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Chapter 1: Welcome to TopRank

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

**TopRank and What-If Analysis**

TopRank uses an automated What-If analysis to help you determine which of your model inputs affect your “bottom line” results the most. TopRank typically varies the value of each input, one input at a time, to see the effect of that input. However, TopRank can also run a Multi-Way analysis, where it tries all possible combinations of values for a set of inputs and shows you the results for each combination.

*Note: In this document, the terms What-If analysis and Sensitivity analysis are interchangeable.*

A spreadsheet model refers to any Microsoft Excel workbook where *inputs* lead directly or indirectly through Excel formulas to *outputs*. The value in an input cell is a number you might want to vary, either because it is a value you control, such as a price, or it is a value not known with certainty, such as the demand for a product. In either case, you want to see how changes in the input value affect an output of interest, such as profit or total cost.

Running a What-If analysis is a key component of making any decision based on a spreadsheet model. This analysis identifies which inputs affect your outputs the most. This identifies 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 model. To set up your What-If analyses, TopRank adds new custom “Vary” functions to Excel’s built-in set of functions. These TopRank functions specify how the input values will be varied in a What-If analysis. For example, some
possibilities are: from -10% to +10%, from -500 to 1000, 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 inputs in your

spreadsheet model that could affect your outputs. It can then vary the

values of these inputs automatically and determine which have the

most effect on your outputs.

TopRank applications are the same as spreadsheet applications. If you

can build your model in Excel, you can use TopRank to analyze it.

Businesses use TopRank to identify the critical factors—price, initial

investment cost, sales volume, or overhead—that most affect the success

of a new product. Engineers use TopRank to identify 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 rates, loan amounts, 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 inputs that affect your outputs.

**Modeling Features**

As an add-in to Microsoft Excel, TopRank links directly to Excel to add

What-If analysis capabilities. TopRank 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.

You probably already perform What-If analysis in Excel in an ad hoc

manner, by changing input values in various cells and seeing how

outputs change. You might even use Excel’s data tables to vary one or

inputs in a systematic manner to see their effect on outputs. The

advantage of TopRank is that it performs these tasks automatically and

analyzes the results for you. It instantly performs What-If analysis on

all input variables in your spreadsheet model that could affect your

outputs, instead of requiring you to individually change values and

recalculate. It then shows the What-If results in easily understandable

reports and graphs.

TopRank also runs data table combinations automatically, without

requiring you to set up tables in your spreadsheet. You can combine

more than two variables in its Multi-Way What-If analysis, and then

you can rank the combinations of input values by their affect on your

outputs. 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.

TopRank defines variations in input variables by using functions. To do this, TopRank adds a set of new functions to the Excel function set, each of which specifies a particular type of variation for your inputs. These functions include RiskVary, RiskAutoVary, RiskVaryTable, RiskVaryMulti, and RiskVaryMultiTable. Each of these “Vary” functions specifies how one or two inputs will vary in a What-If analysis. Their specific definitions are provided later in this manual.

Note: TopRank includes the five “Vary” functions just listed. Each of these has a slightly different behavior. In the following discussion, they are sometimes referred to by their specific names, such as RiskVary, and sometimes more generically as “Vary” functions (to indicate that the explanation applies to more than one of these functions). Just remember that there is no function spelled “Vary”; each such function starts with “Risk”.

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 input values.

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 model, and they can include cell references and expressions as arguments. This provides extreme flexibility in defining variation in inputs in spreadsheet models.

TopRank can even automatically enter “Vary” functions for you. (In this case, the “Vary” functions are RiskAutoVary.) You can use this powerful feature to quickly analyze your spreadsheet model, without manually identifying variables to vary and typing in functions.

When automatically entering RiskAutoVary functions, TopRank traces back through your spreadsheet and finds all possible input cells that could affect the output cell you identify. When it finds such an input cell, it substitutes in a RiskAutoVary function with the default variation parameters (such as -10% to +10%) you have selected. With a set of RiskAutoVary functions inserted, TopRank can then run its What-If analysis, ranking the variables in order of importance.

With TopRank, you can step through your “Vary” and functions and change the variation each function specifies. The default is to use a -10% to +10% variation, but you can change this as you like. You can also select to not vary an input in case its 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 model using each new value. Each time it recalculates, it collects the new value calculated in each output cell. This process of changing value and recalculating is repeated for each “Vary” function. The number of recalculations performed depends on the number of “Vary” functions entered and the number of input values for each function.

TopRank Results

TopRank ranks all varied values by their impact on each output you have selected. Impact is defined as the amount of change in the output value that was calculated when the input value was changed. For example, if an output value is initially 100, and it changes to 150 when an input value changes, there is a +50% change caused by changing the input value.

TopRank results can be view graphically in a tornado, spider, or sensitivity graph. These graphs summarize your results so that you can easily see the inputs with the largest effects on your outputs.

What-If Analysis and Risk Analysis

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

Moving from What-If to Simulation

What-If analyses initially identify the most important inputs in your model. You can then focus on these important inputs 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 with 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, uncertain inputs are described with probability distributions such as normal, lognormal, beta, and binomial. A probability distribution is a much more detailed description of the uncertainty present in an input’s value than a simple +/- 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.
The simple +/- change that defines the inputs to a What-If analysis can be refined to create the probability distributions required for a Risk analysis. TopRank’s What-If inputs can be directly used in a Risk analysis using @RISK.

**Sensitivity Analysis Using Risk Analysis**

A sensitivity analysis can be conducted on the data generated by a Risk analysis to identify the inputs that most affect outputs. This is a robust and highly refined form of sensitivity analysis. It uses simulation data where all inputs were changed simultaneously. In many cases, it just confirms the results of your initial TopRank What-If analysis, but there are times when there can be differences in the results. Assuming the simulation model is properly specified, the sensitivity analysis results from the simulation are the ones you should use.

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 to see how changes in assumptions affect your results.
Sensitivity Analysis in @RISK versus TopRank

For a simple What-If calculation, TopRank determines how a single input affects the output by changing only the value of that 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 process of finding and defining inputs, and it needs to run only a few iterations to obtain meaningful results. Then it provides answers in an easy to understand format. For example, a spider graph indicates exactly how much a given % change in an input affects the output.

