output. TopRank provides this type of information by performing a Multi-Way What-If analysis.

In a Multi-Way What-If analysis, the user selects a group of inputs to be included in the analysis and specifies the number of inputs in each combination. The number of inputs in each combination is the "Group Size". TopRank then calculates the spreadsheet using all possible combinations in value of the selected inputs. All calculated combinations are then ranked according to their relative importance in determining the output value.

Example Model: MULTIWAY.XLS

To examine a Multi-Way What-If analysis, first open the worksheet MULTIWAY.XLS. Then:

- 1) Bring up the Model Window list by pressing the Model Window icon.
- 2) Highlight all inputs that are to be considered in the Multi-Way analysis, right click and select the Multi-Way command. The selected inputs are changed from and to VaryMulti functions.
- 3) Click the Analysis Settings icon, switch to the Other tab and set the Group Size to 2.
- 4) Click the What-If command to run your Multi-Way analysis.

A Word of Caution: The number of calculations required to complete a Multi-Way analysis can grow exponentially with increases in the Group Size, #Multi-Way steps, and number of VaryMulti and VaryMultiTable functions. To see an example of a dramatic increase in number of calculations required, change the Group Size in MULTIWAY.XLS from 2 to 9.

Multi-Way Analysis Results

TopRank identifies the combinations of factors that affect the output most. It also provides a detailed Multi-Way analysis report of how much each factor in the group varies to achieve a particular change in the output value. In this example, the effectiveness of **Drug B on Category #4 cells** combined with the effectiveness of **Drug A on Category #4 cells** is the most significant combination of inputs in determining overall effectiveness after biosynthesis.

Modeling with @RISK Functions

@RISK, the risk analysis companion to TopRank, defines uncertainty in your spreadsheet models by entering probability distributions in cells and formulas. These functions describe the range of possible values for an input and the likelihood of values in that range occurring.

Distributions can be **continuous** – where any value in the range of the distribution is possible – or **discrete** – where only specific values can be returned. An example of a continuous distribution function is **RiskNormal(100,25)**, representing a normal distribution with mean of 100 and standard deviation 25. An example of a discrete distribution function is **RiskDiscrete({0,1},{0.5,0.5})**, which models a two point distribution with 50% chance of the value 0 occurring and 50% chance of the value 1 occurring.

For Users of TopRank Industrial

The industrial version of TopRank, TopRank Industrial, recognizes @RISK distribution functions and incorporates them in What-If analyses. This ability provides more flexibility and accuracy in modeling the possible variation in input value in your What-If analysis.

As compared with TopRank's standard Vary functions, an @RISK distribution can model a greater variety of ranges and probabilities. In addition, if data on an input is already collected in the form of a probability distribution, entering it as a distribution in TopRank is the easiest way to go.

Example Model: @RISK.XLS

To examine how @RISK distribution functions can be used in a TopRank What-If analysis, first open the worksheet titled @RISK.XLS. Then, review some of the distribution functions used in this model:

- Select cell C42. The formula in this cell reads
=RiskDiscrete({6000000000,8000000000},{0.7,0.3})

The Discrete distribution can take either of two values – 6,000,000,000 or 8,000,000,000. There is a 70% chance of 6,000,000,000 and a 30% chance of 8,000,000,000. During a What-If analysis each of these values is used.

What-If Analysis with @RISK Functions

As with Vary functions, TopRank steps across the min-max range defined by a distribution function by using a distribution's percentiles. Any probability distribution can be divided into 100 segments of equal probability. At the 20th segment or percentile there is a 20% chance of a lower value and a 80% chance of a higher value occurring. TopRank always returns the 0% percentile (minimum) and the 100% percentile (maximum) – a minimum of two steps for each distribution function (except for unbounded distributions – such as Normal – where 5% and 95% percentiles are returned instead). Additional steps are spread equally on a percentile basis across the min-max range. If you specify five steps, for example, TopRank returns values for the min and max, plus the 25%, 50% and 75% percentiles – a total of five values returned, 5 recalculations and 5 new results generated.

To run a What-If analysis on the @RISK worksheet:

- 1) Click the What-If icon. Five values are returned for each distribution function in the worksheet and results are calculated for each returned value.
- 2) For the @RISK worksheet, Year 1 Fixed Costs and Year 1 Sales are the most critical factor in determining Total Revenues from the new car production project.

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Introduction

All TopRank operations are performed using menus and commands. You can execute these commands with the menu bar, the command icons or by right-clicking on the appropriate window.

This chapter contains descriptions of each command as well as a section describing the toolbar icons. The commands in this chapter are presented in the order in which they appear on the menus.

TopRank Menu Commands

Menu commands are discussed as they appear on the TopRank menu in Excel 2003 and earlier. TopRank icons can be used to perform many of the available commands. The *TopRank Toolbar Icons* section of this chapter gives the command equivalents for each TopRank icon.

Reference: TopRank Icons

TopRank icons are used to quickly and easily perform tasks necessary to set up and run What-If analyses. TopRank icons appear as a custom toolbar in Excel 2003 or earlier, and on a ribbon in Excel 2007. The following icons are shown on the TopRank toolbar in Excel 2003 and earlier and/or in TopRank dialog boxes.

Icon Function Performed and Command Equivalent



Adds a TopRank input

Command equivalent: Model menu Add Input command



Adds or removes AutoVary functions

Command equivalent: Model menu Add or Remove AutoVary Functions commands



Adds a TopRank output

Command equivalent: Model menu Add Output command



Displays a table of TopRank inputs and outputs

Command equivalent: Model menu Model Window command



View or change TopRank settings for identifying and changing inputs and running multi-way analyses

Command equivalent: What-If Analysis menu Analysis Settings command



Display reporting options

Command equivalent: Report Settings command



Run a what-if analysis

Command equivalent: What-If Analysis menu Run command



Swap Functions in and out

Command equivalent: Swap Functions command



Display TopRank Utilities

Command equivalent: Utilities commands



Display Help options

Command equivalent: Help commands

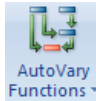
The following icons are shown on the TopRank ribbon in Excel 2007.

Icon Function Performed and Command Equivalent



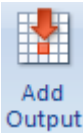
Adds a TopRank input

Command equivalent: Model menu Add Input command



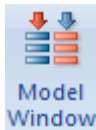
Adds or removes AutoVary functions

Command equivalent: Model menu Add or Remove AutoVary Functions commands



Adds a TopRank output

Command equivalent: Model menu Add Output command



Displays a table of TopRank inputs and outputs

Command equivalent: Model menu Table of Input and Outputs command



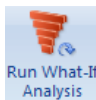
View or change TopRank settings for identifying and changing inputs and running multi-way analyses

Command equivalent: Analysis menu Analysis Settings command



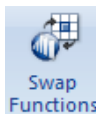
Display reporting options

Command equivalent: Analysis menu Report Settings command



Run a what-if analysis

Command equivalent: Analysis menu Run command



Swap Functions in and out

Command equivalent: Swap Functions command



Display TopRank Utilities

Command equivalent: Utilities commands



Display Help options

Command equivalent: Help commands

Reference: TopRank Add-In Commands

Introduction

This section of the TopRank Reference Guide details the available TopRank commands as they appear on the TopRank add-in menu in Excel. Commands are discussed as they appear on the menu. TopRank icons can be used to perform many of the available commands. The **Reference: TopRank Icons** section of this chapter gives the command equivalents for each TopRank icon.

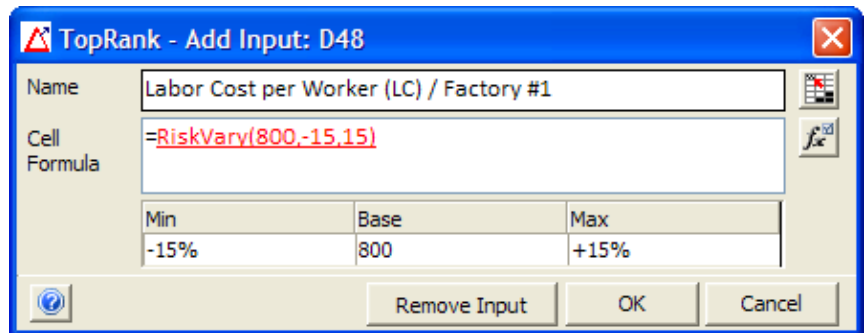
Several TopRank commands are also available in a pop-up floating menu that is displayed when the right mouse button is clicked on a cell in Excel.

Model Menu

Add Input Command

Add or change TopRank and @RISK functions in the selected cell formula.

The Model menu Add Input command displays the formula for each cell you select while the Add Input window is displayed. The Add Input window makes it easy to modify the parameters of Vary functions without typing the functions directly in your spreadsheet. Use the Add Input command to view or define the variability in your input values.



As you click on different cells while the Add Input window is open, the window changes to show the formula and functions in the new cell. Values and functions in a displayed formula are selected by clicking on them - turning them "red". Once a value is selected, you can change it to a Vary function. You can also edit or remove existing Vary or @RISK functions. Do this by either:

- **Typing** directly in the formula, or
- Clicking **Add Input** to replace a value with a Vary function built from the entries in the Min-Base-Max table displayed below the formula.
- Using the **Properties (fx)** icon to change parameters for a displayed Vary function.

As you leave cells, formulas in Excel are updated with any changes you have made in the Add Input window. Click **Close** to dismiss the Add Input window.

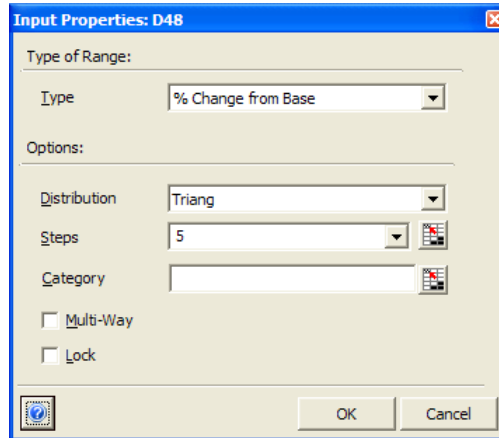
Add Input Window Options

The options available in the Add Input window include:

- **Name.** The Name entry displays the name of the current input (i.e., the value shown in red in the cell formula box). You may type in a new name or, optionally, you can click the Reference entry button to select cell(s) in your spreadsheet with the name.
- **Cell Formula.** The Cell Formula box displays the formula, with any edits you have made, for the selected cell. Clicking on a value (or TopRank or @RISK function) in the formula selects it by turning it red. Once selected, you can add a new TopRank function to the formula, replacing the value, or edit or remove an existing function. If you select an existing TopRank function in the formula, the Entry table at the bottom updates to show the arguments to that function.
- **Min, Base, Max.** These cells in the table at the bottom of the window allow you to quickly edit the parameters of a Vary function. Select the desired Min-Base-Max range using the drop down lists, or type a value in. Click the Reference entry button in the dropdown list to reference an Excel cell with a min or max value.
- **Add Input and Remove Input.** If you are replacing an existing fixed value in a formula with a Vary function, click the **Add Input** button. This adds the new function to the formula. Click **Remove Input** to take an existing function out of a formula and replace it with its expected value. If you are simply editing the range of an existing function, the function is immediately updated as you make changes.

Properties Window

The Properties window (displayed by clicking the fx icon) allows you to add or change additional options for an entered function.



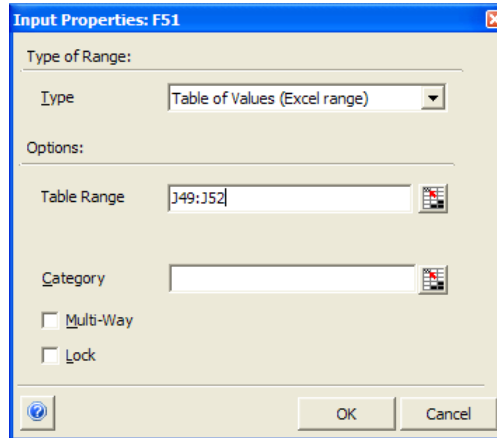
Options in the Properties window include:

- **Type of Range** selects the type of change described by your entered Min-Max range. Typically you will use a percentage change (**% Change from Base**) but optionally you can use an absolute change (**+/-Change from Base**), enter actual Min-Max values for the range (**Actual Min and Max**) or use a table of values - **Table of Values (Excel Range)** or **Table of Values (actuals)** - with a VaryTable function. **@RISK Distribution** enters a probability distribution supported by @RISK.
- **Distribution** is a probability distribution type which shows the likelihood of a value in an input's minimum-maximum range occurring.
- **Steps** are the number of values across an input's minimum-maximum range to be used in a What-If analysis.
- **Category** assigns the input to a category to be used in grouping related inputs together. For more information on Categories, see **Using Input Categories** in the **Model Window** command listing.
- **Multi-Way** changes a Vary or VaryTable function to its multi-way form for use in a multi-way what-if analysis.
- **Lock** locks or unlocks an input. Locking keeps an input from being changed in an analysis.

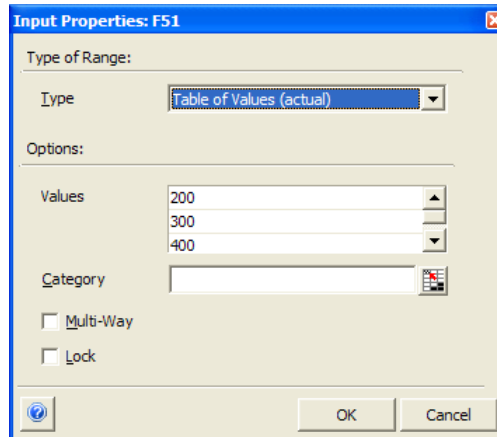
Entering Tables of Values with VaryTable

For more information on the possible settings for these arguments to Vary and VaryTable functions, see the section **More About Vary and VaryTable Functions** below.

In the Properties window, when **Type of Range** is set to **Table of Values (Excel Range)**, the Reference entry button selects an Excel cell range with the values you wish to use in the VaryTable function. Each of the values in the selected range will be used for the input in a What-If analysis.



When **Type of Range** is set to **Table of Values (actuals)**, the values entered in the displayed grid are used in the VaryTable function. Each of the values will be used for the input in a What-If analysis.



More About Vary and VaryTable Functions

Vary and VaryTable functions allow you to specify the possible variation in value of your inputs in many ways. For a Vary function, the **Range** and **Type of Range** arguments specify the nature of the range you are specifying, while the **Distribution** argument specifies how values are distributed across the Min-max range. The Steps argument selects the number of values TopRank will test across the Min-max range during a What-If analysis. These are described in detail here:

Range

The Range setting defines the **minimum change** (possible downside or negative change you think an input can reasonably have) and **maximum change** (possible upside or positive change you think an input can reasonably have).

Type of Range


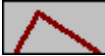
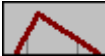
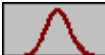
Any change entered is relative to the base value or the first argument to the Vary function. The minimum-maximum range defines the values that TopRank returns for the Vary function during a What-If analysis. This range can be defined as any of three **Type of Range** options:

- **% Change from Base**, or a -% change and +% change from the displayed base value
- **+/-Change from Base**, or + value and - value from the displayed base value
- **Actual Min and Max**, or an actual minimum value and maximum value to be used in defining the range

Distribution

The actual values returned by TopRank for each step of a Vary function depend on the **Distribution** setting. The distribution selected describes how values are distributed across the minimum-maximum range of the function. For example, if the Uniform distribution is selected any value in the minimum-maximum range described by the Vary function is equally likely to occur.

Four distribution types are available with TopRank. They are:

- **Uniform** 
- **Triangular** 
- **Tri1090** 
- **Normal** 

TopRank steps across the min-max range defined by the Vary function by using the selected distribution type's percentiles. Any probability distribution can be divided into 100 segments of equal probability. At the 20th segment or percentile there is a 20% chance of a lower value and a 80% chance of a higher value occurring. TopRank always returns the 0% percentile (minimum) and the 100% percentile (maximum) – a minimum of two steps for each Vary function (except for unbounded distributions – such as Normal – where 5% and 95% percentiles are returned instead). Additional steps are spread equally on a percentile basis across the min-max range. If you select five steps, for example, TopRank returns values for the min and max, plus the 25%, 50% and 75% percentiles – a total of five values returned, 5 recalculations and 5 new results generated.

Converting Min-max Ranges to Distribution Parameters

For Tri1090 and Normal distribution types, TopRank converts your Vary function's minimum and maximum values (as calculated from the base value, minimum argument, maximum argument, and range type) into parameters for the selected distribution type.

A Tri1090 distribution has a minimum, most likely and maximum value argument, plus a percentile location for the minimum and maximum values. For the Tri1090 distribution type, TopRank uses the 10th and 90th percentiles as the location for the minimum and maximum values. For example, the TopRank function **RiskVary(100,-10,+10,,,"Tri1090")** is the equivalent to the @RISK function **RiskTrigen(90,100,110,10,90)**, where 90 is the 10th percentile value, 110 is the 90th percentile value and 100 is the most likely value.