The disadvantage of a TopRank sensitivity analysis is that is does not take the simultaneous variability of other inputs into account. The Multi-Way sensitivity analysis compensates for this weakness to an extent, but it does not provide the same level of information as @RISK.

In an @RISK simulation, the value of each input changes simultaneously. Data are collected for both the inputs and the output, and the sensitivity analysis is performed with one of several methods.

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. Also, even though the results tell you which inputs have the greatest effect on an output, 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. Also, correlations between inputs are always reported in the results.

We recommend using TopRank and then @RISK in most situations. TopRank is quick and easy, and it present results in an easy-to-interpret form. Then you can use @RISK for a more in-depth analysis.
Why TopRank First?

If you are still wondering whether you should use TopRank before an ultimate @RISK analysis, here are some of its benefits.

- **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 +/– change is easier and more understandable than the probability distributions required by Risk analysis with @RISK.

- **It saves time for a subsequent Risk analysis.** Quickly identifying the most critical inputs with a TopRank What-If analysis saves time when developing a Risk analysis model with @RISK. You can then concentrate your efforts in defining probability distributions for those most important inputs. Describing the range and shape of a probability distribution can be time-consuming so it’s easier if you can focus on a more limited set of inputs.

- **Its results are understandable and accessible.** 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.

- **For some analyses, there’s not enough time for Risk analysis.** Many decision makers deal with reams and reams of models—some more critical, some less. They don’t have the time to build a simulation model for all cases. A quick TopRank What-If, however, gives them useful information in little time for the less crucial decisions.
**Conclusions**

What-If analysis is a powerful technique that has gained great popularity with the advent of the spreadsheet and the personal computer. TopRank’s 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 with @RISK.
Chapter 2: Getting Started

Introduction

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

About This Version

This version of TopRank can be installed with Microsoft Excel 2007 or higher.

Working with your Operating Environment

This manual 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, ribbon, and window.
- You understand basic concepts such as directory (folder) structures and file naming.

If You Need Help

Palisade provides free technical support to all registered users of TopRank with a current maintenance plan. Technical support is also 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 Palisade by telephone, please have your serial number and this online manual handy. We can offer better technical support if you are at your computer and ready to work.
Before Calling

Before contacting technical support, please review the following checklist:

- Have you consulted the relevant sections of this online manual?
- Have watched the online Quick Start videos available from the TopRank Welcome screen?
- Have you read the README file? It contains current information on TopRank that might not be included in this manual.
- Can you duplicate the problem consistently? Can you duplicate the problem on a different computer or with a different model?
- Have you consulted our Web site, http://www.palisade.com? This Web site contains the latest FAQ (a searchable database of tech support questions and answers). 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 @RISK. 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:

  Technical Support
  Palisade Corporation
  798 Cascadilla St
  Ithaca, NY 14850
  USA

If you want to contact Palisade Europe:

- Email us at support@palisade-europe.com.
- Telephone us at +44 1895 425050 (UK).
- Fax us at +44 1895 425051 (UK).
- Mail us 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 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 About TopRank command on the Help menu on the TopRank ribbon.

**Student Version** 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.
- Go to [http://www.palisade.com](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 for Microsoft Excel for Windows include:

- Microsoft Windows XP or higher.
- Microsoft Excel 2007 or higher.
Installation Instructions

General Installation Instructions

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

1. Double-click the TopRank Setup.exe (or the DTSuite Setup.exe) from your download or installation CD.
2. 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 have freed up adequate space, try rerunning the installation.

If you wish to remove TopRank from your computer, use the Control Panel’s Add/Remove Programs utility and select the entry for TopRank (or the DecisionTools Suite).

Removing TopRank from Your Computer

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 subfolder of a main Program Files\Palisade (or Program Files (x86)\Palisade) folder.

One subfolder of this Palisade folder will be the TopRank folder (by default called TopRank7). This folder contains the program files, plus example models and other files necessary for TopRank to run. Another subfolder of the Palisade folder is the SYSTEM folder. This contains files required by every add-in in the DecisionTools Suite, including common help files and program libraries.
Software Activation

Activation is a one-time license verification process that is required for your Palisade software to run as a fully licensed product. An activation ID such as DNA-6438907-651282-CDM is on your printed/emailed invoice. If you enter your activation ID during installation, your software is activated at the end of the installation process and no further user action is required. If you need to activate your software after installation, you should select the License Manager command on the TopRank Help menu.

The License Manager can be used to activate, deactivate, or move software licenses. It can also be used to manage licenses for network installations. You can follow the prompts and dialogs in the License Manager to perform the desired licensing operation.
Instructional Materials

The TopRank package includes a number of instructional materials to help you learn TopRank features and how to model with TopRank.

Example Spreadsheets

TopRank includes several example spreadsheets. Some of these examples illustrate specific features of TopRank, whereas others illustrate potential uses of TopRank in various fields. These examples not only help you learn how to use TopRank, but they illustrate how extensively TopRank can be applied.

You can find these example spreadsheets from the TopRank Help menu. When you click its Example Spreadsheets command, an “example file list” file opens in Excel. This file contains links to all of the example files.

Quick Start Tutorials

From the TopRank Welcome screen, which you see when you launch TopRank or you can access at any time from the TopRank Help menu, you can click the Quick Start link to see a series of short videos that lead you through the basic features of TopRank. These Quick Start videos are intended for beginners, but they are sufficient to get you started creating your own TopRank models.

Guided Tour Videos

A series of Guided Tour videos is also available from the TopRank Welcome Screen. These are more in-depth videos, and they lead you through practically all of the TopRank features, from simple to more complex.
Chapter 3: Overview of TopRank

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:

- **Input** is a constant value in a cell or formula in your spreadsheet model that affects your results.
- **Output** is a cell on which you want to run a What-If analysis.
- The **base case** of an input is the number you entered in the model when you first designed the model. When the input contains uncertainty, this is 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 that shows the likelihood of a value in an input’s minimum-maximum range occurring.
- A **What-If Table** is a table of values to be substituted for an input in a What-If analysis.
- **RiskVary**, **RiskAutoVary**, and **RiskVaryTable** are TopRank functions used to describe the base case, minimum change, maximum change, steps, distribution, and/or 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 input values.
- **RiskVaryMulti** and **RiskVaryMultiTable** are TopRank functions used to identify the inputs 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.

**One-Way What-If Analysis**

A One-Way What-If analysis studies the effect of changes in individual input values on the output values of a spreadsheet model. The inputs are changes, one at a time, while holding the other inputs at their base case values. In TopRank, a One-Way What-If analysis is conducted on all inputs identified with several custom TopRank “Vary” functions.

**Defining a What-If Input**

Inputs to be changed in a One-Way What-If analysis can be identified individually by you or automatically by TopRank. At a minimum, each TopRank input is defined by three values: its base value (the one originally present in the model), its possible downside (negative) change, and its possible upside (positive) change. Negative and positive changes are typically entered as percentages, such as -10% or +20%. (It is also possible to enter an actual change, such as -1000 or +950, or an actual minimum and maximum value, such as 100 or 200.)

**RiskVary Functions**

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

- \( \text{RiskVary}(100,-10,+10) \), indicating a base case of 100 and a possible -10% and +10% change.
- \( \text{RiskVary}(50,-45,+10) \), indicating a base case of 50 and a possible -45% and +10% change

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

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

**RiskVaryTable Functions**

If there is a table of possible values you want to try for an input, you should use the \( \text{RiskVaryTable} \) function. With RiskVaryTable, you enter a base value and a reference to the location in the spreadsheet that contains the table of values. Alternatively, you can also enter the table...
of values directly in the function itself. Typical RiskVaryTable functions are:

- \( \text{RiskVaryTable}(100, \text{G1:G50}) \), where 50 values located in the range G1:G50 are successively returned by the RiskVaryTable function during the What-If analysis and new output values are calculated for each.

- \( \text{RiskVaryTable}(42, \{40,42,44,46,48\}) \), where five different values (even integers from 40 to 48) are successively returned by the RiskVaryTable function during the What-If analysis and new output values are calculated for each. The base value is 42.

### Letting TopRank Define What-If Inputs

You can enter RiskVary and RiskVaryTable functions directly in your spreadsheet model, just like any standard Excel functions. However, TopRank also includes a powerful automatic mode where RiskAutoVary functions are automatically inserted in your spreadsheet model for all inputs that could affect each output you select. That is, TopRank can automatically search your spreadsheet model for all cells that are precedents, direct or indirect, of each output cell. With this option, TopRank can identify inputs either when you start an analysis or when you add an output.

You could perform automatic detection yourself, but it would be tedious. For each cell, you would try varying its value to see whether a particular output ever changes. If it does, then this is an input cell for that output; otherwise, it isn’t. Fortunately, TopRank automates this simple but tedious process for you.

When TopRank detects inputs for you, it automatically inserts a RiskAutoVary function for each input it finds that could affect your output. These RiskAutoVary functions use a default +/- variation that you select, such as from -20% to +20%. For example, TopRank can enter:

\[ \text{=RiskAutoVary}(50, -10, +10) \]

This indicates a base case value of 50 and a possible -10% to +10% change. This is the equivalent to the function

\[ \text{=RiskVary}(50, -10, +10) \]

The “Auto” identifies it as a function entered automatically by TopRank.

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

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

**Note:** A RiskAutoVary function is simply a RiskVary function that was automatically added to your spreadsheet model by TopRank. If you change argument values in a RiskAutoVary function via the Add Input dialog, the function will change to a RiskVary function.

### 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.

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

If a table of values is entered using the RiskVaryTable function, such as `RiskVaryTable(100,G1:G100)`, TopRank calculates spreadsheet results for each of the values entered in the table.
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, as in `RiskVary(100,-10,+10, „Uniform”), any value in the min-max range described by the RiskVary function is equally likely to occur.

Four distribution types are available with TopRank. They are:

- **Uniform**
- **Triangular**
- **Trigen**
- **Normal**

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 an 80% chance of a higher value occurring. TopRank always returns the 0% percentile (minimum) and the 100% percentile (maximum), except for unbounded distributions such as the Normal, where it returns the 5% and 95% percentile instead. Additional steps are spread equally on a percentile basis across the min-max range. For example, if you request five steps, TopRank returns values for the minimum and maximum, plus the 25%, 50%, and 75% percentiles from the distribution you specify.
Adding Inputs by Cell

TopRank makes it easy to examine values in your spreadsheet model and add, change, update, or remove Vary 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 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 the necessary Vary function in the spreadsheet formula to match the parameters you’ve selected for an input. You can also easily remove any Vary functions you don’t want.
Viewing All Model Inputs and Outputs

You can click the Model Window icon on the TopRank ribbon to display the Model window. This lists all selected output cells and all identified input “Vary” functions in your workbook(s).

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. You simply enter the new Min or Max value you want, or use the drop-downs to select a value from the list.

**Note:** The Model window lists inputs and outputs for all open workbooks, not just the active workbook. This can be confusing if you open a new example model and forget to close another example model. In this case, the inputs and outputs from both models will appear in the Model window.
Running a One-Way What-If Analysis

Once you have identified inputs and outputs, you click the the **Run What-If Analysis** icon on the TopRank ribbon to start a what-if analysis. TopRank first locates all Vary functions in your model. 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:

![TopRank - Run What-If Analysis dialog box](image)

Following the Status dialog, TopRank runs the analysis. During the analysis, TopRank changes the values returned by each Vary function, one at a time, recalculates the spreadsheet, and collects and stores the new output values. The values returned by each Vary function depend on the min-max range you entered for the function, the number of steps, and the distribution selected.
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 analyzed, all are returned to their original base values and the ranking of results is performed.

**Results from a One-Way What-If Analysis**

The standard results of a One-Way What-If analysis are a set of rankings of inputs by their impact on your outputs. As always, inputs refer to cells with Vary functions, and outputs refer to cells you designated as such prior to the analysis.

A different ranking is made for each selected output cell (because inputs have different effects on different outputs). For example, a Vary function used for Labor Cost for Factory 1 can affect the output Profit for Factory 1 but have no effect on the 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’s Vary function to a new value. The amount of change is measured as a percentage change. This is calculated using the formula:

\[
\% \text{ change} = \frac{\text{New Output Value} - \text{Base Value}}{\text{Base Value}}
\]
Graphical Results from a One-Way What-If Analysis

Three 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 way to view different aspects of What-If analysis results.