A Normal distribution has a mean and standard deviation as arguments. A Vary function is converted to a Normal distribution by setting your Vary function's minimum and maximum values to equal the 5th and 95th percentile in a Normal distribution, with the mean located half way in between the two values. Using this information, TopRank generates a Normal distribution with the appropriate mean and standard deviation to include these 5th, mean and 95th percentile values.

Note: The default distribution setting is used when a distribution type has not been explicitly entered as a Vary function argument.

#Steps

The **#Steps** entry specifies the number of steps TopRank calculates across the minimum-maximum range of Vary functions. During a What-If analysis a value is returned (and a new result calculated) for each step for each Vary function.

During a What-If analysis, a differing number of possible values can be returned for each Vary function. For each value returned, TopRank recalculates the worksheet and stores a new possible result for each output. The number of values returned is given by the **#Steps** argument to the Vary function or a default **#Steps** entered in the Analysis Settings dialog.

In the function's simplest form – such as **RiskVary(100,-10,+10)** – there is no entry in the function for the **#Steps**. In this case TopRank uses the default **#Steps** as defined using the What-If Analysis menu Analysis Settings command. A typical default is three or four steps. With four steps TopRank calculates the spreadsheet at the minimum possible value for the Vary function, the maximum possible value, and two values spaced in between.

If you enter a **#Steps** value in the Vary function, such as **RiskVary(100, -10,+10, , 8)**, TopRank overrides the default **#Steps** and, in this case, return eight different values for the Vary function.

Add AutoVary Functions Command

Defines AutoVary functions for inputs which could affect the selected output.

The Model menu Add AutoVary Functions Command adds AutoVary functions for outputs in your worksheets. First, input values which affect outputs are identified by TopRank using the criteria specified using the **What-If Analysis menu Analysis Settings command**. Then, AutoVary functions are substituted for identified input values. For more information on the criteria for identifying inputs, see the What-If Analysis menu Analysis Settings command.

Remove AutoVary Functions Command

Removes all AutoVary functions from open workbooks

The Model menu Remove AutoVary Functions Command removes all AutoVary functions from open workbooks.

Add Output Command

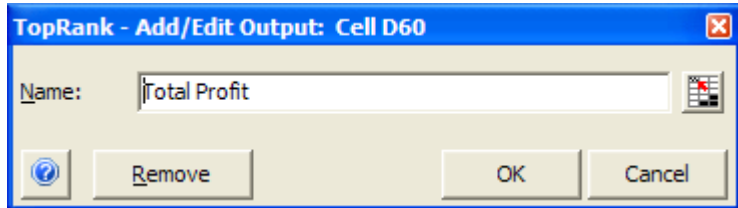
Adds a cell or range of cells as a What-If analysis output or output range

Selecting the Model menu Add Output command (or clicking the Add Output icon) adds the currently selected range of worksheet cells as a What-If analysis output. A ranking of how inputs affect results can be generated for an output cell. Such a ranking is created by collecting the values calculated for the output cell each iteration of a What-If analysis.

Output cells are also evaluated in a Multi-Way What-If analysis. A ranking of how combinations of inputs affect results is generated for an output cell.

Adding a Single Output Cell

To add an output for a single cell, select the cell in your spreadsheet and click the Add Output icon (the one with the single red arrow).



Naming an Output

When an output is added, you are given the opportunity to name it or use the default name TopRank has identified. Optionally, you can click the Reference entry button to select cell(s) in your spreadsheet with the name. If you select a reference for a name, the name from the referenced cell(s) will be shown in *italics* in the Add/Edit Output dialog. The name (if not the TopRank default name) is added as an argument to the RiskOutput function used to identify the output cell.

At any time a name may be changed by:

- Editing the name argument to the RiskOutput function in Excel
- Changing the name in the Model Window list.
- Re-displaying the Add/Edit Output dialog with the cell selected in Excel and changing the name.

RiskOutput Functions

When a cell is added as an output, a RiskOutput function is placed in the cell. The function allows the easy copying, pasting and moving of output cells. RiskOutput functions may also be entered in formulas the same way you would type in any standard Excel function, bypassing the Add Output command. RiskOutput functions optionally allow you to name your outputs and add individual output cells to output ranges. A typical RiskOutput function might be:

`=RiskOutput("Profit")+NPV(.1,H1:H10)`

where the cell, prior to its selection as a output, simply contained the formula

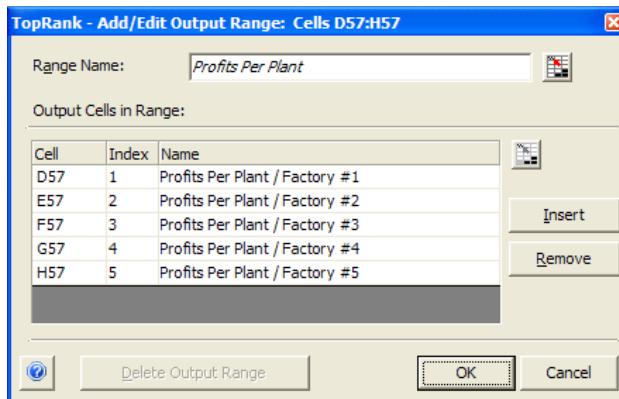
`= NPV(.1,H1:H10)`

The added RiskOutput function selects the cell as an output and gives the output the name "Profit". For more information on RiskOutput functions, see the section: **Reference: TopRank Functions.**

How To Add a What-If Analysis Output Range

Output ranges are groups of related cells (such as Profit by Year). To add a new output range with multiple cells:

- 1) Highlight the range of cells in your spreadsheet that you wish to add as an output range. If multiple cells are included in the range, highlight all the cells by dragging the mouse.
- 2) Click the Add Output icon (the one with the single red arrow).



The Add Output Range dialog allows you to name your range as a whole, plus set the names for individual cells in the range. Optionally, you can click the Reference entry button to select cell(s) in your spreadsheet with the name. A range of names from Excel can be applied to all individual cells in the output range by:

- Selecting a block of names in the Add Output Range dialog and clicking the Reference entry button. Each output cell is matched the name from a cell in the selected range.

- 3) Click OK and the selected range of cells will be added as outputs and RiskOutput functions will be entered.
- 4) To view the outputs in the Model Window list, click the Model Window icon (the one with both a blue and red arrow) or select the TopRank Model menu Model Window command.

Use the **Insert** or **Remove** buttons to remove individual cells from an output range.

Removing an Output

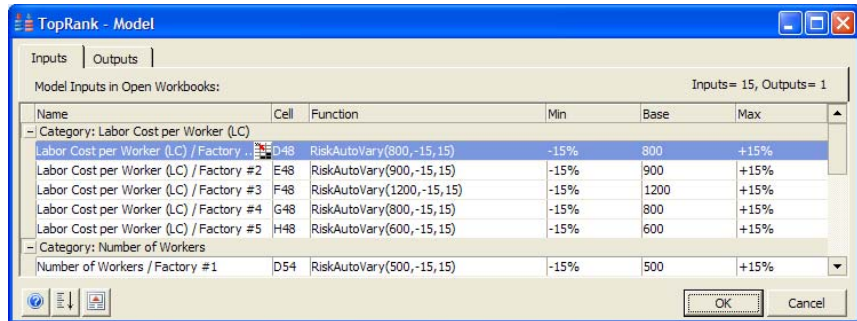
To remove an output, simply select the output cell in your spreadsheet and click the Add Output Icon. Click the Remove or Delete Output Range buttons to delete the output. Alternatively, you can use the Delete command on the right click menu in the Model Window to delete outputs.

Model Window Command

Displays the Inputs and Outputs table, listing output cells, Vary functions and @RISK distribution functions in your workbook(s).

The Model Window lists all selected output cells and all identified input functions in your workbook(s). This table is displayed when the Model menu Model Window command is selected or the Model Window icon is clicked.

Model Window



The screenshot shows the 'TopRank - Model' dialog box with the 'Inputs' tab selected. The 'Model Inputs in Open Workbooks' table is displayed, showing a list of input variables with their respective cells, functions, and distribution parameters. The table has columns for Name, Cell, Function, Min, Base, and Max. The 'Inputs = 15, Outputs = 1' indicator is visible in the top right corner of the dialog box.

Name	Cell	Function	Min	Base	Max
- Category: Labor Cost per Worker (LC)					
Labor Cost per Worker (LC) / Factory #1	D48	RiskAutoVary(800,-15,15)	-15%	800	+15%
Labor Cost per Worker (LC) / Factory #2	E48	RiskAutoVary(900,-15,15)	-15%	900	+15%
Labor Cost per Worker (LC) / Factory #3	F48	RiskAutoVary(1200,-15,15)	-15%	1200	+15%
Labor Cost per Worker (LC) / Factory #4	G48	RiskAutoVary(800,-15,15)	-15%	800	+15%
Labor Cost per Worker (LC) / Factory #5	H48	RiskAutoVary(600,-15,15)	-15%	600	+15%
- Category: Number of Workers					
Number of Workers / Factory #1	D54	RiskAutoVary(500,-15,15)	-15%	500	+15%

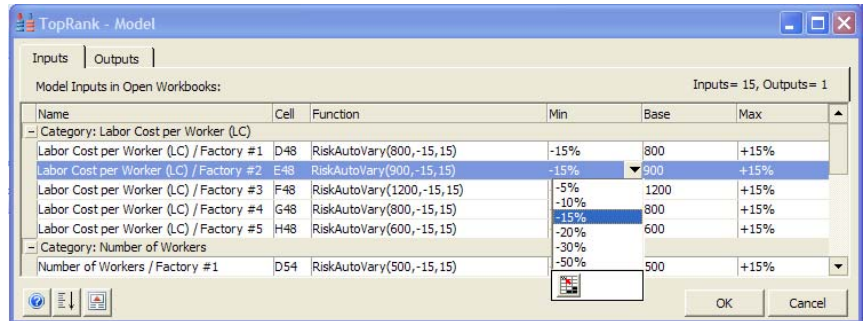
For each input or output variable, the list shows:

- **Name**, or the name of the cell as determined by TopRank or entered by you
- **Cell (and Worksheet, if necessary)**, showing the location of the input
- **Function**. The function cell for an input shows the actual Vary function or @RISK distribution as it is used in the cell formula in Excel.
- **Min, Base and Max** values for each input. For vary functions, these columns allow editing of arguments of the function.

Some of the entries in the list may be edited, as follows:

- **Name**. The name of an input or output can be changed by clicking in the Name cell of a row in the table and entering the desired name. Optionally, you can click the Reference entry button to select cell(s) in your spreadsheet with the name. If you select a reference for a name, the name from the referenced cell(s) will be shown in *italics* in the Model Window table.
- **Function**. If desired, you may edit the function directly in this cell or press <F2> to edit the function directly in Excel.

- **Min, Base and Max.** These cells allow you to quickly edit the parameters of a Vary function. Select the desired Min-Max range using the drop down lists, or type a Min or Max value in. Optionally, you can click the Reference entry button to select cell(s) in your spreadsheet with the min or max value.



How Are Default Names Created?

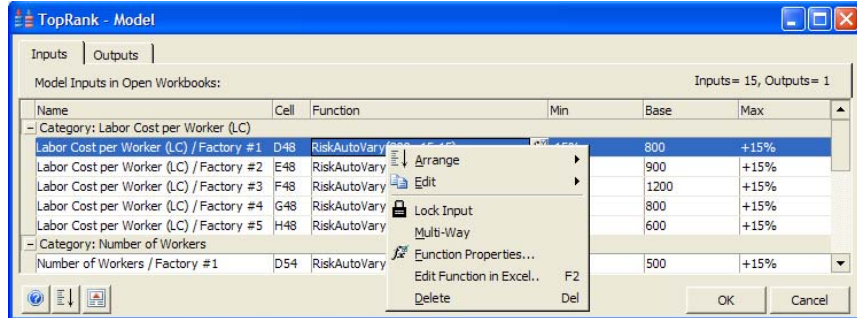
When an Input is added, TopRank automatically tries to create a name for the input or output it displays in the Model Window table. These names are created by scanning the spreadsheet around the cell where the input or output is located. To identify names, TopRank moves from the input or output cell across the row of the spreadsheet to the left and up the column towards the top. It moves across these ranges of the spreadsheet until it finds 1) a label cell, or a cell without a formula in it, or 2) a recognizable sequence of values, such as years.

It then takes these row and column headings and combines them to create a possible name for the input or output. Many times, in standard spreadsheets with row labels down the left and column labels across the top, this process results in accurate names. However, in some spreadsheets, automatic naming creates nonsensical labels. In these cases you must edit the names displayed in the Model Window table in order to enter more meaningful names.

Any names you define are entered as a **RiskName** property function which is used as an argument to the function in Excel. Properties can also be specified or changed by adding property functions directly to the function. For more information on property functions, see **Property Functions** in the **Reference: TopRank Functions** section of this chapter.

Model Window Right-Click Menu

The right-click menu in the Model Window can be used to access additional options for the selected items in the table.



Commands available on the right-click menu in the Model Window include:

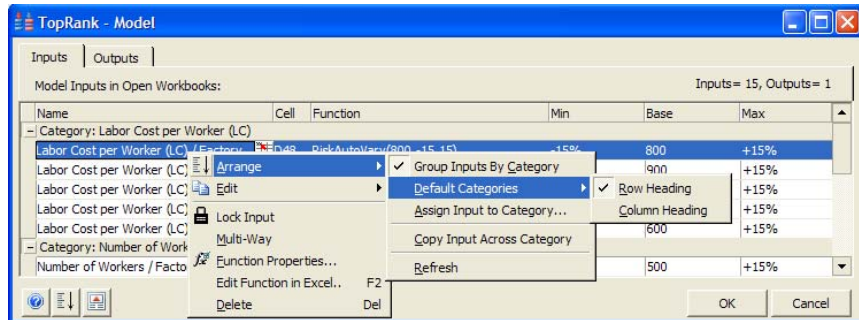
- **Arrange.** The Arrange menu commands allow you to arrange inputs by categories and copy the variation in value for on input across all inputs in a category. For outputs, the Arrange commands allow you to arrange outputs by output range. The Arrange icon at the bottom of the window can also be used to access the Arrange menu commands. For more information on Arrange commands, see **The Arrange Menu** in this section.
- **Lock Input.** The Lock Input command specifies whether or not the Vary function or @RISK distribution will be "stepped across" during a what-if analysis. If Lock is selected, the Vary function or distribution will return its expected value during analysis. This allows you to remove a Vary function or distribution from a what-if analysis without deleting it from your model. A locked function has a **RiskLock** property function which is used as an argument to the function in Excel. Properties can also be specified or changed by adding property functions directly to the function. For more information on property functions, see **Property Functions** in the **Reference: TopRank Functions** section of this chapter.

- **Multi-Way** changes a Vary or VaryTable function to its multi-way form for use in a multi-way what-if analysis, or removes a multi form. TopRank functions can also be selected for inclusion in a Multi-Way What-If analysis by directly changing the functions in your spreadsheet to their Multi form. For example, **Vary** is changed to **VaryMulti** or **VaryTable** to **VaryMultiTable**. To change @RISK functions to their Multi form, the word "Multi" is added to the end of the function name. For example, NormalMulti or DiscreteMulti are "multi" forms of the probability distributions Normal and Discrete.
- **Function Properties.** The Function Properties command allows you to add or change additional options for an entered function in the Properties window. For more information on the Properties window, see the **Add Input command** in this chapter. Note: the Properties window can also be displayed by clicking the dropdown arrow on a cell in the Function column of the Model Window table.
- **Edit Function in Excel.** The Edit Function in Excel command allows you to edit a function in Excel, where you can easily add references to the entered formula.
- **Delete.** Delete removes any Vary function or @RISK distribution entry from the Model Window table. Although entries are removed from the Model Window with Delete, they are not actually removed from the cell formulas in your workbook until the OK button is clicked dismissing the Model Window.

Arrange Menu

The **Model Window Table** may be arranged by category or output range name using the commands on the **Arrange Menu**. For inputs, typically a category defines a group of related inputs, such as *Development Costs* or inputs in the year *2010*. TopRank can automatically assign **Default Categories** to inputs based on their names, or you can assign inputs to categories using the **Category Assign** command. When Categories are used, a common variation in value may be assigned to all inputs in a category by using the **Copy Input Across Category** command.

The contents of the Arrange menu change depending on whether you are viewing the Inputs tab or the Outputs tab. The only option for the Outputs tab is to **Arrange Outputs by Range Name**.



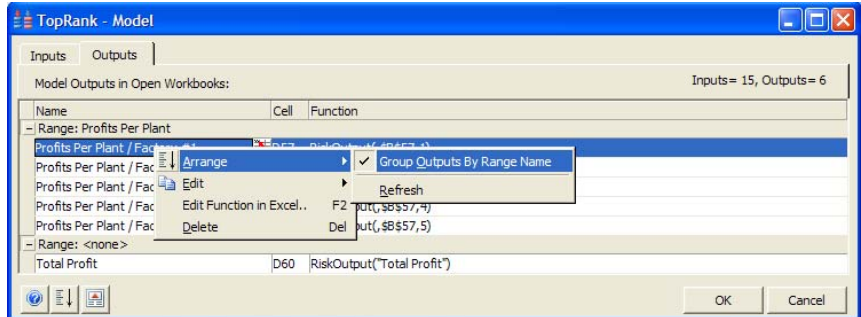
The Arrange icon at the bottom of the window can also be used to access the Arrange menu commands.

Group Inputs By Category Command

The **Group Inputs By Category** command specifies whether or not the table of inputs will be arranged by category. When Group Inputs By Category is checked, categories entered using a RiskCategory function will always be shown. Default categories will also be shown if the **Default Categories** command **Row Heading** or **Column Heading** option is selected.

Group Outputs By Range Name Command

The **Group Outputs By Range Name** command specifies whether or not the table of outputs will be arranged by output range name. When Group Outputs By Range Name is checked, RiskOutput functions will be grouped by range name, if they are part of an output range.



Default Categories Commands

The **Default Categories** command specifies how TopRank will automatically generate category names from input names. Default category names are easily created from the default input names generated by TopRank. The section of this manual **How Are Default Names Created?** describes how default names are generated for an input using a Row Heading and a Column heading in your spreadsheet. The Row Heading portion of a default name is shown to the left of the “/” separator in the default name, and the Column heading portion to the right of the separator. The Default Categories options are as follows:

- **Row Heading** specifies that names which use a common Row Heading will be grouped together in a category.
- **Column Heading** specifies that names which use a common Column Heading will be grouped together in a category.
- **None** turns off any automatic generation of default categories.

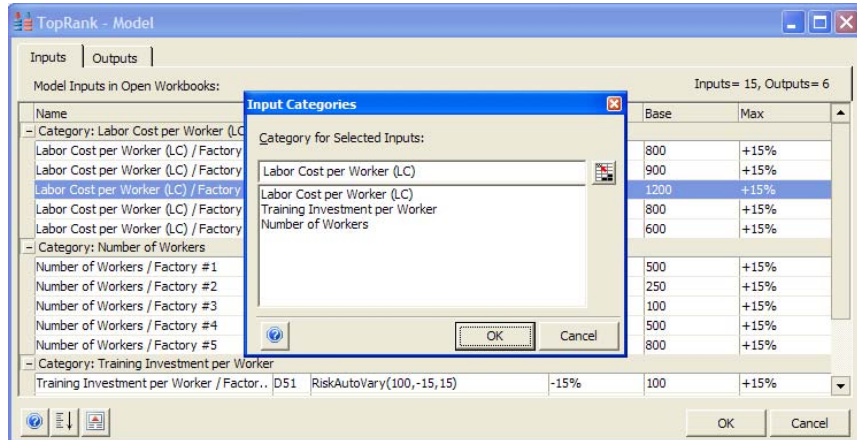
Default Categories can also be created from input names entered using a RiskName function, as long as a “/” separator is included to separate text to use as row or column “headings” in the name. For example, the input:

=RiskVary(100,-10,10,RiskName(“R&D Costs / 2010”))

would be included in a default category named “R&D Costs” if the Default Categories command Row Heading command was checked, and would be included in a default category named “2010” if the Default Categories command Column Heading command was checked.

Assign Input to Category Command

The **Assign Input to Category** command places an input or set of inputs into a category. The **Input Categories** dialog allows you to create a new category or select a previously created category in which to place the selected inputs.



When an input is assigned to a category by you, the input category is defined in a TopRank or @RISK function using the **RiskCategory** property function. For more information on this function, see the **Listing of Property Functions** in the Function Reference in this manual.

Copy Input Across Category Command

The **Copy Input Across Category** command takes the variation described for one input in a category and copies that variation across all inputs in the category. This is useful when you wish to quickly assign a common variation in value across a category.

To copy an input across a category:

- 1) Assign the variation in value you wish to copy to a single input in the category
- 2) Right-click on the input you changed in the list, and select the Arrange menu **Copy Input Across Category** command.
- 3) Click OK to confirm the copy, and all inputs in the category will be changed to match the copied input.

How is the Model Window Table Created?

The Model Window table is set up automatically when you select to display the table. When the table is displayed, your worksheets are scanned or re-scanned for TopRank Vary functions and @RISK distribution functions.

As new functions are found, they are added to the Inputs list. This list summarizes all your input functions – their parameters, cell addresses and the names.

Note: You can limit the workbooks and worksheets TopRank searches when identifying inputs and outputs by clicking the Search Ranges command in the Analysis Settings dialog Find Inputs tab.

What-If Analysis Menu

Analysis Settings Command

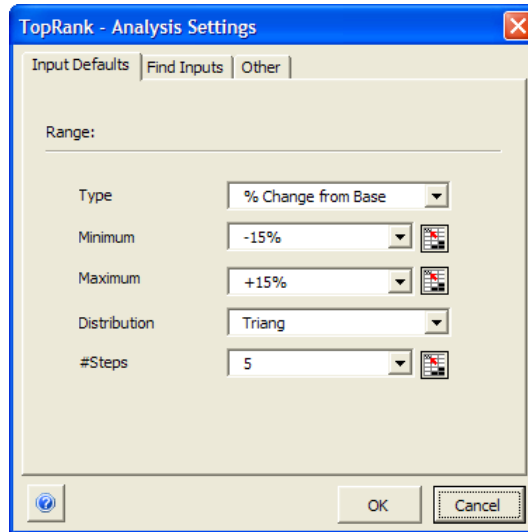
Changes the default settings used in a What-If analysis.

The What-If Analysis menu Analysis Settings command affects the nature of a What-If analysis and the TopRank functions used in it. All settings come with default values that can be changed.

The What-If analysis settings affect the minimum and maximum range TopRank uses in AutoVary functions, the default number of one-way and Multi-Way What-If steps, the default distribution setting, the settings for TopRank's automatic identification of spreadsheet inputs, the number of runs to be performed, the updating of the worksheet display during What-If analysis, and others. All What-If analysis settings are saved when you save a workbook you have used with TopRank.

Input Defaults Tab — Analysis Settings Command

Sets the default changes automatically applied to TopRank inputs.



Options in the Input Defaults tab include **Type**, **Minimum and Maximum**, **Distribution** and **#Steps**.

Type

Any change in a Vary function is entered relative to the base value or the first argument of the function. This change is entered as a minimum-maximum range that defines the values that TopRank returns for the Vary function during a What-If analysis. This range can be defined as any of three **Types**:

- **% Change From Base** or a -% change and +% change from the displayed base value
- **+/- Change From Base**, or + value and - value from the displayed base value
- **Actual Min and Max**, or an actual minimum value and maximum value to be used in defining the range

Each AutoVary function entered by TopRank has the same default minimum change and maximum change and the same default range type. Because of this, it is recommended that a default **% Change From Base** range type be used so that ranges can be more meaningfully applied to the various inputs TopRank identifies in your spreadsheet.

Note: A Range Type can be also selected in a Vary function by using the Range Type argument. This is the third argument for the function. For more information on specifying the Range Type in a Vary function, see the Vary function in the TopRank Function Reference of this manual.

Minimum and Maximum

Minimum and Maximum specify the default changes that will be applied by TopRank to inputs it automatically identifies in your spreadsheet. AutoVary function are substituted for these inputs. You can enter a value, select a value from the drop down list or click the Reference button to select a cell in your spreadsheet that contains a minimum or maximum value you wish to use. Note: the type of value entered for minimum and maximum depend on the **Type** of Range specified.

When TopRank inserts AutoVary functions when identifying inputs, the minimum and maximum you specify is inserted into each newly created AutoVary function. This range, of course, can be edited at any time by directly modifying the AutoVary function in the spreadsheet or by using the Add Input command.

Entered Minimum and Maximum values will also be the defaults displayed when the Add Input dialog is used.

Distribution

The actual values returned by TopRank for each step of a Vary function depend on the Distribution setting.

The distribution selected describes how values are distributed across the minimum-maximum range of the function. For example, if the Uniform distribution is selected any value in the minimum-maximum range described by the Vary function is equally likely to occur.

Four distribution types are available with TopRank. They are:

- **Triang**
- **Uniform**
- **Normal**
- **Tri1090**

TopRank steps across the min-max range defined by the Vary function by using the selected distribution type's percentiles. Any probability distribution can be divided into 100 segments of equal probability. At the 20th segment or percentile there is a 20% chance of a lower value and a 80% chance of a higher value occurring. TopRank always returns the 0% percentile (minimum) and the 100% percentile (maximum) – a minimum of two steps for each Vary function (except for unbounded distributions – such as Normal – where the 5% and 95% percentile are

returned instead). Additional steps are spread equally on a percentile basis across the min-max range. If you select five steps, for example, TopRank returns values for the min and max, plus the 25%, 50% and 75% percentiles — a total of five values returned, 5 recalculations and 5 new results generated.

Converting Min-Max Ranges to Distribution Parameters

For Tri1090 and Normal distribution types, TopRank converts your Vary function's minimum and maximum values (as calculated from the base value, minimum argument, maximum argument, and range type) into parameters for the selected distribution type.

A Tri1090 distribution has a minimum, most likely and maximum value argument, plus a percentile location for the minimum and maximum values. For the Tri1090 distribution type, TopRank uses the 10th and 90th percentiles as the location for the minimum and maximum values. For example, the TopRank function **RiskVary(100,-10,+10,,,"Tri1090")** is the equivalent to the @RISK function **RiskTriGen(90,100,110,10,90)**, where 90 is the 10th percentile value, 110 is the 90th percentile value and 100 is the most likely value.

A Normal distribution has a mean and standard deviation as arguments. A Vary function is converted to a Normal distribution by setting your Vary function's minimum and maximum values to equal the 5th and 95th percentile in a Normal distribution, with the mean located half way in between the two values. Using this information, TopRank generates a Normal distribution with the appropriate mean and standard deviation to include these 5th, mean and 95th percentile values.

Note: The default distribution setting is only used when a distribution type has not been explicitly entered as a Vary function argument.

Steps

The # Steps entry specifies the number of steps TopRank calculates across the minimum-maximum range of Vary functions. During a What-If analysis a value is returned (and a new result calculated) for each step for each Vary function. The #Steps entry is applied only when a #Steps argument, which must be greater or equal to two, is not entered in a Vary function itself.

During a What-If analysis, a differing number of possible values can be returned for each Vary function. For each value returned, TopRank recalculates the worksheet and stores a new possible result for each output. The number of values returned is given by the #Steps argument to the Vary function or a default #Steps entered in the Settings dialog.

In the function's simplest form — such as **Vary(100,-10,+10)** — there is no entry in the function for the #Steps. In this case TopRank uses the

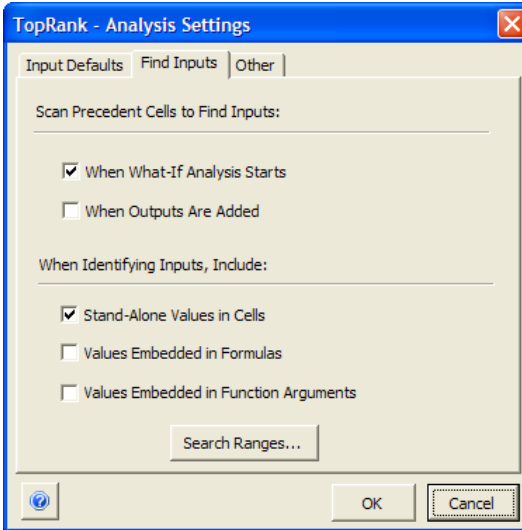
default #Steps. A typical default is be three or four steps. With four steps TopRank calculates the spreadsheet at the minimum possible value for the Vary function, the maximum possible value, and two values spaced in between.

If you enter a #Steps value in the Vary function, such as **Vary(100, -10,+10, , 8)**, TopRank overrides the default #Steps and, in this case, return eight different values for the Vary function.

A different default number of steps value is used for a Multi-Way What-If analysis as opposed to a standard one-way What-If analysis. Typically you want fewer Multi-Way steps as compared to one-way steps (the number of steps must be greater or equal to two). This minimizes the number of recalculations or iterations required to complete a Multi-Way What-If analysis. For more information on Multi-Way steps, see Multi-Way options on **Other Tab** in this section.

Find Inputs Tab — Analysis Settings Command

Turns on or off the automatic insertion of AutoVary functions for inputs and sets the parameters for the identification of inputs.



Scan Precedent Cells to Find Inputs

The Scan Precedent Cells to Find Inputs options control whether or not TopRank automatically identifies inputs and inserts AutoVary functions. When a Scan Precedent Cells to Find Inputs option is selected, TopRank goes through the following procedure:

- 1) TopRank traces through spreadsheet cells that are **precedents** to an output cell. A precedent is a cell whose formula's calculation directly or indirectly affects the value in the output cell.
- 2) When a precedent cell is found, TopRank uses the criteria specified in the **When Identifying Inputs, Include** settings to identify constants in the cell's formula. These are constants which could vary, thus affecting the output's value.
- 3) For identified constants, TopRank inserts an **AutoVary** function that uses the current constant value as the base value and the default minimum-maximum change.

TopRank will insert AutoVary functions either **When What-If Analysis Starts** or **When Outputs are Added**:

- **When What-If Analysis Starts** specifies that TopRank will insert AutoVary functions at the start of the analysis and then remove them once the run is complete. This allows you to perform a what-if analysis without directly adding inputs to your spreadsheet.
- **When Outputs are Added** specifies that TopRank will insert AutoVary functions when you add a new output. AutoVary functions added by TopRank when this setting is used will not be automatically removed once the run is complete. All AutoVary functions, however, may be removed at any time using the **Remove AutoVary functions** command.

When Identifying Inputs, Include

The **When Identifying Inputs, Include** settings control the type of constants that TopRank selects as inputs in the precedent cells and formulas for an output cell. For each selected constant TopRank inserts an AutoVary function. By changing the criteria TopRank uses you can change the number of inputs TopRank automatically identifies.

During TopRank's identification of inputs, constants can be found as:

- **Stand-Alone Values in Cells**, where a constant is the only item in the formula in a precedent cell, such as **100** or **=100**. In this case, TopRank changes the cell's formula to:
=RiskAutoVary(100,-10,10).
- **Values Embedded in Formulas**, where a constant is part of a mathematical expression in a precedent cell's formula, such as **=1.22*A10**, where the identified constant is the value **1.22**. In this case, TopRank changes the cell's formula to:
=RiskAutoVary(1.22,-10,10)*A10.
- **Function Arguments**, where a constant is an argument to a spreadsheet function that is present in the precedent cell's formula, such as **=NPV(0.1,C31:L31)**, where the identified constant is the value **0.1**. In this case, TopRank changes the cell's formula to:
=NPV(RiskAutoVary(0.1,-10,10),C31:L31).

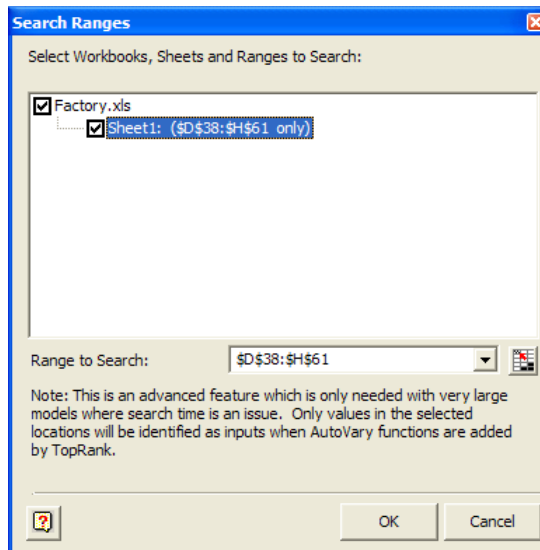
Any combination of the above identification criteria can be used when TopRank automatically identifies inputs for a new output cell.

Notes:

- 1) *@RISK distribution functions, such as =RiskNormal(100,10), are always identified when TopRank identifies inputs.*
- 2) *AutoVary functions may be added to inputs affecting an output at any time after an output is selected by clicking the Model menu Add AutoVary Functions command.*

Search Ranges

By default, TopRank will search for inputs and outputs in all worksheets in all open workbooks. There may be times, however, that you wish to limit TopRank to only find inputs and outputs in specific workbooks, worksheets or ranges. The Search Ranges command allows you to do this.

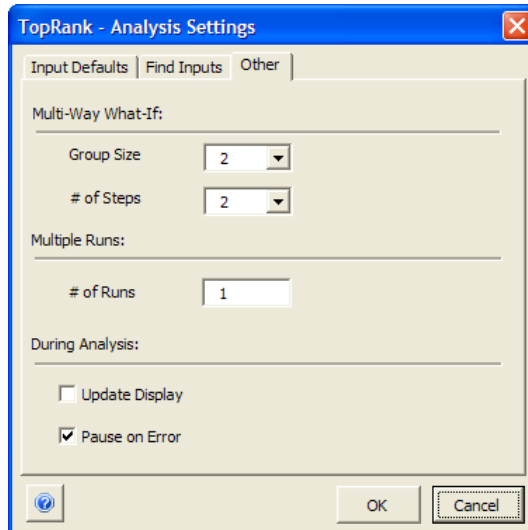


By unchecking workbooks or worksheets in the displayed list, you can keep them from being searched for inputs. In addition, you can select a specific range on a worksheet that will be searched by clicking on the name of the sheet in the upper part of the Search Ranges dialog, and specifying the desired range of cells in the Range to Search field. If you add new worksheets or workbooks to an analysis, by default they will be searched by TopRank until you deselect them.