Tornado Graphs

A tornado graph compares the effects of all inputs on a given output. The X-axis is drawn in the units of change (% 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 is plotted on the top of the graph, and the variables proceed down the Y-axis with decreasing range.

The tornado graph makes it obvious which inputs have the greatest effects on an output’s value; they are the inputs at the top of the graph. The tornado graph can summarize the impact of many inputs in a simple and compact graph.
Spider Graphs

A spider graph also compares the effects of multiple inputs on a single output. For each input, 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 indicates the relative change in the output per unit change in the input. The shape of the curve shows whether a linear or nonlinear relationship exists between the input and the output.

Spider graphs actually provide more information than tornado graphs. Spider graphs show the reasonable limits of change caused by each input and the unit impact of these changes on the output. While tornado graphs may lead you to believe that output changes are proportional to input changes, the slope of spider graphs can indicate nonlinear behavior.

The number of variables used in a spider graph should not exceed 7, but a limit of 5 is recommended to avoid clutter. If your What-If analysis contains a large number of inputs, it is a good idea to plot them on a tornado graph first to determine which inputs have the greatest impact. Then you can use only these inputs for your spider graph.
Sensitivity Graphs

A sensitivity (or What-If) graph is a simple graph plotting the output value (Y-axis) versus an input value (X-axis). There is one such graph for each input.

![Sensitivity Graph](image-url)
What is Multi-Way What-If Analysis?

A Multi-Way What-If analysis studies the impact of combinations of several inputs on one or more outputs. In a Multi-Way What-If analysis, combinations of inputs are varied simultaneously and the results calculated by each combination are 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 by using the “Multi” form of the Vary and VaryTable functions. RiskVaryMulti and RiskVaryMultiTable functions identify those inputs to be included in a Multi-Way What-If analysis. These functions are identical in form and arguments to standard RiskVary and RiskVaryTable functions.

Group Size

All RiskVaryMulti and RiskVaryMultiTable 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 RiskVaryMulti and RiskVaryMultiTable functions—Price, Sales Volume, Production Costs, and Investment—and you want to see the impact of every combination of two inputs on the Profit output. In this case, the Group Size is 2. Your analysis might tell you that Price and Sales Volume varying together are the most significant combination affecting Profit. Setting the Group Size to 3 might identify the combination of Price, Sales Volume, and Investment as the most important 3-way combination of inputs on Profit.
Defining Multi-Way What-If Inputs

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

- Directly changing the selected RiskVary and RiskVaryTable functions in your spreadsheet to their equivalent RiskVaryMulti and RiskVaryMultiTable forms, or,

- Highlighting the RiskVary and RiskVaryTable inputs in the Model window list, right-clicking, and selecting Multi-Way.

RiskVaryMulti and RiskVaryMultiTable functions take the same arguments as do RiskVary and RiskVaryTable functions. The Multi option just instructs TopRank to run a second analysis (following the standard One-Way What-If analysis) that tries all Multi-Way combinations using Multi functions in your model. RiskVaryMulti and RiskVaryMultiTable functions are also evaluated as standard RiskVary and RiskVaryTable 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

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 cells with `RiskVaryMulti` or `RiskVaryMultiTable` functions. 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.

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

- The number of `RiskVaryMulti` and `RiskVaryMultiTable` functions in your spreadsheet.

- The **#Steps** entered in `RiskVaryMulti` functions or number of values in the table for each `RiskVaryMultiTable` function. If no #Steps is entered in a `RiskVaryMulti` function, the default Multi-Way What-If #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; there is no Group Size limit in the Industrial version.

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

![TopRank - Analysis Settings dialog](image-url)
The number of calculations required to complete a Multi-Way analysis grows exponentially with increases in each of these three parameters, so user beware! When a large number of RiskVaryMulti and RiskVaryMultiTable functions are included in your spreadsheet model, it is important to keep the Group Size small to limit the total number of recalculations required.

There are certain analyses that 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 similar to using an Excel two-way data table, where two inputs are varied simultaneously and an output is reported in the table.

In TopRank, a data table calculation can be performed with a Multi-Way What-If analysis. You set the Group Size equal to the number of Multi-Way inputs. Then the results are calculated for all possible combinations of input values. Unlike an Excel data table, a TopRank Multi-Way data table can have any number of inputs, each at any number of steps. That is, you are not limited to two inputs.

**Results from a Multi-Way What-If Analysis**

The standard results of a Multi-Way What-If analysis are a set of rankings of combinations of inputs by their impact on outputs. The inputs all refer to cells with RiskVaryMulti or RiskVaryMultiTable functions, and the outputs are all cells designated as such 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 include:

- A grid that details the output values generated and input values used in each combination (top screenshot above), and

- A list of combinations of inputs, ranked by their impact on an output, for each designated output (bottom screenshot above).

You might want to use the first of these for further analysis. For example, you could break down the results with a pivot table.

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:

\[
\frac{(\text{New Output Value} - \text{Output Base Value})}{\text{Output Base Value}}.
\]
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 graph represents the change in an output 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.
### TopRank Icons

The following icons appear on the TopRank ribbon.

<table>
<thead>
<tr>
<th>Icon</th>
<th>Function Performed</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Add Input" /></td>
<td>Adds a TopRank input</td>
</tr>
<tr>
<td><img src="image" alt="AutoVary Functions" /></td>
<td>Adds or removes AutoVary functions</td>
</tr>
<tr>
<td><img src="image" alt="AutoVary Functions" /></td>
<td>Adds a TopRank output</td>
</tr>
<tr>
<td><img src="image" alt="Model Window" /></td>
<td>Displays a table of TopRank inputs and outputs</td>
</tr>
<tr>
<td><img src="image" alt="Analysis Settings" /></td>
<td>View or change TopRank settings for identifying and changing inputs and running multi-way analyses</td>
</tr>
<tr>
<td><img src="image" alt="Report Settings" /></td>
<td>View or change TopRank reporting options</td>
</tr>
<tr>
<td><img src="image" alt="Run What-If Analysis" /></td>
<td>Run a TopRank What-If analysis</td>
</tr>
<tr>
<td><img src="image" alt="Swap Functions" /></td>
<td>Swap TopRank Functions in and out</td>
</tr>
<tr>
<td><img src="image" alt="Utilities" /></td>
<td>Display TopRank Utilities</td>
</tr>
<tr>
<td><img src="image" alt="Help" /></td>
<td>Display TopRank Help options</td>
</tr>
</tbody>
</table>
TopRank Commands

The TopRank commands discussed in depth in this section fall into three groups, as indicated on the TopRank ribbon.