TopRank will use entered search ranges when **it is automatically identifying inputs in precedent cells**. When generating the list of inputs and outputs in your model, TopRank will still include any explicitly entered TopRank or @RISK functions present in workbooks or worksheets not selected for searching. These functions will also be used in an analysis.

Other Tab — Analysis Settings Command

Defines other settings affecting a What-If analysis.



Multi-Way What-If Analysis

Multi-Way What-If analyses vary inputs at the same time and calculate the effect of each combination of input values on results. When you have Multi forms of functions in your worksheets (**VaryMulti**, **VaryMultiTable** or **@RISK** functions in their Multi form, such as **NormalMulti** or **DiscreteMulti**), an analysis run using the **What-If Analysis Run** command will include a multi-way what-if analysis.

When executing a Multi-Way What-If, TopRank first identifies all **VaryMulti** and **VaryMultiTable** functions in your spreadsheet. Then, using the Group Size entered, TopRank tries all combinations of input values possible. As with a one-way What-If, TopRank recalculates your spreadsheet for each combination and collects the new output values generated. Once the Multi-Way What-If is completed, TopRank ranks all calculated combinations according to their impact on each output.

Multi-Way What-If options include:

- **Group Size.** The number of inputs to be included in each combination tested in a Multi-Way analysis is determined by the Multi-Way **Group Size** setting. By default all **VaryMulti** and **VaryMultiTable** functions in a spreadsheet are included in a Multi-Way What-If analysis. For example, you might have four inputs defined using **VaryMulti** and **VaryMultiTable** functions – *price, sales volume, production costs, and investment* – and you want to see the impacts of every combination of two inputs on your result, *profit*. In this case, the Group Size is two. Your analysis might tell you that *price and sales volume* varying together are the most significant combination affecting your result – *profit*. Setting the Group Size to three might identify the combination of *price, sales volume and investment* as the most important three-way combination of inputs on results.

A Group Size of **Auto** forces the Group Size to equal the number of all **VaryMulti** and **VaryMultiTable** functions in a spreadsheet. Use this setting if you want to force TopRank to calculate every possible combination of input values.

Note: Group Size is a default entry that is set at the start of a Multi-Way What-If analysis. If you want Multi-Way What-If results with a different Group Size than was calculated in your current results, simply change the default Group Size and re-run the analysis.

- **# of Steps.** The **# of Steps** entry specifies the number of steps TopRank calculates across the minimum-maximum range of Vary and distribution functions during a Multi-way What-If analysis. A different default number of steps value is used for a Multi-Way What-If analysis as opposed to a standard one-way What-If analysis. Typically you want fewer Multi-Way steps as compared to one-way steps (the number of steps must be greater or equal to two). This minimizes the number of recalculations or iterations required to complete a Multi-Way What-If analysis.

Multiple Runs

Multiple runs can be executed for any What-If analysis in TopRank. When the **# of Runs** setting is greater than one, TopRank sequentially executes the desired number of What-If analyses one after another. Multiple runs are used to run several What-If analyses on the same model, using different assumptions for each analysis. Compare the results from each run to see the effect of the changing assumptions on the What-If results.

Assumptions can be changed by run by using the SIMTABLE function. Each run a new value is used for every SIMTABLE function in the model. The SIMTABLE function takes a list of values as arguments, such as:

=RiskSimtable({100,200,300,400})

Each run, the SIMTABLE function returns the argument whose position in the list is the run number. In the above SIMTABLE function, the value 100 is returned the first run, 200 the second and so on. The # of Runs defined should be less than or equal to the number of arguments entered into all SIMTABLE functions. If the number of runs is greater than the number of arguments entered into a SIMTABLE function, the SIMTABLE function returns an error value during a run whose number is greater than the number of arguments.

Refer to the *@RISK Function Reference* in the *@RISK User's Guide* for more information on using the Simtable function.

During Analysis

The **Update Display** option toggles on and off the updating of the worksheet displayed during a What-If analysis. For each iteration of a What-If analysis, a new value is returned for a Vary or VaryTable function and the spreadsheet is recalculated.

Update display shows the results of each recalculation on the screen (box checked) or suppresses the display (no check). Selecting the Update Display option causes What-If analyses to run slower. The Update Display setting can be changed while a What-If analysis is running by pressing the <Num Lock> key.

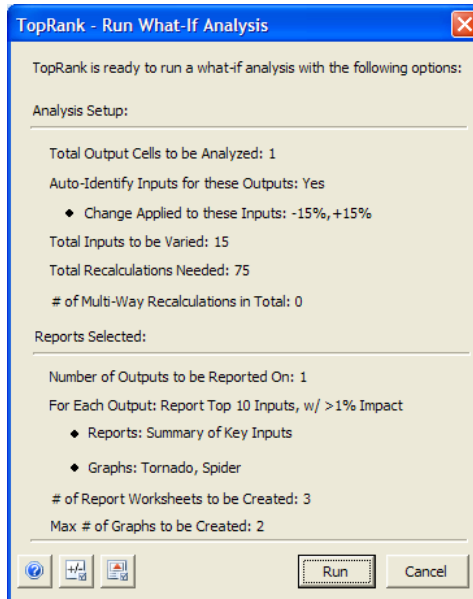
The **Pause on Error** setting pauses a *What-If* analysis if an error value is generated in any of the selected outputs during a calculation. When the analysis pauses, the output range containing the error value is highlighted in the worksheet. Scroll about the worksheet to examine the combination of input values which leads to the error condition. Then, continue the simulation if you wish.

Run Command

Starts a What-If analysis.

The What-If Analysis menu Run command starts a What-If analysis using the current settings. When the Run command is selected, first TopRank will insert AutoVary functions (if necessary) in open workbooks. It then displays a Status dialog showing the settings for the run it is about to execute.

Run What-If Analysis Status Dialog



The Status dialog shows the number of recalculations TopRank will perform during the analysis along with the reports it will generate. By clicking the **Analysis Settings** or **Reports Settings** buttons, you can change any settings prior to executing the analysis.

Running a What-If Analysis

Clicking the Run button in the Status dialog starts the What-If analysis. During an analysis, a status dialog box displays the progress of the calculation. Click the Cancel command on the status dialog box to halt the calculation at any time.

If Update Display is selected, you can watch your spreadsheet change every iteration. But, this will slow down the What-If analysis. Press the Num-Lock key to toggle the Update Display setting.

When the analysis is complete, an Excel workbook displays the reports selected with the **Report Settings** command.

TopRank Summary Results

Book2 - Microsoft Excel

Home Insert Page Layout Formulas Data Review View Add-Ins TopRank

Add Input AutoVary Add Functions Output Model Window Analysis Settings Report Settings Run What-If Analysis Swap Functions Utilities Help

A1

31 What-If Analysis Summary for Output Total Profit

32 Top 10 Inputs Ranked By Change in Actual Value

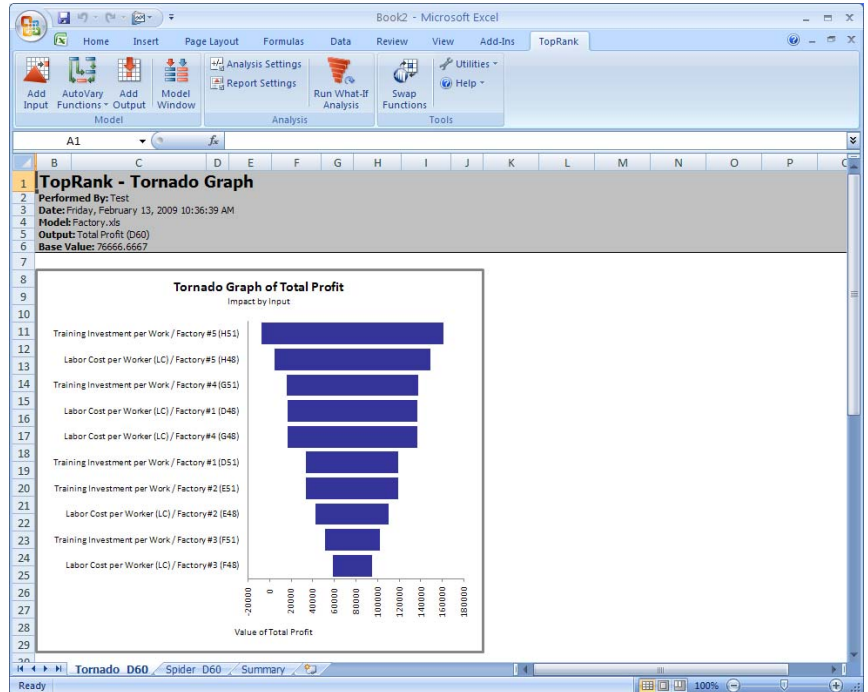
Rank	Input Name	Cell	Minimum		Maximum		
			Output Value	Change (%)	Input Value	Change (%)	
1	Training Investment per Work / Factory #5 (H51)	H51	\$7,333	-109.57%	255	\$160,667	109.57%
2	Labor Cost per Worker (LC) / Factory #5 (H48)	H48	\$4,667	-93.91%	690	\$148,667	93.91%
3	Training Investment per Work / Factory #4 (G51)	G51	\$15,917	-79.24%	229.5	\$137,417	79.24%
4	Labor Cost per Worker (LC) / Factory #1 (D48)	D48	\$16,667	-78.26%	920	\$136,667	78.26%
5	Labor Cost per Worker (LC) / Factory #4 (G48)	G48	\$16,667	-78.26%	920	\$136,667	78.26%
6	Training Investment per Work / Factory #1 (D51)	D51	\$34,167	-55.43%	85	\$119,167	55.43%
7	Training Investment per Work / Factory #2 (E51)	E51	\$34,167	-55.43%	170	\$119,167	55.43%
8	Labor Cost per Worker (LC) / Factory #2 (E48)	E48	\$42,917	-44.02%	1035	\$110,417	44.02%
9	Training Investment per Work / Factory #3 (F51)	F51	\$51,167	-33.26%	255	\$102,167	33.26%
10	Labor Cost per Worker (LC) / Factory #3 (F48)	F48	\$58,667	-23.48%	1380	\$94,667	23.48%

Ready Tornado D60 Spider D60 Summary 100%

The standard results of a one-way What-If analysis are a ranking of input variables by their impact on your outputs. Input variables are all Vary, VaryTable and @RISK functions that were changed by TopRank during the What-If analysis. Outputs are output cells identified by you prior to the analysis. If a subset of outputs was selected for reporting using the **Report Settings dialog Output for Reports tab**, only those outputs will be reported on.

Tornado Graphs

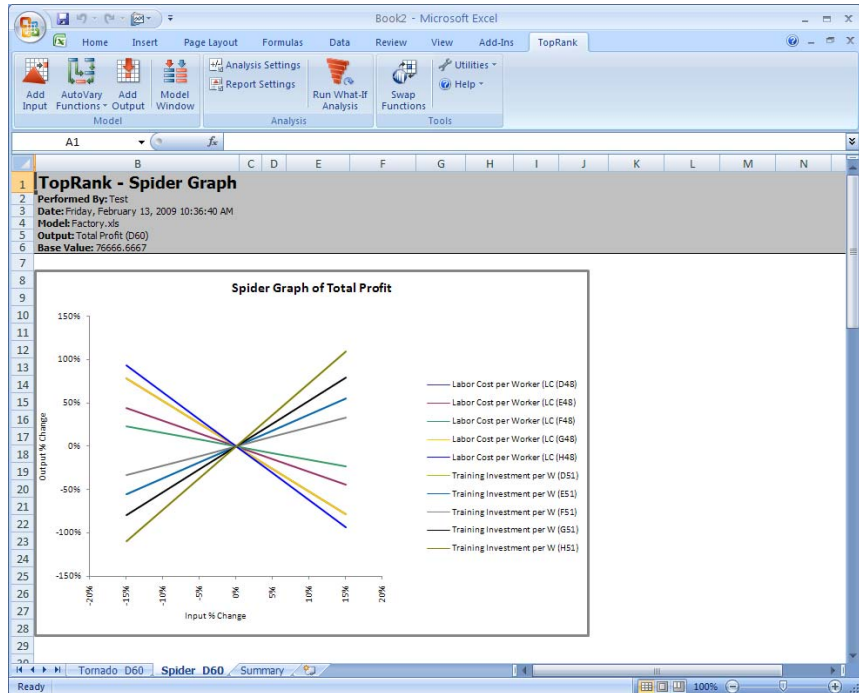
A tornado graph compares the effects of all input variables on a given output. The X-Axis displays the percentage change in output value. For each variable (listed on the Y-Axis), a bar is drawn between the extreme values of the output as calculated using the lower and upper input values.



The variable with the greatest range or longest bar (the difference between the maximum and minimum value) is plotted on the top of the graph, and the variables proceed down the Y-Axis with decreasing range. The variable that has most influence on the output has the longest bar on the graph.

Spider Graphs

A spider graph also compares the results for a single output as generated by multiple input variables. For each input variable, the percentage of the base case is plotted on the X-Axis and the percent change in output value calculated is plotted on the Y-Axis. The slope of each line depicts the relative change in the output per unit change in the input variable. The shape of the curve shows whether a linear or non-linear relationship exists between the input and the output.

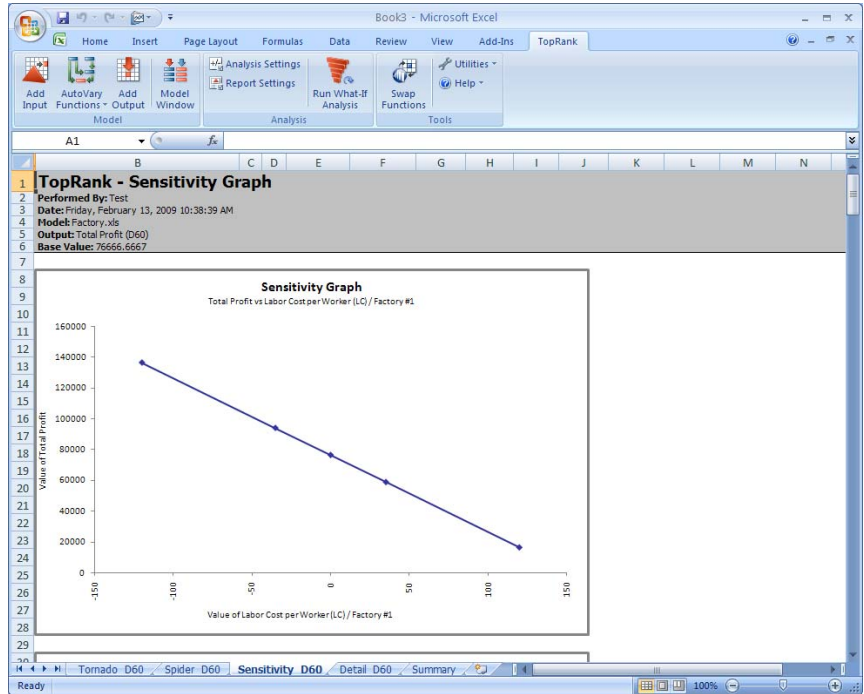


Spider graphs provide more information about the variables than tornado diagrams. For example, spider graphs show the reasonable limits of change caused by each input variable and the unit impact of these changes on the outcome. While tornado graphs may lead the decision maker to think that risk is proportional, the slope of spider graphs demonstrate any unproportional changes in outcomes.

The number of variables used in a spider graph should not exceed seven, but a limit of five is recommended to avoid clutter. If your What-If analysis contains a large number of input variables, it is a good idea to plot them on a tornado graph first to determine which variables have the greatest impact. Then, use only these variables on your spider graph.

Sensitivity Graphs

The sensitivity or What-If graph is a simple diagram plotting input value used vs. output value calculated. The value of the selected input variable is plotted on the X-Axis and the calculated output value is plotted on the Y-Axis. The base case is always noted.



Report Settings Command

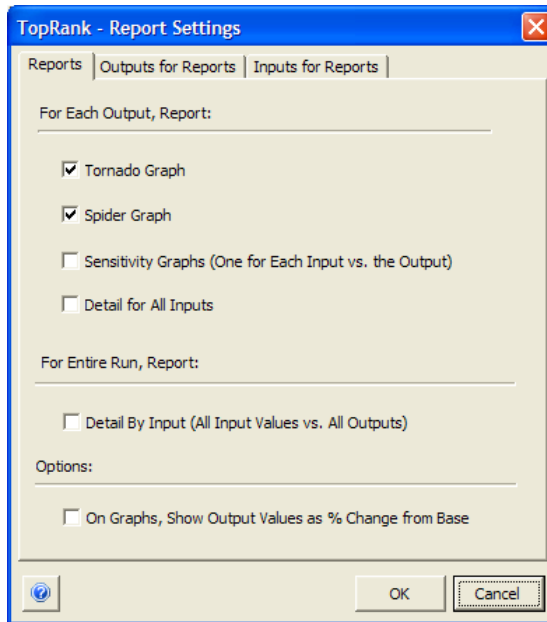
Specifies the type of reports and graphs that will be generated in Excel for each output, the location of those reports and the outputs and inputs that will be reported on

The Report Settings command allows you to specify the location and type of reports that will be generated by TopRank. In addition, you can select to limit reporting to only specific outputs in your workbooks and set criteria for selecting which inputs to report on.