Model Group

The commands in this group let you add inputs and outputs, and they let you view your current inputs and outputs.

Analysis Group

The commands in this group allow to change settings for the way a What-If analysis is run and the types of reports it generates, as well as to run a What-If analysis.

Utilities Group

The commands in this group allow you to swap out TopRank functions (for users without TopRank) and to access a variety of utilities and help documents.
Add Input Command

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

The Add Input command (in the Model group) displays the formula for each cell you select while the Add Input dialog is displayed. The Add Input dialog makes it easy to modify the parameters of “Vary” functions without typing the functions directly in your spreadsheet. You can use the Add Input command to view or define the variability in your input values.

As you select different cells while the Add Input dialog is open, the dialog changes to show the formula and functions in the new cell. Values and functions in a displayed formula are selected by clicking 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. You can do this by either:

- Typing directly in the formula, or
- Clicking Add Input to replace a value with a RiskVary 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.

When you click OK (or select another cell), formulas in Excel are updated with any changes you have made in the Add Input dialog.
The options available in the Add Input dialog include:

- **Name.** This displays the name of the current input. You can type in a new name or 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. You can select any part of this formula to add a new TopRank function to the formula, replace a 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 of the function.

- **Min, Base, Max.** You can select the desired Min-Base-Max range by using the dropdown lists or by typing values. Note that there is a Reference entry button in the dropdown list to allow you to reference cell values.

- **Add Input and Remove Input.** If you are replacing an existing fixed value in a formula with a Vary function, you should click the Add Input button. This adds the new function to the formula. You can click Remove Input to remove an existing function from a formula and replace it with its base value.
The Input Properties dialog, displayed by clicking the $fx$ icon, allows you to add or change additional options for an entered function.

Options in the Input Properties dialog 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) or enter actual Min-Max values for the range (Actual Min and Max). You can also specify a table of values (Table of Values (Excel Range) or Table of Values (actuals)) with a RiskVaryTable function. Finally, the @RISK Distribution allows you to enter a probability distribution supported by @RISK.

- **Distribution** is one of four possible distribution type: Uniform, Triang, Normal, or Trigen. This determines the input values (percentiles of the distribution) that will be used as the input varies through its min-max range.

- **Steps** is the number of values across an input’s min-max range to be used in a What-If analysis.

- **Category** assigns the input to a category to be used in grouping related inputs together. Categories are discussed later in this section.

- **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 a What-If analysis.
For more information on the possible settings for these arguments to “Vary” functions, see the Analysis Settings Command section of this manual.

In the Input Properties dialog, when Type of Range is set to Table of Values (Excel Range), the Reference entry button lets you select a cell range with the values you want to use in the RiskVaryTable 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), you can enter values in the displayed grid, and these values will be used in the RiskVaryTable function.
Add AutoVary Functions Command

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

The AutoVary Functions Command (from the AutoVary Functions menu in the Model group) adds RiskAutoVary functions for outputs in your worksheets. First, all inputs that affect your designated outputs are identified by TopRank using the criteria specified in the Analysis Settings dialog. Then, RiskAutoVary functions are substituted for identified input values.

Remove AutoVary Functions Command

Removes all AutoVary functions from open workbooks

The Remove AutoVary Functions command (from the AutoVary Functions menu in the Model group) removes all RiskAutoVary functions from all open workbooks.
Add Output Command

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

The Add Output command (in the Model group) adds the currently selected range of worksheet cells as a What-If analysis output. You do this so that a analysis. Outputs are also evaluated in a Multi-Way What-If analysis. In this case, a ranking of how combinations of inputs affect the output is generated.

To add an output for a single cell, select the cell in your spreadsheet and click the Add Output icon.

Adding a Single Output Cell

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.

Naming an Output

You can change an output name at any time by:

- Editing the name argument of 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.
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 can 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(0.1,H1:H10)

This cell, prior to its selection as an output, contained the formula

= NPV(0.1,H1:H10)

This RiskOutput function designates the cell as an output and gives the output the name Profit.

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

1) Select the range of cells in your spreadsheet that you want to add as an output range.

2) Click the Add Output icon.

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.

You can use the **Insert** or **Remove** buttons to remove individual cells from an output range.

**Removing an Output**

To remove an output, select the output cell in your spreadsheet and click the Add Output icon. Then click the Remove (or Delete Output Range) button to delete the output (or output range).

Alternatively, you can remove outputs from the Model window by right-clicking the outputs to remove and selecting Delete.
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 command (in the Model group) opens the TopRank Model window opens. This window lists all selected output cells and all identified input functions in your workbook(s).

For each input or output, 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 or output cell.
- **Function**. The function cell for an input shows the Vary function (or @RISK distribution function) 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 can be edited, as follows:

- **Name**. The name of an input or output can be changed by clicking 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 can edit the function in this table, or you can 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. You can select the desired Min-Max range using the dropdown lists, or you can type a Min, Base, or Max value. Optionally, you can click the Reference entry button to select cell(s) in your spreadsheet with the desired values.

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 toward the top, 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 “nice” names. However, in some spreadsheets, automatic naming creates meaningless labels. In these cases, you should edit the names displayed in the Model window table to make them more meaningful.

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 manual.
When you right-click one or more selected items in the Model window to get a pop-up menu. This can be used to access additional options for the selected items in the table.

Commands available on the right-click menu include:

- **Arrange.** The Arrange menu commands allow you to arrange inputs by categories and copy the variation in value for an input across all inputs in a category. For outputs, the Arrange commands allow you to arrange outputs by output range. The Arrange (middle) icon at the bottom of the window can also be used to access the Arrange options. For more information on Arrange commands, see *The Arrange Menu* in this section.

- **Lock Input.** The Lock Input command specifies whether the “Vary” function (or @RISK distribution function) will be "stepped across" during a What-If analysis. If Lock is selected, the Vary function or distribution will return its base 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 includes a *RiskLock* property function as an argument. 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 manual.
• **Multi-Way.** This changes a “Vary” function to its Multi-Way form for use in a Multi-Way What-If analysis, or it removes a Multi-Way form. You can also select TopRank functions for inclusion in a Multi-Way What-If analysis by directly changing the functions in your spreadsheet to their Multi-Way form. Specifically, `RiskVary` can be changed to `RiskVaryMulti`, or `RiskVaryTable` can be changed to `RiskVaryMultiTable`. To change @RISK functions to their Multi-Way form, you should add the word “Multi” to the end of the function name, as in `NormalMulti` or `DiscreteMulti`.

• **Function Properties.** This command allows you to add or change additional options for a 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.** This command allows you to edit a function in Excel, where you can easily add references to the entered formula.

• **Delete.** This removes any Vary function or @RISK distribution functions 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 you click the OK button, dismissing the Model window.

**Arrange Menu**

The Model window table can be arranged by category or output range name using the commands on the **Arrange** menu. For inputs, a category typically defines a group of related inputs, such as Development Costs or inputs in the year 2015. 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 can 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 (middle) icon at the bottom of the window can also be used to access the Arrange menu commands.

The **Group Inputs By Category** command specifies whether 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.

The **Group Outputs By Range Name** command specifies whether 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.
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 earlier section **How Are Default Names Created** of this manual describes how default names are generated for an input using a row heading and a column heading in your spreadsheet. The row heading part 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, as in Profit / 2015. 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 with a RiskName function, as long as a “/” separator is included. For example, the input:

```
=RiskVary(100,-10,10,RiskName("R&D Costs / 2015"))
```

will be included in a default category named “R&D Costs” if the Default Categories command Row Heading command is checked, and it will be included in a default category named “2015” if the Default Categories command Column Heading command is checked.

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 input(s).
When you assign an input to a category, 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.

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 want to copy to a single input in the category.

2) Right-click 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.

The Model window table is set up automatically when you click the Model Window icon to display the table. When the table is displayed, your worksheets are scanned (or re-scanned) to locate TopRank Vary functions, @RISK distribution functions, and RiskOutput functions.

As new functions are found, they are added to the Inputs and Outputs lists. These lists summarize all your input and output 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 Find Inputs tab of the Analysis Settings dialog.
Analysis Settings Command

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

The Analysis Settings command (in the Analysis group) opens the Analysis Settings dialog. These settings affect the nature of a What-If analysis and the TopRank functions used in it. All settings have default values that can be changed.

The What-If analysis settings affect the minimum and maximum range TopRank uses in RiskAutoVary 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

The Input Defaults tab sets the default changes automatically applied to TopRank inputs.
Options in the Input Defaults tab include **Type**, **Minimum**, **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 base value.
- **+/− Change From Base**, or + value and - value from the 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, we recommend that a default % Change From Base range type be used so that ranges can be more meaningfully applied to the inputs that 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 of the function.*

**Minimum and Maximum**

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

When TopRank inserts RiskAutoVary functions when identifying inputs, the minimum and maximum you specify are inserted into each newly created RiskAutoVary function. Of course, you can edit this range at any time by directly modifying the RiskAutoVary function in the spreadsheet or by using the Add Input command.

The minimum and maximum values entered here will also be the defaults displayed when the Add Input dialog is used.

You will see the option to update existing Vary functions when you change default minimum and maximum values and exit the Analysis Settings dialog. By using this, you can quickly change existing Vary function ranges, allowing a new analysis under different assumptions.
Either **AutoVary functions only** or **all Vary functions and AutoVary functions** can be updated. Use this with care as it will overwrite current arguments for existing Vary functions.

**Distribution**

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

TopRank steps across the min-max range 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 an 80% chance of a higher value occurring. TopRank returns the 0% percentile (minimum) and the 100% percentile (maximum), although the Normal and Trigen distributions are handled slightly differently as explained below. Additional steps are spread equally on a percentile basis across the min-max range. For example, if you select five steps, for example, TopRank returns values for the min and max, plus the 25%, 50% and 75% percentiles.

**Converting Min-max Ranges to Distribution Parameters**

For Trigen 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 Trigen distribution has minimum, most likely, and maximum parameters, plus a percentile location for the minimum and maximum values. For the Trigen 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,, „Trigen“)` 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 two arguments, the mean and the standard deviation. If you select Normal, the RiskVary function’s minimum and maximum values are set equal to the 5th and 95th percentiles of a Normal distribution, with the mean located halfway between the two values. Using this information, TopRank generates a Normal distribution with the appropriate mean and standard deviation to include the 5th, mean, and 95th percentile values.

**Note:** The default distribution setting, Uniform, is used when a distribution type has not been explicitly entered as a Vary function argument. You can change this default in the Application Settings dialog.
The # Steps entry specifies the number of steps TopRank calculates across the minimum-maximum range of Vary functions. During a What-If analysis, a new input value is used to calculate a new output value for each step for each Vary function. The #Steps entry in the Analysis Settings dialog is applied only when a #Steps argument 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 RiskVary(100,-10,+10), there is no entry in the function for #Steps. In this case TopRank uses the default #Steps. A typical default is 4 or 5 steps, but you can use any value greater than or equal to 2. The only downside to more steps is extra computing time.

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 8 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. You typically want fewer Multi-Way steps as compared to One-Way steps. 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.
The Find Inputs tab turns on or off the automatic insertion of AutoVary functions for inputs and sets the parameters for the identification of inputs.

The Scan Precedent Cells to Find Inputs options control whether TopRank automatically identifies inputs and inserts AutoVary functions. When a Scan Precedent Cells to Find Inputs option is selected, TopRank uses 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 that could vary, thus affecting the output’s value.

3) For identified constants, TopRank inserts an RiskAutoVary function that uses the current constant value as the base value and the default min-max range.
TopRank will insert RiskAutoVary functions either **When What-If Analysis Starts** or **When Outputs are Added**:

- **When What-If Analysis Starts** specifies that TopRank will insert RiskAutoVary 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 model.