Reports Tab — Report Settings Command

Specifies the type of reports and graphs to be generated by TopRank and their the location

The Reports tab in the Report Settings dialog allows you to specify the location and type of reports that will be generated by TopRank.



A variety of different pre-built reports are available directly in Excel at the end of a What-If analysis. The **For Each Output, Report:** options include:

- **Tornado** graphs graphically display the the key inputs affecting an output. A Summary table of key inputs is created with the graph.
- **Spider** graphs also graphically display the key inputs affecting an output. The slope of each line depicts the relative change in the output per unit change in the input variable.
- **Sensitivity Graphs** display the impact of an individual input on an output.
- **Detail for All Inputs** report contains information on how each input change made in the analysis affected an output.

The **For Entire Run, Report:** option is:

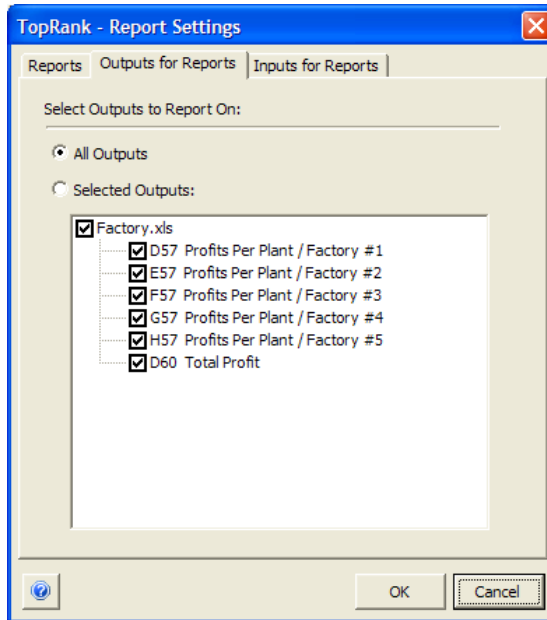
- **Detail By Input Report** is a single report that details the impact of individual inputs on all outputs in a model. Use this to quickly compare how individual inputs affect different outputs.

Output values may be shown in graphs in terms of the actual output value calculated or as a percent change from the output's base value. Select **On Graphs, Show Output Values as % Change From Base** to view percent change in graphs.

Outputs for Reports Tab — Report Settings Command

Selects the outputs to be reported on by TopRank

The Outputs for Reports tab in the Report Settings dialog allows you to specify a subset of outputs to be reported on from an analysis.

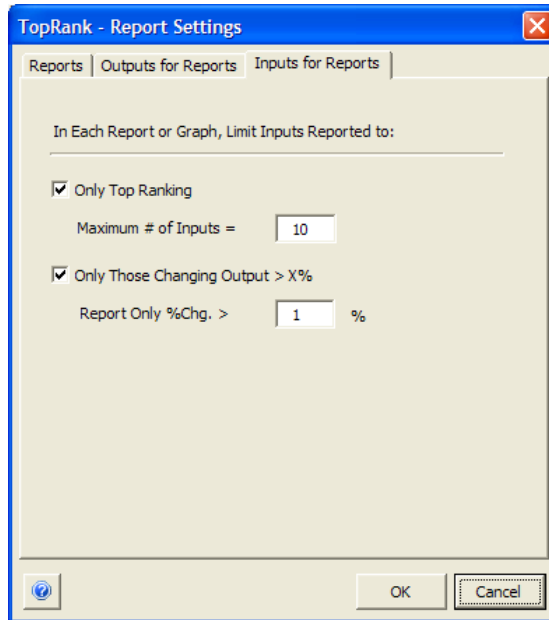


You can select to report on **All Outputs** or only **Selected Outputs**. This is useful if you have a model with many outputs but are only interested in analyzing one of them in a specific analysis. You can leave all your output functions in your model but select specific ones to analyze here.

Inputs for Reports Tab — Report Settings Command

Specifies significant inputs to be included in reports

The Inputs for Reports tab in the Report Settings dialog allows you to specify a cutoff for inputs to be reported on from an analysis. By using these settings you can limit your reports to show only critical inputs, eliminating those inputs which have minimal affects on results.



Options on the Inputs for Reports tab include:

- **Only Top Ranking** specifies that only the entered top number of inputs that impact an output will be included in reports.
- **Only Those Changing Output > %** specifies that only those inputs that cause a greater than the entered % change in output value will be included in reports.

Swap Functions Command

Swaps TopRank and @RISK functions in and out of cell formulas

With the **Swap Functions Command**, TopRank and @RISK functions can be swapped in and out of your workbooks. This makes it easy to give models to colleagues who do not have TopRank. If your model is changed when TopRank and @RISK functions are swapped out, TopRank will update the locations and static values of TopRank and @RISK functions when they are swapped back in.

When the **Swap Functions** icon is clicked, you may immediately swap out functions using the current swap settings, or change the settings to be used.

The screenshot shows the Microsoft Excel interface with the 'Swap TopRank Functions' dialog box open. The dialog box contains the following text:

OK to swap out TopRank and @RISK functions, replacing them with their Static or "Corrected" expected Values?

Buttons: OK, Cancel

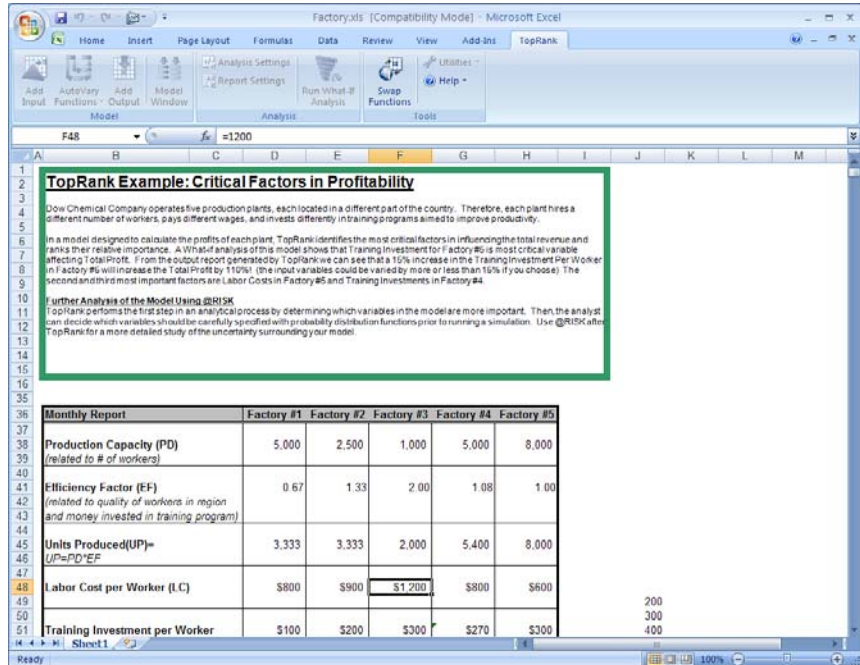
The background spreadsheet shows a 'Monthly Report' table with the following data:

Monthly Report	Factory #1	Factory #2	Factory #3	Factory #4	Factory #5
Production Capacity (PD) (related to # of workers)	5,000	2,500	1,000	5,000	8,000
Efficiency Factor (EF) (related to quality of workers in region and money invested in training program)	0.67	1.33	2.00	1.08	1.00
Units Produced(UP)= UP=PD*EF	3,333	3,333	2,000	5,400	8,000
Labor Cost per Worker (LC)	\$800	\$900	\$1,200	\$800	\$600
Training Investment per Worker	\$100	\$200	\$300	\$270	\$300

TopRank After Function Swap

When functions are swapped out, the TopRank toolbar is disabled, and if you enter a TopRank function it will not be recognized.

The Swap options dialog allows you to specify how TopRank will operate when functions are swapped in and out. If your workbook is changed, when TopRank functions are swapped out, TopRank can report to you how it will re-insert TopRank functions into your changed model. In most cases, TopRank will be able to automatically handle changes to a workbook when functions are swapped out.



The screenshot shows the Microsoft Excel interface with the TopRank toolbar visible. The worksheet contains the following table:

Monthly Report	Factory #1	Factory #2	Factory #3	Factory #4	Factory #5
Production Capacity (PD) (related to # of workers)	5,000	2,500	1,000	5,000	8,000
Efficiency Factor (EF) (related to quality of workers in region and money invested in training program)	0.67	1.33	2.00	1.08	1.00
Units Produced (UP)= $UP=PD*EF$	3,333	3,333	2,000	5,400	8,000
Labor Cost per Worker (LC)	\$800	\$900	\$1,200	\$800	\$600
Training Investment per Worker	\$100	\$200	\$300	\$270	\$300

Swap Options

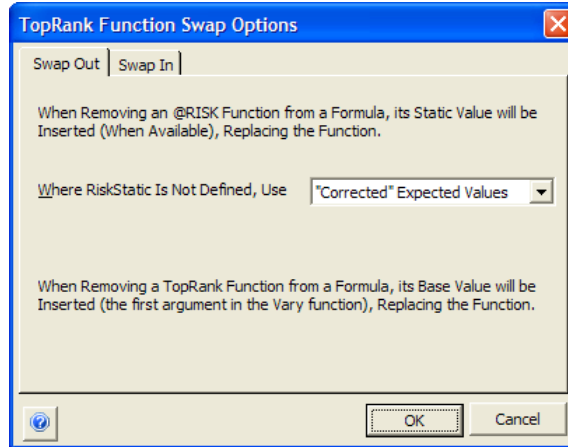
Clicking the **Swap Option** icon (next to the Help icon in the Swap TopRank Functions dialog) displays the Swap Options dialog.

Swap Options are available for:

- **Swap Out** (when TopRank and @RISK functions are removed)
- **Swap In** (when TopRank and @RISK functions are returned to your workbook)

Swap Out Options

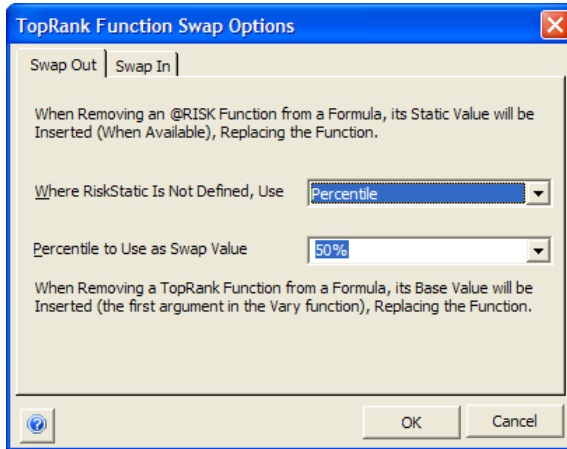
When swapping out, the primary value used for replacing a TopRank function is the **base value** that is given in the first argument of a Vary function. For an @RISK function, the value used for replacing the function is its **static value**. Typically this is the value in a formula in your model that was replaced by an @RISK function. It is stored in an @RISK distribution in the RiskStatic property function.



Swapping @RISK Functions

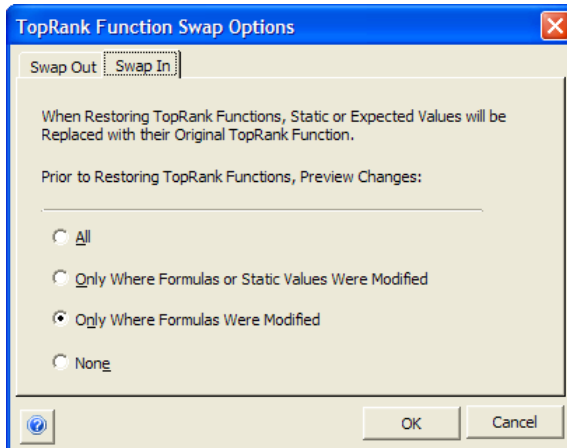
The Function Swap command swaps @RISK distribution functions out, along with TopRank's Vary functions. Options for swapping @RISK functions out in TopRank are the same as available in @RISK. For @RISK functions, if a Static value is not defined (i.e., no RiskStatic function is present), a set of different values are available for replacing the @RISK functions value. These are selected in the **Where RiskStatic is Not Defined, Use** options, and include:

- **“Corrected” Expected Value**, or a distribution's expected or mean value, except for discrete distributions. For discrete distributions, the setting “Corrected” Expected Value will use the discrete value in the distribution closest to the true expected value as the swap value.
- **True Expected Value**. This setting causes the same values to be swapped as the option “Corrected” Expected Value, except in the case of discrete distribution types such as DISCRETE, POISSON and similar distributions. For these distributions the true expected value will be used as the swap value, even if the expected value could not occur for the entered distribution, i.e., it is not one of the discrete points in the distribution.
- **Mode**, or a distribution's mode value.
- **Percentile**, or the entered percentile value for each distribution.



Swap In Options

Swap In Options control how TopRank will report changes that it will make to your spreadsheet, prior to inserting distribution functions back into formulas. Spreadsheet formulas and values can be changed when TopRank and @RISK functions are swapped out. When swapping in, TopRank will identify where it should re-insert TopRank and @RISK functions and, if desired, show all the changes it is going to make to your formulas. You can check these changes to make sure TopRank and @RISK functions are returned as you wish. In most cases, Swap In is automatic, as TopRank captures all changes to static values that were made when functions were swapped out. It also, automatically, handles moved formulas and inserted rows and columns. However, if formulas where TopRank and @RISK functions were previously located were deleted when functions were swapped out, TopRank will notify you of the problem formulas prior to swapping functions back in.



Swap In options for **Prior to Restoring TopRank and @RISK Functions, Preview Changes** include:

- **All.** With this option all changes to be made to the model are reported, even if a formula and swapped out value were not changed when TopRank and @RISK functions were swapped out.
- **Only Where Formulas or Static Values Were Modified.** With this option only changes to be made, that include a changed static value or formula, are reported. For example, if the original TopRank and @RISK distribution was:

C10: =RiskNormal(990,100,RiskStatic(1000))

After swap out, the formula would be:

C10: =1000

If the value of C10 was changed while functions were swapped out to:

C10: =2000

TopRank would swap the following function back in, updating the static value:

C10: =RiskNormal(990,100,RiskStatic(2000))

If the Swap In option **Only Where Formulas or Static Values Were Modified** was selected, TopRank would report this change prior to swapping in.

- **Only Where Formulas Were Modified.** Only changes to be made that include a changed formula are reported with this option. For example, if the original TopRank and @RISK distribution was in a formula:

C10: =1.12+RiskNormal(990,100,RiskStatic(1000))

After swap out, the formula would be:

C10: =1.12+1000

If the formula for C10 was changed when functions were swapped out to:

C10: =1000

TopRank would swap the following formula and function back in:

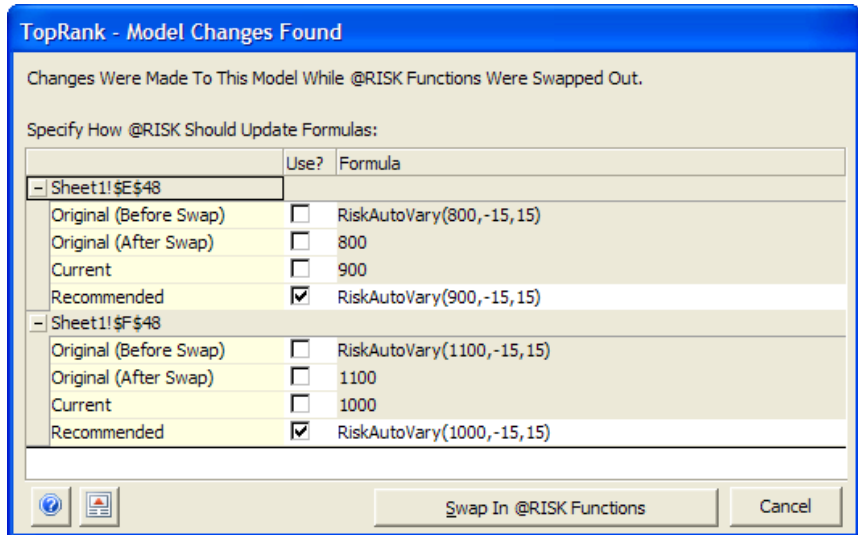
C10: =RiskNormal(990,100,RiskStatic(1000))

If the options **Only Where Formulas or Static Values Were Modified** or **Only Where Formulas Were Modified** were selected, TopRank would report this change prior to swapping in.

- **None.** No changes to be made to the model are reported, and TopRank automatically swaps in its recommended change.

Previewing Changes Prior to Swapping TopRank and @RISK Functions In

TopRank creates a report which you can use to preview the changes that will be made to a workbook when swapping functions in. The report includes the **Original (Before Swap)**, the **Original (After Swap)**, the **Current**, and the **Recommended** formulas to be swapped back in.



If desired, you can edit the **Recommended** formula to be swapped back in, or alternatively, select one of the other displayed formulas to be used when swapping back in. By selecting the Edit icon's **Create Report to Excel** command at the bottom of the window, you can choose to create a report in Excel of the changes made to the model.

Swapping in Functions When a Workbook is Opened

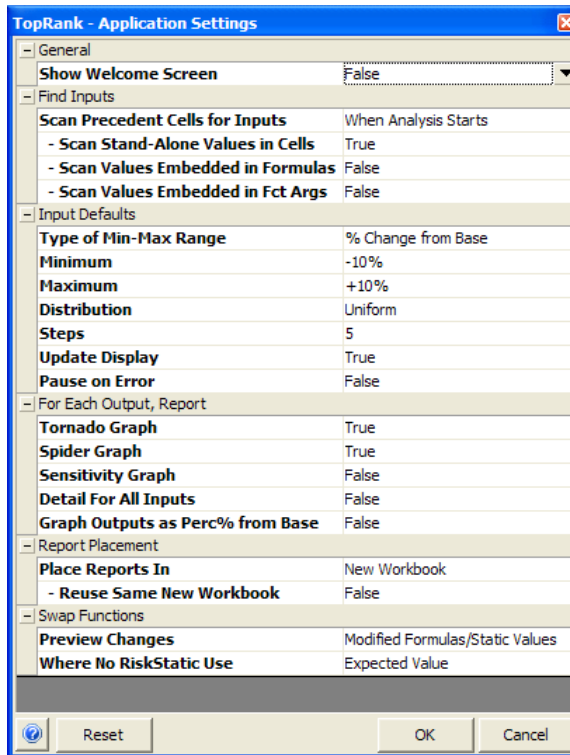
If TopRank is running, it will automatically offer to swap in functions when a “swapped out” workbook is opened. However, this will not happen if the “swapped out” workbook is opened while TopRank’s toolbar is disabled because functions are swapped out.

Utilities Commands

Application Settings Command

Displays the Application Settings dialog where program defaults can be set

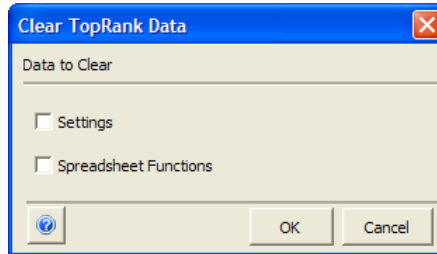
A wide variety of TopRank settings can be set at default values that will be used each time TopRank runs. These include defaults for scanning precedents for inputs, default input min-max ranges, reporting options and others.



Clear TopRank Data Command

Clears the Selected TopRank Data from Open Workbooks

The Clear TopRank Data Command clears the selected TopRank data from open workbooks.



The following data may be cleared:

- **Settings.** This clears any TopRank settings and defined Excel names used by TopRank.
- **Spreadsheet Functions.** This removes all TopRank and @RISK functions from open workbooks, replacing them with their Static value or, if a Static value is not found, the Swap Out value as specified in the Swap Options dialog. However, this is not a Function Swap, as TopRank will not place swap information in your workbook to be used when swapping functions back in, and thus, **all model information will be gone.**

Selecting all options allow you to remove all TopRank information from open workbooks.

Unload TopRank Add-in Command

Unloads the TopRank add-in from Excel

The Unload TopRank Add-in Command unloads TopRank, closing all TopRank windows.

Help Commands

TopRank Help

Opens on-line help file for TopRank

The Help menu TopRank Help command opens the main help file for TopRank. All of TopRank's features and commands are described in this file.

Online Manual

Opens online manual for TopRank

The Help menu Online Manual command opens this manual in PDF format. You must have Adobe Acrobat reader installed to view the online manual.

License Activation Command

Displays licensing information for TopRank and allows the licensing of trial versions

The Help menu License Activation command displays the License Activation dialog box, listing the version and licensing information for your copy of TopRank. Using this dialog box you can also convert a trial version of TopRank into an licensed copy.

For more information on licensing your copy of TopRank, see **Chapter 1: Getting Started** in this manual.

About Command

Displays version and copyright information about TopRank

The Help menu About command displays the About dialog box, listing the version and copyright information for your copy of TopRank

Reference: TopRank Functions

Introduction to TopRank Functions

TopRank adds a new set of functions to Excel to run What-If analyses on spreadsheets. These functions are called Vary functions. They specify how a spreadsheet input could change during a What-If analysis. There are several forms of Vary functions:

- **Vary**, the standard function for specifying how an input value can vary
- **AutoVary**, a Vary function that is automatically added by TopRank
- **VaryTable**, a Vary function that uses a table to define the possible values for an input
- **VaryMulti**, a Vary function that is also used in a Multi-Way What-If analysis
- **VaryMultiTable**, a VaryTable function that is also used in a Multi-Way What-If analysis

As with Excel functions, Vary functions contain two elements, a function name and argument values which are enclosed in parentheses. A typical Vary function is:

=RiskVary(100,10)

Vary Function Arguments

The number and type of arguments required for a Vary function depend on whether a Vary or VaryTable function is used. For example, the function:

=RiskVaryTable(base value, table ref)

takes a fixed number of arguments that are specified each time you use the function. For others, such as Vary, you specify the number of arguments you desire, based on your situation. A Vary function can have three arguments, or more as needed.

Like Excel functions, Vary functions can have arguments which are references to cells or expressions. For example:

=RiskVary(100,B2*1.5,B3)

In this case the value for the input minimum is specified by the value taken from cell B2 multiplied it by 1.5 and the value for input maximum is taken from cell B3.

Vary functions can be used in cell formulas, just as are Excel functions. For example, a cell formula could read:

**B2: =100 + RiskVary(10,-20,20) +
(1.5 * RiskVaryTable(40,A1...A1000))**

All standard Excel editing commands are available to you when entering Vary functions. However, TopRank must be loaded for the Vary functions to be recognized by Excel. If TopRank is not attached, Excel returns #VALUE for the function when the worksheet is recalculated.

Entering Arguments in Vary Functions

The guidelines for entering Excel functions presented in the relevant users manual are also applicable to entering TopRank Vary functions. However, some additional guidelines specific to TopRank functions are:

- Vary functions can have between three and six and arguments. A minimum of three arguments are required and additional arguments can be added as necessary.
- In Excel, VaryTable functions with tables entered directly in the function require the list of values to be entered as an array, i.e.,

=VaryTable(100,{80,90,110,120,130}).

- Arrays in Excel are denoted by either enclosing the values of the array in {} brackets or using a reference to a contiguous range of cells – such as **A1:C1**.

Some additional guidelines:

- VaryTable functions return error values if an insufficient number of arguments are entered and ignore extra arguments if too many are entered.
- Vary functions return error values if arguments are of the wrong type (number, array or text).

Please refer to the function descriptions later in this chapter for a list of arguments (and their descriptions) for each TopRank function.

Important Note

In Excel, you can not list cell references or names in arrays as you list constants. For example, you can not use {A1,B1,C1} to represent the array containing the values in cells A1, B1, and C1. Instead, you must use the cell range reference A1:C1 or enter the values of those cells directly in the arrays as constants – for example, {10,20,30}.

Output Function

Output cells are defined using RiskOutput functions. These functions allow the easy copying, pasting and moving of output cells. RiskOutput functions are automatically added when the standard TopRank Add Output icon is pressed. RiskOutput functions optionally allow you to name your outputs and add individual output cells to output ranges. A typical RiskOutput function might be:

```
=RiskOutput("Profit")+NPV(.1,H1:H10)
```

where the cell, prior to its selection as a simulation output, simply contained the formula

```
= NPV(.1,H1:H10)
```

The added RiskOutput function selects the cell as a simulation output and gives the output the name "Profit".

Note: All outputs added with TopRank will also be recognized when running a simulation with @RISK.

Property Functions

Optional arguments to TopRank functions can be entered using **Property** functions. These optional arguments are used to name an input and its category for reporting and graphing and keep an input from being varied in an analysis. These arguments are not required, but can be added as needed.

Optional arguments specified using property functions are embedded inside of a TopRank function. Property functions are entered just as are standard Excel functions and can include cell references and mathematical expressions as arguments.

For example, the following function names the entered Vary function:

```
=RiskVary(100,-10,10,RiskName("My Input"))
```

Sampling from Vary Functions During an @RISK Simulation

The simple + and - change defined by a Vary function in a What-If analysis can be used directly in an @RISK simulation. @RISK actually samples your Vary functions directly in a simulation.

The values sampled by @RISK from Vary and VaryTable functions during a simulation depend on either a distribution argument entered for the function or the default distribution setting used in TopRank. For example, the TopRank function **RiskVary(100,-10,+10)**, using a default distribution setting of Uniform and a default range type of +/- percentage, is sampled like the @RISK distribution **RiskUniform(90,110)**. VaryTable functions from TopRank are sampled as RiskDuniform functions in @RISK.

TopRank Function Reference

TopRank functions return values from across a range or from a table during a What-If analysis in TopRank. When used, all functions are preceded by the entry **Risk** in Excel.

Table of Vary Functions

This table lists the custom Vary functions that are added to Excel by TopRank.

Vary Function	Returns
RiskAutoVary (<i>base, min, max, type, #Steps, dist</i>)	Returns values between min and max with number of values returned equal to #Steps, min max range by type, and distribution across the min-max range.
RiskVary (<i>base, min, max, type, #Steps, dist</i>)	Returns values between min and max with number of values returned equal to #Steps, min max range by type, and distribution across the min-max range.
RiskVaryMulti (<i>base, min, max, type, #Steps, dist</i>)	Returns values between min and max with number of values returned equal to #Steps, min max range by type, and distribution across the min-max range (also used in a Multi Way What if).
RiskVaryMultiTable (<i>base, table</i>)	Returns values from table (also used in a Multi Way What if).
RiskVaryTable (<i>base, table</i>)	Returns values from table.

Table of Property Functions

This table lists the custom Property functions that can be added to TopRank Vary functions.

Property Function	Specifies
RiskLock()	Blocks the varying of the input in which the Lock function is included
RiskName("input name")	<i>Name</i> for the input in which the Name function is included
RiskCategory("category name")	<i>Category name</i> for the category of inputs in which the input will be placed

Table of Output Function

This table lists the Output function that can be used in TopRank.

Output Function	Specifies
RiskOutput("name", "output range name", position in range)	What-If analysis output cell with <i>name</i> , <i>output range name</i> to which the output belongs, and the <i>position in range</i> (<i>Note: all arguments to this function are optional</i>)

Listing of TopRank Functions

RiskAutoVary

Description	<p>AUTOVARY(base, minimum, maximum, range type, #Steps, distribution) specifies an input variable in a What if analysis that was automatically entered by TopRank. The arguments to this function are identical to those of the Vary function. For more information, see VARY.</p>
-------------	---

RiskVary

Description	<p>VARY(base, minimum, maximum, range type, #Steps, distribution) specifies an input variable in a What if analysis with a range defined by minimum and maximum. If desired, arguments for range type, #Steps and distribution can be entered. If not entered, the default range type, steps and distribution are used. The base value is the value returned by the function when a What if analysis is not underway. Typically, this is the value the was used in the spreadsheet prior to entering the Vary function.</p>
Examples	<p>RiskVary(100,-10,10,0,8,"TRIANG") specifies a What if input with a base value of 100, a -10% and +10% range, a percentage range type, 8 steps and a triangular distribution across the min-max range</p> <p>RiskVary(100,A1,B1) specifies a What if input with a range minimum defined by the value in A1 and range maximum defined by the value in B1. The default range type, #Steps and distribution are used.</p>
Guidelines	<p><i>Maximum</i> must be greater than Base</p> <p><i>Base</i> must be greater than <i>Minimum</i></p> <p><i>Range Type</i> = 0 indicates a -/+ percentage change from base case is defined by <i>minimum</i> and <i>maximum</i> (i.e., -20% and +20%). Percentage is entered as an absolute percentage value (such as -20) instead of -.2.</p> <p><i>Range Type</i> = 1 indicates a -/+ actual change is defined by <i>minimum</i> and <i>maximum</i> (i.e., -150 and +150)</p> <p><i>Range Type</i> = 2 indicates that the <i>minimum</i> entered is the actual minimum value in the range and the <i>maximum</i> entered is the actual minimum value in the range (i.e., 90 and 110)</p> <p><i>#Steps</i> must be a positive integer</p> <p><i>Distrib</i> must be "TRIANG", "UNIFORM", "TRI1090", or "NORMAL", and must be surrounded by quotes.</p>

RiskVaryMulti

Description	VARYMULTI(base, minimum, maximum, range type, #Steps, distribution) specifies an input variable for use in both a What if analysis and a Multi Way What if analysis. The arguments to this function are identical to those of the Vary function. For more information, see VARY.
--------------------	---

RiskVaryMultiTable

Description	VARYMULTITABLE(base, table) specifies an input variable for both 1) a What if analysis and 2) a Multi Way What if analysis, along with a table of values to substitute for the input. The arguments to this function are identical to those of the VARYTABLE function. For more information, see VARYTABLE.
--------------------	--

RiskVaryTable

Description	VARYTABLE(base, table) specifies an input variable for a What if analysis along with a table of values to substitute for the input. The table of values can be directly entered in the function itself or a reference to the location of the table can be entered. Any number of values can be included in a referenced table.
Examples	RiskVaryTable(100,{70,80,90,110,120,130}) specifies a What if input with a base value of 100. Six different values — 70,80,90,110,120 and 130 — are returned by the VaryTable function during a What if analysis and results are calculated at each of the six values. RiskVaryTable(100,A1:A100) specifies a What if input with a base value of 100. Each of the 100 values in the range A1:A100 are returned by the VaryTable function during a What if analysis and results are calculated at each of the returned values.
Guidelines	Table values directly entered into the VaryTable function must be entered as arrays with {} notation.

Listing: Property Functions

The following functions are used to add optional arguments to TopRank functions. The arguments added by these functions are not required, but can be added as needed.

Optional arguments are specified using property functions that are embedded inside of a TopRank function.

RiskLock

Description	RiskLock() keeps an input from being varied in an analysis. Locking an input causes it to return its base value during a what-if analysis or in a simulation in @RISK.
Examples	RiskVary(100,-10,10,RiskLock()) stops the input from being varied in an analysis.
Guidelines	None.

RiskName

Description	RiskName("Input Name") names the input in which the function is used as an argument. This name will appear in both the TopRank Model Window list and in any reports and graphs which include results for the input.
Examples	RiskVary(100,-10,10,RiskName("Price")) gives the name Price to the input described by the base value of 100 and a variation of -10 and +10. RiskVary(100,-10,10,RiskName(A10)) gives the name contained in the cell A10 to the input described by the Vary function RiskVary(100,-10,10).
Guidelines	The name specified must be entered in quotes. Any valid cell references can be used to define a name.

RiskCategory

Description	<i>RiskCategory</i> ("Category Name") names the category in which the input will be placed. This name will appear in the category grouping in the TopRank Model Window list.
Examples	<i>RiskVary</i> (100,-10,10, <i>RiskCategory</i> ("Research Costs")) places the input described by the Vary function <i>RiskVary</i> (100,-10,10) in a category named " Research Costs" along with other Research Cost inputs. <i>RiskVary</i> (100,-10,10, <i>RiskCategory</i> (A10)) places the input described by the Vary function <i>RiskVary</i> (100,-10,10) in a category named with the contents of the cell A10.
Guidelines	The category name specified must be entered in quotes. Any valid cell references can be used to define a category name.

Listing: Output Function

Output cells are defined using RiskOutput functions. These functions allow the easy copying, pasting and moving of output cells. RiskOutput functions are automatically added when the standard TopRank Add Output icon is pressed. RiskOutput functions optionally allow you to name your outputs and add individual output cells to output ranges.

RiskOutput

<p>Description</p>	<p>The function RiskOutput is used to identify output cells you have selected in your spreadsheet. This function takes up to three arguments as shown here:</p> <p>=RiskOutput("output cell name", "output range name", element# in range)</p> <p>These arguments are optional, as a simple =RiskOutput() is sufficient for entering a single element output range where TopRank creates the name of the output for you. RiskOutput used with a single argument such as:</p> <p>=RiskOutput("output cell name")</p> <p>specifies for a single element output range where the name is entered by you.</p> <p>When a multiple element output range is identified, the form:</p> <p>=RiskOutput("output cell name", "output range name", position# in range)</p> <p>is used; however, the output cell name entry can be omitted if you wish to have TopRank automatically generate a name for each output cell in the range.</p> <p>RiskOutput functions are automatically generated for you when you select outputs using the TopRank Add Output icon. However, like any other TopRank function, RiskOutput may be typed directly in the cell which you wish to reference as an output.</p> <p>A RiskOutput function is entered by adding it to the cell formula which is already present in the cell that is to be an analysis output. For example, a cell containing the formula:</p> <p>=NPV(.1,G1:G10)</p> <p>would become</p> <p>=RiskOutput()+NPV(.1,G1:G10)</p> <p>when the cell is selected as an output.</p>
<p>Examples</p>	<p>=RiskOutput("Profit 1999", "Annual Profit", 1)+NPV(.1,G1:G10) identifies the cell where the RiskOutput function is located as an output and gives it the name <i>Profit 1999</i> and makes it the first cell in a multiple cell output range named <i>Annual Profit</i>.</p>
<p>Guidelines</p>	<p>If names are entered directly in the RiskOutput function, the entered output cell name and output range name must be enclosed in quotes. Names may also be included by referencing cells with labels in them.</p> <p>Position# must be a positive integer >=1.</p> <p>Note: All outputs added with TopRank will also be recognized when running a simulation with @RISK.</p>

Using @RISK Functions

@RISK's probability distribution functions may be used in TopRank Industrial to describe input variables. When an @RISK distribution function is used in TopRank Industrial, values across the percentiles of the entered probability distribution are used in a What-If analysis.