- **When Outputs are Added** specifies that TopRank will insert RiskAutoVary functions when you add a new output. When this setting is used, RiskAutoVary functions added by TopRank will not automatically be removed once the run is complete. All RiskAutoVary functions, however, can be removed at any time using the **Remove AutoVary functions** command.

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 a RiskAutoVary 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) RiskAutoVary functions can 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 will be times, however, when you want to limit TopRank’s search 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 selecting worksheet name and specifying the range in the Range to Search field. If you add new worksheets or workbooks to an analysis, they will be searched by TopRank until you deselect them.

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.
The Other tab defines other settings affecting a What-If analysis.

### Multi-Way What-If Analysis

Multi-Way What-If analyses vary inputs simultaneously and calculate the effect of each combination of input values on results. When you have Multi forms of functions in your worksheets (RiskVaryMulti, RiskVaryMultiTable, 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.

In this case, TopRank first identifies all “Multi” functions in your spreadsheet. Then, using the Group Size entered, TopRank tries all possible combinations of input values. 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.** All “Multi” 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 RiskVaryMulti and RiskVaryMultiTable functions—Price, Sales Volume, Production Costs, and Investment—and you want to see the impact of every combination of two inputs on the Profit output. In this case, the Group Size is 2. Your analysis might tell you that Price and Sales Volume varying together are the most significant combination affecting Profit. Setting the Group Size to 3 might identify the combination of Price, Sales Volume, and Investment as the most important 3-way combination of inputs on Profit.

A Group Size of **Auto** forces the Group Size to equal the number of all VaryMulti and VaryMultiTable functions in the spreadsheet model. You can 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. This minimizes the number of recalculations or iterations required to complete a Multi-Way What-If analysis.
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. You can compare the results across runs to see the effect of the changing assumptions on the What-If results.

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

\[ \text{RiskSimtable}([100,200,300,400]) \]

On each run, the RiskSimtable function returns the argument whose position in the list is the run number. In the above RiskSimtable 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 RiskSimtable functions. If the number of runs is greater than the number of arguments entered into a RiskSimtable function, the RiskSimtable 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 Help Manual for more information on using the RiskSimtable function.

During Analysis

The Update Display option toggles on and off the updating of the worksheet displayed during a What-If analysis. In 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 recalculation. When the analysis pauses, the output range containing the error value is highlighted in the worksheet. You can then examine the worksheet to find the combination of input values that leads to the error condition. Then you can continue the analysis if you wish.
Run What-If Analysis Command

Starts a What-If analysis

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

The Status dialog shows the number of recalculations TopRank will perform during the analysis, along with the reports it will generate. If you like, you can cancel out and then change analysis or report settings (from the Analysis Settings or Reports Settings buttons on the TopRank ribbon) before running the analysis again.
Clicking the Run button in the Status dialog starts the What-If analysis. During an analysis, a Progress dialog displays the progress of the analysis. You can click the Cancel command on this dialog to halt the calculation at any time.

If Update Display is selected, you can watch your spreadsheet change each iteration. However, this slows down the What-If analysis. You can press the Num-Lock key to toggle the Update Display setting.

When the analysis is complete, an Excel workbook displays the reports selected in the Report Settings dialog.

The standard results of a One-Way What-If analysis are a ranking of inputs 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 results for those outputs will be reported.
A tornado graph compares the effects of all inputs on a given output. The X-Axis displays the change (actual or %) in output value. For each input 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 longest bar, that is, the greatest difference between the maximum and minimum values, is plotted on the top of the graph, and the variables proceed down the Y-Axis in decreasing order. In other words, the most influential inputs always appear at the top.
Spider Graphs

A spider graph also compares the effects of multiple inputs on a single output. For each input, 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 indicates the relative change in the output per unit change in the input. The shape of the curve shows whether a linear or nonlinear relationship exists between the input and the output.

Spider graphs actually provide more information than tornado graphs. Spider graphs show the reasonable limits of change caused by each input and the unit impact of these changes on the output. While tornado graphs may lead you to believe that output changes are proportional to input changes, the slope of spider graphs can indicate nonlinear behavior.

The number of variables used in a spider graph should not exceed 7, but a limit of 5 is recommended to avoid clutter. If your What-If analysis contains a large number of inputs, it is a good idea to plot them on a tornado graph first to determine which inputs have the greatest impact. Then you can use only these inputs for your spider graph.
A sensitivity (or What-If) graph is a simple graph plotting the output value (Y-axis) versus an input value (X-axis). There is one such graph for each input.
Report Settings Command

Specifies the type of reports and graphs that will be generated in Excel for each output, the location of these reports, and the outputs and inputs included in the reports.

The Report Settings command (in the Analysis group) 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 include in your reports.

Reports Tab

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 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. You can use this to quickly compare how individual inputs affect different outputs.

Output values can be shown in graphs in terms of the actual output value calculated or as a percent change from the output's base value. You should check the **On Graphs, Show Output Values as % Change From Base** option to view percent change in graphs.
The Outputs for Reports tab in the Report Settings dialog allows you to specify a subset of outputs to be included in an analysis's reports.

You can select to report All Outputs or only Selected Outputs. This is useful if you have a model with many outputs, but you are interested in analyzing a subset of them in a specific analysis. This allows you to keep all your output functions in your model and select only those of interest here.
The Inputs for Reports tab in the Report Settings dialog allows you to specify a cutoff for inputs to include in an analysis’s reports. By using these settings you can limit your reports to show only critical inputs, eliminating those inputs with 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

The Swap Functions command (in the Help group) lets you swap TopRank and @RISK functions in and out of your workbooks. This makes it easy to give models to colleagues who do not have TopRank (or @RISK). 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 you click the Swap Functions icon, you immediately swap out functions using the current swap settings, or you can click the Options button to change the settings to be used.

When functions are swapped out, the TopRank ribbon is disabled, and any TopRank functions you enter 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.

Swap Options

Clicking the Options button 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, 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 Swap Functions 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 (that is, 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 uses 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 distributions. For these distributions the true expected value is used as the swap value, even if it is not a possible discrete value for 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 it will make to your spreadsheet, prior to inserting distribution functions back into formulas. It is possible that spreadsheet formulas and values will be changed after TopRank and @RISK functions are swapped out. In this case, 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 the way you want. 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 after functions were swapped out, TopRank will notify you of the problem formulas prior to swapping functions back in.