Using @RISK distributions you can:

- 1) Describe variation in value that cannot be precisely described by a Vary function, and
- 2) Conduct a What-If analysis on a model that was previously used in an @RISK simulation.

For more information on @RISK distribution functions, see your @RISK User's Guide.

Using @RISK Functions in a Multi-Way What-If Analysis

Most @RISK functions can be included in a TopRank Multi-Way What-If analysis by including the word "Multi" at the end of the function name (but before the first parenthesis that surrounds the function arguments). For example:

=RiskNormalMulti(100,10)

would identify a normal distribution to include in a Multi-Way What-If analysis. Inputs can also be identified in the Model Window table using the Multi-Way button.

The following @RISK functions cannot be defined as Multi-Way inputs:

- CURRENTITER
- CURRENTSIM
- SIMTABLE

Appendix A: Using TopRank With Other DecisionTools[®]

Palisade's DecisionTools Suite is a complete set of decision analysis solutions for Microsoft Windows. With the introduction of DecisionTools, Palisade brings you a decision-making suite whose components combine to take full advantage of the power of your spreadsheet software.

The DecisionTools Suite

The DecisionTools Suite focuses on providing advanced tools for any decision, from risk analysis, to sensitivity analysis, to distribution fitting. Software packaged with the DecisionTools Suite includes:

- *@RISK* – risk analysis using Monte-Carlo simulation
- *TopRank*[®] – sensitivity analysis
- *PrecisionTree*[®] – decision analysis with decision trees and influence diagrams
- *NeuralTools*[®] – neural networks in Excel
- *Evolver*[®] – genetic optimization in Excel
- *StatTools*[®] – statistics in Excel

While all the tools listed above can be purchased, and used separately, they become more powerful when used together. Analyze historical and fit data for use in an @RISK model, or use TopRank to determine which variables to define in your @RISK model.

This chapter explains many of the ways the components of the DecisionTools suite interact, and how they will make your decision making easier and more effective.

Note: Palisade also offers a version of @RISK for Microsoft Project. @RISK for Project allows you to run risk analyses on project schedules created in Microsoft Project, the leading software package for project management. Contact Palisade for more information on this exciting implementation of @RISK!

Purchasing Information

All of the software mentioned here, including the DecisionTools Suite, can be purchased directly from Palisade Corporation. To place an order or receive more information, please contact the technical sales department at Palisade Corporation using one of the following methods:

- *Telephone: (800) 432-7475 (U.S. only) or (607) 277-8000 Mon-Fri. from 8:30 AM to 5:00 PM, EST*
- *Fax: (607) 277-8001*
- *E-mail: sales@palisade.com*
- *Visit us on the Web: at <http://www.palisade.com>*
- *Or, mail a letter to:*
**Technical Sales
Palisade Corporation
798 Cascadilla St
Ithaca, NY 14850
USA**

To contact Palisade Europe:

- *E-mail: sales@palisade-europe.com.*
- *Telephone: +44 1895 425050 (UK).*
- *Fax: +44 1895 425051 (UK).*
- *Or, mail a letter to:*
**Palisade Europe
31 The Green
West Drayton
Middlesex
UB7 7PN
United Kingdom**

If you want to contact Palisade Asia-Pacific:

- *Email us at sales@palisade.com.au*
- *Telephone us at + 61 2 9252 5922 (AU).*
- *Fax us at + 61 2 9252 2820 (AU).*
- *Mail us a letter to:*
**Palisade Asia-Pacific Pty Limited
Suite 404, Level 4
20 Loftus Street
Sydney NSW 2000
Australia**

Palisade's DecisionTools Case Study

The Excelsior Electronics company currently makes desktop computers. They are working on a laptop computer, the Excelsior 5000, and want to know whether or not the company will profit from this venture. They built a spreadsheet model which spans the next two years, each column representing one month. The model takes into account production costs, marketing, shipping, price per unit, units sold, etc. The bottom line for each month is "Profit". Excelsior expects some initial setbacks on this venture, but as long as they are not too great and profits are up towards the end of two years, they will go ahead with the E5000.

Run TopRank First, Then @RISK

TopRank is used on the model to find the critical variables. The "Profit" cells are selected as outputs, and an automatic What-if analysis is run. The results quickly show there are five variables (out of many more) that have the most impact on profits: price per unit, marketing costs, build time, price of memory, and price of CPU chips. Excelsior decided to concentrate on these variables.

Next, Assess Probabilities

Distribution functions are needed to replace the five variables in the spreadsheet model. Normal distributions are used for price per unit and build time, based on internal decisions and information from Excelsior's manufacturing division.

Add Distribution Fitting

Research is done to get weekly price quotes for memory and CPU's over the past two years. This data is fed into @RISK's distribution fitting, and distributions are fitted to the data. Confidence level information confirms that the distributions are good fits, and the resulting @RISK distribution functions are pasted into the model.

Simulate with @RISK

Once all the @RISK functions are in place, the "Profit" cells are selected as outputs and a simulation is run. Overall, the results look promising. Although there will be losses initially, there is an 85% chance they will make an acceptable profit, and a 25% chance the venture will generate more revenue than they had initially assumed. The Excelsior 5000 project has been given the go-ahead.

Decide with PrecisionTree

Excelsior Electronics had assumed they would sell, and distribute, the Excelsior 5000 themselves. However they could use various catalogs and computer warehouses to distribute their product. A decision tree model is built using PrecisionTree, taking into account unit prices, sales volume, and other critical factors for direct sales versus catalog sales. A Decision Analysis is run, and PrecisionTree suggests using catalogs and warehouses. Excelsior Electronics puts that plan into full motion.

Introduction to TopRank®

TopRank is the ultimate *What-if* tool for spreadsheets, from Palisade Corporation. TopRank greatly enhances the standard *What-if* and data table capabilities found in your spreadsheet. In addition, you can easily step up to powerful risk analysis with its companion package, @RISK.

TopRank and *What-if* Analysis

TopRank helps you find out which spreadsheet value(s) or variable(s) affects your results the most – an automated *What-if* or sensitivity analysis. You also can have TopRank, automatically, try any number of values for a variable – a data table – and tell you the results calculated at each value. TopRank also tries all possible combinations of values for a set of variables (a Multi-Way *What-if* analysis), giving you the results calculated for each combination.

Running a *What-if* or sensitivity analysis, is a key component of making any decision based on a spreadsheet. This analysis identifies which variables affect your results the most. It shows you those factors you should be most concerned with as you 1) gather more data and refine your model, and 2) manage and implement the situation described by the model.

TopRank is a spreadsheet add-in for Microsoft Excel. It can be used with any pre-existing, or new, spreadsheet. To set up your *What-if* analyses, TopRank adds new custom “Vary” functions to the spreadsheet function set. These functions specify how the values in your spreadsheet can be varied in a *What-if* analysis; for example, +10% and -10%, +1000 and -500, or according to a table of values you’ve entered.

TopRank can also run a fully automatic *What-if* analysis. It uses powerful auditing technology, to find all possible values in your spreadsheet, which could affect your results. It can then change all these possible values automatically, and find out which is most significant in determining your results.

TopRank Applications

TopRank applications are the same as spreadsheet applications. If you can build your model in a spreadsheet, you can use TopRank to analyze it. Businesses use TopRank to identify the critical factors — price, up front investment amount, sales volume, or overhead — that most affect the success of their new product. Engineers use TopRank to show them the individual product components whose quality most affects final product production rates. A loan officer can have TopRank quickly run a model at any possible interest rate, loan principle amount, and down payment combinations, and review results for each possible scenario. Whether your application is in business, science, engineering, accounting, or another field, TopRank can work for you to identify the critical variables which affect your results.

Modeling Features

Why TopRank?

As an add-in to Microsoft Excel, TopRank links directly to your spreadsheet to add *What-if* analysis capabilities. The TopRank system provides all the necessary tools for conducting a *What-if* analysis on any spreadsheet model. And TopRank works in a style you are familiar with — Excel style menus and functions.

What-if analysis and Data Tables are functions that can be performed directly in your spreadsheet, but only in a manual, unstructured format. Simply changing a cell value in your spreadsheet and calculating a new result is a basic *What-if* analysis. A Data Table, which gives a result for each combination of two values, can also be built in your spreadsheet.

TopRank, however, performs these tasks automatically and analyzes their results for you. It instantly performs *What-ifs* on all possible values in your spreadsheet which could affect your result, instead of requiring you to individually change values and recalculate. It then tells you what spreadsheet value is most significant in determining your result.

Multi-Way What-if Analysis

TopRank also runs data table combinations automatically, without requiring you to set up tables in your spreadsheet. Combine more than two variables in its Multi-Way *What-if* analysis — you can generate combinations of any number of variables — and rank your combinations by their affect on your results. You can perform these sophisticated and automated analyses quickly, as TopRank keeps track of all the values and combinations it tries, and their results, separate from your spreadsheet. By taking an automated approach, TopRank gives you *What-if* and Multi-Way *What-if* results, almost instantly. Even the least experienced modeler can get powerful analysis results.

TopRank Functions

TopRank defines variations in spreadsheet values using functions. To do this, TopRank has added a set of new functions to the Excel function set, each of which specifies a type of variation for your values. These functions include:

- *Vary and AutoVary* functions which, during a *What-if* analysis, change a spreadsheet value across a + and – range you define.
- *VaryTable* functions which, during a *What-if* analysis, substitute each of a table of values for a spreadsheet value.

TopRank uses functions to change spreadsheet values during a *What-if* analysis, and keeps track of the results calculated for each value change. These results are then ranked by the amount of change from the original expected results. Then functions which caused the greatest change are identified as the most critical to the model.

TopRank Pro also includes over 30 probability distribution functions found in @RISK. These functions can be used, along with Vary functions, to describe variation in spreadsheet values.

How are TopRank Functions Entered?

TopRank functions are entered wherever you want to try different values in a *What-if* analysis. The functions can be added to any number of cells in a spreadsheet, and can include arguments which are cell references and expressions – providing extreme flexibility in defining variation in value in spreadsheet models.

In addition to adding Vary functions yourself, TopRank can automatically enter Vary functions for you. Use this powerful feature to quickly analyze your spreadsheets, without manually identifying values to vary and typing in functions.

Automated What-if's

When automatically entering Vary functions, TopRank traces back through your spreadsheet and finds all possible values which could affect the result cell you identify. As it finds a possible value, it substitutes in an “AutoVary” function with the default variation parameters (such as +10% and -10%) you’ve selected. With a set of AutoVary functions inserted, TopRank can then run its *What-if* analysis, and rank the values which could affect your results by their importance.

With TopRank, you can step through your Vary and AutoVary functions and change the variation each function specifies. As a default you can use a -10% and +10% variation, but for a certain value you may feel that a -20% and +30% change is possible. You can also select to not have a value varied – as in some cases a spreadsheet value is fixed and could never be changed.

Running a What-if Analysis

During its analysis TopRank individually changes values for each Vary function and recalculates your spreadsheet using each new value. Each time it recalculates, it collects the new value calculated in each result cell. This process of changing value and recalculating is repeated for each Vary and VaryTable function. The number of recalculations performed depends on the number of Vary functions entered, the number of steps (i.e., values across the min-max range) you want TopRank to try for each function, the number of VaryTable functions entered, and the values in each table used.

TopRank Results

TopRank ranks all varied values by their impact on each result cell, or output you've selected. Impact is defined as the amount of change in the output value that was calculated when the input value was changed. If, for example, the result of your spreadsheet model was 100 prior to changing values, and the result was 150 when an input changed, there is a +50% change in results caused by changing the input.

TopRank results can be view graphically in a Tornado, Spider or Sensitivity graph. These graphs summarize your results to easily show the most important inputs for your results.

Using @RISK with TopRank

What-if analysis is often the first analysis performed on a spreadsheet. Its results lead to a further refinement of the model, additional analyses and ultimately, a final decision based on the best model possible. Risk analysis, a powerful analytical technique available using TopRank's companion product, @RISK, is often the next analysis performed on a spreadsheet after a *What-if* analysis.

Moving from *What-if* to Simulation

A *What-if* analysis initially identifies what's important in your model. You can then focus on these important components and better estimate what their values could be. Usually, however, there are several or more of these important uncertain components, and, in reality, they could all vary at the same time. To analyze an uncertain model, such as this, you need risk analysis or Monte Carlo simulation. Risk analysis varies all uncertain inputs simultaneously – just as they do in real life – and builds a range and distribution of the possible results that could occur.

With risk analysis, inputs are described with a probability distribution – such as normal, lognormal, beta or binomial. This is a much more detailed description of the uncertainty present in an input's value than a simple + or – percentage variation. A probability distribution shows both the range of values possible for an input, and the likelihood of occurrence of any value in the range. Simulation combines these input distributions to generate both a range of possible results from your model, and the likelihood of any result occurring.

Using *What-if* Definitions in a Risk Analysis

The simple + and – change defined by a Vary function in a *What-if* analysis can be used directly in risk analysis. @RISK actually samples your Vary functions directly in a risk analysis.

The values sampled by @RISK from Vary and VaryTable functions, during a simulation, depend on either distribution argument entered for the function, or the default distribution setting used in TopRank. For example, the TopRank function **RiskVary(100,-10,+10)**, using a default distribution setting of Uniform and a default range type of +/- percentage, is sampled like the @RISK distribution **RiskUniform(90,110)**. VaryTable functions from TopRank are sampled as RiskDuniform functions in @RISK.

The Differences Between TopRank and @RISK

TopRank and @RISK share many common features, so it's easy to think that they perform the same functions. In fact, the two programs perform different, but complementary, tasks. Don't ask yourself "Which should I use, @RISK or TopRank?", ask yourself "Shouldn't I use both?"

The Similarities

Both @RISK and TopRank are *add-ins* for analysis of models designed in spreadsheets. By using special spreadsheet formulas, both programs explore how uncertainty affects your model, and thus the decisions you make. And, a common user-interface guarantees a smooth transition between the two products: one learning curve instead of two.

The Differences

There are three main areas where @RISK and TopRank differ:

- *Inputs* *how uncertainty is defined in your model*
- *Calculations* *what happens during an analysis*
- *Results* *what types of answers the analyses provide*

Inputs

@RISK defines uncertainty in your model using probability distribution functions. These functions define all the possible values an input can have, with a corresponding probability of that value occurring. There are over 30 probability distribution functions available in @RISK.

To define uncertainty in @RISK, you need to assign a distribution function to every value that you think is uncertain. It's up to you, the user, to determine which inputs are uncertain, and which distribution function describes the uncertainty.

TopRank defines uncertainty in your model using Vary functions. Vary functions are simple: they define possible values that an input can have without assigning probabilities to those values. There are only two basic Vary functions in TopRank – Vary and VaryTable.

TopRank can automatically define variable cells in your model every time you select an output. You don't need to know which cells are uncertain or important, TopRank identifies those cells for you.

Calculations

@RISK runs a Monte Carlo or Latin Hypercube simulation. For each iteration (or step), every @RISK distribution in the spreadsheet model takes on a new value determined by the probability distribution function. To run a thorough analysis, @RISK needs to run hundreds, sometimes thousands, of iterations.

TopRank runs a single or Multi-Way sensitivity analysis. During the analysis, only one cell (or a small number of cells) varies at a time according to the values defined in the Vary function. With TopRank, only a few iterations are needed to study a large number of uncertain cells.

Results

For each output defined, @RISK produces a probability distribution as an analysis result. The distribution describes which values an output (such as profit) could have, as well as how probable certain outcomes are. For example, @RISK can tell you whether there is a 30% chance that your company will not make a profit next quarter.

For each output defined, TopRank tells you which inputs have the largest effect on the output. The results show how much change you can expect in an output, when a given input changes by a defined amount. For example, TopRank can tell you that your company's profits are most sensitive to sales volume, and that when the sales volume is 1000 units, you will lose \$1 million. So, TopRank told you that, to make a profit, you'll need to concentrate on keeping sales volumes high.

The most important difference between the two packages is that @RISK studies how the combined uncertainty of all variables affect the output. TopRank only tells you how an individual input (or a small group of inputs) affects the output. So, while TopRank is faster and easier to use, @RISK provides a more detailed, comprehensive look at the problem.

We strongly recommend using TopRank first to determine which variables are the most important. Then, use @RISK to run a comprehensive analysis of your problem for the best possible results.

Summary

In summary, TopRank tells you what the most important variables are in your model. The results of a TopRank *What-if* analysis can be used on their own to make better decisions. But, for the most thorough analysis, use TopRank to find the most important variables in your model, then use @RISK to define uncertainty in those variables and run a simulation. TopRank can help you optimize your @RISK simulations by defining uncertainty in only the most important variables, making your simulation faster and more compact.

Introduction to PrecisionTree™

PrecisionTree from Palisade Corporation is a decision analysis add-in to Microsoft Excel. Now you can do something you've never been able to do before — define a decision tree or influence diagram directly in your spreadsheet. PrecisionTree allows you to run a complete decision analysis, without leaving the program where your data is — your spreadsheet!

Why You Need Decision Analysis and PrecisionTree

You might wonder if the decisions you make are suitable for decision analysis. If you are looking for a way to structure your decisions, to make them more organized and easier to explain to others, you should definitely consider using formal decision analysis.

When faced with a complex decision, decision makers must be able to organize the problem efficiently. They have to consider all possible options by analyzing all available information. In addition, they need to present this information to others in a clear, concise format. PrecisionTree allows decision makers to do all this, and more!

But, what exactly does decision analysis allow you to do? As the decision maker, you can clarify options and rewards, describe uncertainty quantitatively, weigh multiple objectives simultaneously, and define risk preferences. All in an Excel spreadsheet.

Modeling Features

PrecisionTree and Microsoft Excel

As an “add-in” to Microsoft Excel, PrecisionTree “links” directly to Excel to add Decision Analysis capabilities. The PrecisionTree system provides all the necessary tools for setting up and analyzing decision trees and influence diagrams. And PrecisionTree works in a style you are familiar with – Excel-style menus and toolbars.

With PrecisionTree, there's no limit to the size tree you can define. Design a tree which spans multiple worksheets in an Excel workbook! PrecisionTree reduces the tree to an easy-to-understand report right in your current workbook.

PrecisionTree Nodes

PrecisionTree allows you to define, as well as influence diagrams and decision tree nodes, in Excel spreadsheets. Node types offered by PrecisionTree include:

- *Chance nodes*
- *Decision nodes*
- *End nodes*
- *Logic nodes*
- *Reference nodes*

Values and probabilities for nodes are placed directly in spreadsheet cells, allowing you to easily enter and edit the definition of your decision models.

Model Types

PrecisionTree creates both decision trees and influence diagrams. Influence diagrams are excellent for showing the relationship between events and the general structure of a decision clearly and concisely, while decision trees outline the chronological and numerical details of the decision.

Values in Models

In PrecisionTree, all decision model values and probabilities are entered directly in spreadsheet cells, just like other Excel models. PrecisionTree can also link values in a decision model directly to locations you specify in a spreadsheet model. The results of that model are then used as the **payoff** for each path through the decision tree.

All calculations of **payoff** happen in “real-time” – that is, as you edit your tree, all **payoff** and node values are automatically recalculated.

Decision Analysis

PrecisionTree's decision analyses give you straightforward reports, including statistical reports, risk profiles and policy suggestions* (*PrecisionTree Pro only). Also, decision analysis can produce more

qualitative results by helping you understand tradeoffs, conflicts of interest, and important objectives.

All analysis results are reported directly in Excel for easy customization, printing and saving. There's no need to learn a whole new set of formatting commands, since all PrecisionTree reports can be modified like any other Excel worksheet or chart.

Sensitivity Analysis

Have you ever wondered which variables matter most in your decision? If so, you need PrecisionTree's sensitivity analysis options. Perform both one, and two-way sensitivity analyses, and generate Tornado Graphs, spider graphs, strategy region graphs (PrecisionTree Pro only), and more!

For those who need more sophisticated sensitivity analyses, PrecisionTree links directly to TopRank, Palisade Corporation's sensitivity analysis add-in.

Reducing a Tree

Because decision trees can expand as more possible decision options are added, PrecisionTree offers a set of features designed to help you reduce trees to a more manageable size. All nodes can be collapsed, hiding all paths which follow the node from view. A single subtree can be referenced from multiple nodes in other trees, saving the repeated re-entry of the same.

Utility Assessment

Sometimes you need help in creating a utility function that is used to factor your attitude towards risk into the calculations in your decision models. PrecisionTree contains features which help you identify your attitude towards risk and create your own utility functions.

Advanced Analysis Capabilities

PrecisionTree offers many advanced analysis options including:

- *Utility functions*
- *Use of multiple worksheets to define trees*
- *Logic nodes*

Using @RISK with PrecisionTree

@RISK is a perfect companion to PrecisionTree. @RISK allows you to 1) quantify the uncertainty that exists in the values and probabilities which define your decision trees, and 2) more accurately describe chance events as a continuous range of possible outcomes. Using this information, @RISK performs a Monte-Carlo simulation on your decision tree, analyzing every possible outcome and graphically illustrating the risks you face.

Using @RISK to Quantify Uncertainty

With @RISK, all uncertain values and probabilities for branches in your decision trees, and supporting spreadsheet models, can be defined with distribution functions. When a branch from a decision or chance node has an uncertain value, for example, this value can be described by an @RISK distribution function. During a normal decision analysis, the expected value of the distribution function will be used as the value for the branch. The expected value for a path in the tree will be calculated using this value.

However, when a simulation is run using @RISK, a sample will be drawn from each distribution function during each iteration of the simulation. The value of the decision tree, and its nodes, will then be recalculated using the new set of samples and the results recorded by @RISK. A range of possible values will then be displayed for the decision tree. Instead of seeing a risk profile with a discrete set of possible outcomes and probabilities, a continuous distribution of possible outcomes is generated by @RISK. You can see the chance of any result occurring.

Chance Events as a Continuous Range of Possible Outcomes

In decision trees, chance events must be described in terms of discrete outcomes (a chance node with a finite number of outcome branches). But, in real life, many uncertain events are continuous, meaning that any value between a minimum and maximum can occur.

Using @RISK with PrecisionTree, makes modeling continuous events easier, using distribution functions. Also, @RISK functions can make your decision tree smaller and easier to understand!

Methods of Recalculation During a Simulation

Two options are available for recalculation of a decision model during a simulation performed with @RISK. The first option, *Expected Values of the Model*, causes @RISK to first sample all distribution functions in the model, and supporting spreadsheets each iteration, then recalculates the model using the new values to generate a new expected value.

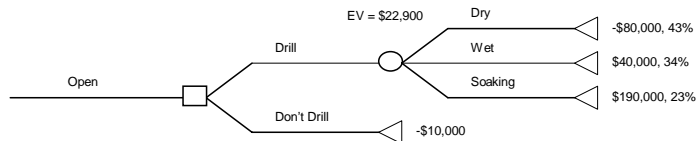
Typically the output from the simulation is the cell containing the expected value of the model. At the end of the run an output distribution, reflecting the possible range of expected values for the model and their relative likelihood of occurrence, is generated.

The second option, *Values of One Sampled Path Through the Model*, causes @RISK to randomly sample a path through the model each iteration of a simulation. The branch to follow from each chance node is randomly selected, based on the branch probabilities entered. This method does not require that distribution functions be present in the model; however, if they are used a new sample is generated each iteration and used in path value calculations. The output from the simulation is the cell containing the value of the model, such as the value of the root node of the tree. At the end of the run an output distribution reflecting the possible range of *out values* for the model, and their relative likelihood of occurrence, is generated.

Using Probability Distributions in Nodes

Let's take a look at a chance node in an oil drilling decision tree:

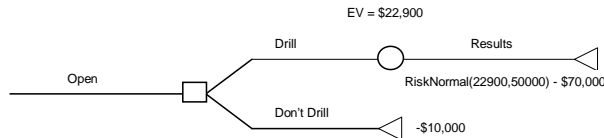
Drilling Decision for Open Test Results



The results of drilling are divided into three discrete outcomes (Dry, Wet, and Soaking). But, in reality, the amount of oil found should be described with a continuous distribution. Suppose the amount of money made from drilling follows a lognormal distribution with a mean of \$22900 and a standard deviation of \$50000, or the @RISK distribution =RiskLognorm(22900,50000).

To use this function in the oil drilling model, change the chance node to have only one branch, and the value of the branch is defined by the @RISK function. Here's how the new model should look:

Drilling Decision With a Probability Distribution



During an @RISK simulation, the RiskLognorm function will return random values for the payoff value of the Results node and PrecisionTree will calculate a new expected value for the tree.

Decision Forcing During Simulation

But, what about the decision to Drill or Not Drill? If the expected value of the Drill node changes, the optimum decision could change iteration to iteration. That would imply that we know the outcome of drilling before the decision is made. To avoid this situation, PrecisionTree has an option *Decisions Follow Current Optimal Path* to force decisions before running an @RISK simulation. Every decision node in the tree will be changed to a forced decision node, which causes each decision node to select the decision that's optimal when the command is used. This avoids changes in a decision, due to changing a decision tree's values and probabilities during a risk analysis.

Using @RISK to Analyze Decision Options

Value of Perfect Information

There may be times when you want to know the outcome of a chance event before making a decision. You want to know the value of perfect information.

Before running a risk analysis, you know the expected value of the Drill or Don't Drill decision from the value of the Drill Decision node. If you ran a risk analysis on the model without forcing decisions, the return value of the Drill Decision node would reflect the expected value of the decision *if you could perfectly predict the future*. The difference between the two values is the highest price you should pay (perhaps by running more tests) to find out more information before making the decision.

Selecting @RISK Outputs

Running a risk analysis on a decision tree can produce many types of results, depending on the cells in your model you select as outputs. True expected value, the value of perfect information, and path probabilities can be determined.

Start Node

Select the value of a start node of a tree (or the beginning of any subtree) to generate a risk profile from an @RISK simulation. Since @RISK distributions generate a wider range of random variables, the resulting graph will be smoother, and more complete, than the traditional discrete risk profile.

Appendix B: Recommended Readings

The TopRank manual has given you a start on understanding the concepts of decision analysis and What-If analysis. If you're interested in finding out more about the decision analysis techniques and the theory behind them, here are some book and articles which examine various areas in the sensitivity analysis field.

Introduction to Sensitivity Analysis

Clemen, R.T. and Reilly, T. Making Hard Decisions, 2nd Ed. with DecisionTools. Pacific Grove, CA: Duxbury Thomson Learning, 2000.

Raiffa, Howard. Decision Analysis: Introductory Lectures on Choices Under Uncertainty. Reading, MA: Addison-Wesley, 1968.

Winston, Wayne. Operations Research: Applications and Algorithms, 3rd Ed.. Belmont, CA: Duxbury Press, 1994.

Albright, S.C. et.al., Managerial Statistics. Pacific Grove, CA: Duxbury Thomson Learning, 2000.

Technical References to Sensitivity Analysis

Eschenbach, T.G. 1992. "Spiderplots versus Tornado Diagrams for Sensitivity Analysis." Interfaces. **22**: 40-46.

French, S. 1992. "Mathematical Programming Approaches to Sensitivity Calculations in Decision Analysis." Journal of the Operational Research Society. **43**: 813-819.

Appendix C: Glossary of Terms

@RISK	Pronounced “at risk,” risk analysis add-in for Excel from Palisade Corporation.
Base Case	The state of a decision model before a sensitivity analysis is run, when all variables are set to their most likely value.
BestFit	Distribution fitting add-in for Excel from Palisade Corporation.
Critical Inputs	Input factors in a spreadsheet model that can produce significant impact on the output when varied.
Critical Combinations	Combinations of inputs in a Multi-Way What-If analysis that produce significant impact on the model.
Continuous Distribution	A probability distribution where any value between the minimum and maximum is possible (has finite probability). <i>See discrete distribution.</i>
Cumulative Distribution	The set of points, each of which equals the integral of a probability distribution starting at the minimum value and ending at the associated value of the random variable.
Dependent Variable	A dependent variable is one that depends in some way on the values of other variables in the model under consideration. In one term, the value of an uncertain dependent variable can be calculated from an equation as a function of other uncertain model variables. Alternatively, the dependent variable can be drawn from a distribution based on the random number which is correlated with a random number used to draw a sample of an independent variable.
Deterministic	Indicates that there is no uncertainty associated with a given value or variable.
Deterministic Sensitivity Analysis	A sensitivity analysis where the variable is a payoff related to an event or events. <i>See Event Sensitivity Analysis, Probabilistic Sensitivity Analysis.</i>
Dimensions	Number of inputs being varied together in a Multi-Way What-If analysis. Dimensions in Multi-Way What-If analysis is equivalent to the Multi-Way Group Size.
Discrete Distribution	A probability distribution where only a finite number of discrete values are possible between the minimum and maximum. <i>See continuous distribution.</i>

Input	An input is a constant value used in a cell or formula in your spreadsheet model that affects your results.
Most Likely Value	The most likely value or mode is the value that occurs most often in a set of values. In a histogram and a result distribution, it is the center value in the class or bar with highest probability.
Mean	The mean of a set of values is the sum of all the values in the set divided by the total number of values in the set. Synonym expected value.
Multi-Way Group Size	Number of inputs being varied together in a Multi-Way What-If analysis.
Multi-Way Sensitivity Analysis	An analysis of the effect of varying multiple variables on outcome of a model. Results are typically displayed in a Multi-Way Tornado Diagram. <i>See Multi-Way Tornado Diagram.</i>
Multi-Way Tornado Diagram	A Multi-Way Tornado Diagram shows the impacts of combinations of varying inputs on the model in a bar format. The Multi-Way Tornado Diagram is usually used to display the results of Multi-Way Sensitivity Analysis.
One-Way Sensitivity Analysis	One-Way Sensitivity Analysis studies the effect of changes in individual input variables on the output values of a spreadsheet. Each input is changed individually while holding all others at their base case value. <i>See Sensitivity Analysis.</i>
One-Way Sensitivity Graph	A graph comparing a variable against the expected value of a model as the value of the variable ranges from its lower to upper bound. <i>See Sensitivity Analysis, One-Way Sensitivity Analysis.</i>
Output	A cell which you want to run a What-If analysis on that contains the result of spreadsheet calculations.
Probabilistic Sensitivity Analysis	A sensitivity analysis where the variable is the probability of a chance occurrence or occurrences. <i>See Deterministic Sensitivity Analysis, Event Sensitivity Analysis.</i>
Probability	A measure of how likely a value or event is to occur.
Probability Distribution	A probability distribution or probability density distribution is the proper statistical term for a frequency distribution constructed from an infinitely large set of values where the class size is infinitesimally small. <i>See Frequency Distribution.</i>
Range	The range is the absolute difference between the maximum and minimum values in a set of values. The range is the simplest measure of dispersion or risk of a distribution.

Risk	Uncertainty or variability in the outcome of some event or decision. In many cases the range of possible outcomes can include some that are perceived of as undesirable along with others that are perceived as desirable. The range of outcomes is often associated with levels of probability of occurrence.
Risk Analysis	Risk Analysis is a general term used to describe any method used to study and understand the risk inherent to a situation of interest. Methods can be quantitative and/or qualitative in nature.
Risk Averse	An attitude toward risky situations where a decision maker is less likely to chose a situation with a higher payoff if it includes a proportionately higher risk. There are situations where individuals may display the opposite behavior; they are risk takers.
RISKview	Distribution viewing companion for @RISK and TopRank from Palisade Corporation.
Sensitivity Analysis	A determination of which variables matter most in a decision (are most critical) by examining the impact of reasonable changes in base-case assumptions. Sensitivity analysis is useful for finding variable that have little impact on the final decision so that they can be treated deterministically.
Steps	The number of steps in a What-If or Multi-Way What-If analysis determines how many varying values are going to be tried for every identified input in a model
Spider Graph	A graph showing the reasonable limits of change for each independent variable and the unit impact of these changes on the expected value of a model.
Standard Deviation	The square root of the variance. <i>See Variance.</i>
TopRank	What-If analysis add-in to Excel by Palisade Corporation. The software discussed by this User's Guide.
TopRank Industrial	The Industrial version of TopRank featuring unlimited Multi-Way Group Size and support for @RISK distribution functions in What-If analyses.
Tornado Graph	Created after a one-way sensitivity analysis, a Tornado graph shows how much the value of an alternative can vary with changes in a specific quantity when all other variables remain at their base values.
Uncertainty	<i>See Risk.</i>
Value Sensitivity Analysis	Measuring the effects of model inputs on the decision policy by varying any value in the model and examining the effects on the optimal policy and expected value.

Variable	A basic model component that can take on more than one value. If the value that actually occurs is not known with certainty, the variable is considered uncertain. Usually a variable is found in a cell or named range in your model.
Variance	A measure of how widely dispersed the values are in a distribution, and thus is an indication of the risk of the distribution. It is calculated as the average of the squared deviations about the mean. The variance gives disproportionate weight to outliers, values that are far away from the mean.
Vary Function	Functions used by TopRank to describe the base case, minimum change of inputs, maximum change of inputs, steps, and distribution.
VaryTable Function	Functions used by TopRank for entering a table of values to be used in a What-If analysis.
VaryMulti Function	Functions used by TopRank to identify inputs which are to be included in a Multi-Way What-If analysis.
What-If Analysis	Any method used to study and understand the risk inherent to a situation of interest. Methods can be quantitative and/or qualitative in nature. <i>Synonym: Sensitivity Analysis.</i>
What-If Value Table	A table of values to be substituted for an input in a What-If analysis. <i>See VaryTable.</i>

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