Swap In options 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 that include a changed static value or formula are reported. For example, suppose the original formula in cell C10 was:

  \[ \text{=RiskNormal}(990,100,\text{RiskStatic}(1000)) \]

  After swap out, the formula would be:

  \[ \text{=1000} \]

  Now suppose the value of C10 was changed after functions were swapped out to:

  \[ \text{=2000} \]
TopRank would then swap the following function back in, updating the static value:

=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 that include a changed formula are reported with this option. For example, suppose the original formula in cell C10 was:

\[ \text{=1.12+RiskNormal(990,100,RiskStatic(1000))} \]

After swap out, the formula would be:

\[ \text{=1.12+1000} \]

Now suppose the formula for C10 was changed after functions were swapped out to:

\[ \text{=1000} \]

TopRank would then swap the following formula and function back in:

=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.
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, you can 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.

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 ribbon is disabled because functions are swapped out.
Application Settings Command

Displays the Application Settings dialog where program defaults can be set

The Application Settings command (from the Utilities menu in the Help group) lets you view or change a wide variety of TopRank settings that are used each time TopRank runs. These include defaults for scanning precedents for inputs, default input min-max ranges, reporting options, and others.

![Application Settings Dialog](image)
Clear TopRank Data Command

Clears the Selected TopRank Data from Open Workbooks

The Clear TopRank Data command (from the Utilities menu in the Help group) clears the selected TopRank data from all open workbooks.

The following data can 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 all 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. In other words, all model information will be gone.

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

Load DecisionTools Add-In

Loads any of the other DecisionTools Add-Ins

This handy command (from the Utilities menu in the Help group) loads @RISK or any of the other Palisade add-ins, assuming you have installed the DecisionTools Suite.

Unload TopRank Add-In Command

Unloads the TopRank add-in from Excel

This command (from the Utilities menu in the Help group) unloads TopRank, closing all TopRank windows.
Help Commands

The Help menu provides a number of self-explanatory commands for learning more about TopRank. You can open the document you are reading now, you can show the Welcome screen (with links to the Quick Start and Guided Tour videos), and you can open an “example file list” file with links to a variety of TopRank example files.

In addition, the License Activation command displays the License Activation dialog, listing the version and licensing information for your copy of TopRank. From here, you can also convert a trial version of TopRank into a licensed copy.

Finally, the About TopRank command displays the version and copyright information for your copy of TopRank.
Chapter 5: TopRank Function Reference

Introduction

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

- **RiskVary**, the standard function for specifying how an input value can vary.
- **RiskAutoVary**, a Vary function that is automatically added by TopRank.
- **RiskVaryTable**, a Vary function that uses a table to define the possible values for an input.
- **RiskVaryMulti**, a Vary function that is used in a Multi-Way What-If analysis.
- **RiskVaryMultiTable**, a Vary function that is used in a Multi-Way What-If analysis.

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

```
=RiskVary(100,10)
```

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

```
=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 require, based on your situation. A Vary function can have three arguments, or more as needed.
Like Excel functions, Vary functions can have arguments that reference cells or expressions, such as:

\[ \text{=RiskVary}(100, B2, B3) \]

In this case the value for the input minimum and maximum are specified by the values in cells B2 and B3.

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

\[ \text{B2: =100+RiskVary(10,-20,20)+(1.5*RiskVaryTable(40,A1...A1000))} \]

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

Here are some additional guidelines specific to TopRank functions are:

- Vary functions can have between three and six 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:
  \[ \text{=VaryTable(100,\{80,90,110,120,130\})} \]
- 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 \text{A1:C1}.

Some additional guidelines:

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

**Note:** In Excel, you cannot list cell references or names in arrays as you list constants. For example, you cannot 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, such as \{10,20,30\}. 

**Entering Arguments in Vary Functions**
Output Function

Output cells are defined using the `RiskOutput` function. This function allows the easy copying, pasting, and moving of output cells. `RiskOutput` functions are automatically added to selected cells when you click the Add Output icon on the TopRank ribbon. `RiskOutput` functions optionally allow you to name your outputs and add individual output cells to output ranges. A typical `RiskOutput` function is the following:

```
=RiskOutput(“Profit”)+NPV(0.1,H1:H10)
```

The formula in this cell, prior to its selection as a TopRank output, was:

```
= NPV(0.1,H1:H10)
```

The added `RiskOutput` function designates the cell as a simulation output and gives the output the name Profit.

**Note:** All outputs added with TopRank will also be recognized when you run 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, or to keep an input from being varied in an analysis. These property functions arguments are not required, but you can add them as needed.

Property functions are embedded inside a TopRank function. They are entered just like standard Excel functions and can include cell references and mathematical expressions as their arguments.

For example, the following function names the input being varied by the `RiskVary` function:

```
=RiskVary(100,-10,10,RiskName("Unit Cost"))
```

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)
```

uses a default distribution setting of Uniform and a default range type of +/- percentage. It is sampled like the @RISK distribution

```
=RiskUniform(90,110)
```
VaryTable functions from TopRank are sampled as RiskDuniform functions in @RISK.

Table of Vary Functions

This table lists the TopRank Vary functions. The base argument is the fixed value in the input cell before the Vary function is added.

<table>
<thead>
<tr>
<th>Vary Function</th>
<th>Returns</th>
</tr>
</thead>
<tbody>
<tr>
<td>RiskAutoVary(base, min, max, type, #Steps, dist)</td>
<td>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.</td>
</tr>
<tr>
<td>RiskVary(base, min, max, type, #Steps, dist)</td>
<td>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.</td>
</tr>
<tr>
<td>RiskVaryMulti(base, min, max, type, #Steps, dist)</td>
<td>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).</td>
</tr>
<tr>
<td>RiskVaryMultiTable(base, table)</td>
<td>Returns values from table (also used in a Multi-Way What if).</td>
</tr>
<tr>
<td>RiskVaryTable(base, table)</td>
<td>Returns values from table.</td>
</tr>
</tbody>
</table>

Table of Property Functions

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

<table>
<thead>
<tr>
<th>Property Function</th>
<th>Specifies</th>
</tr>
</thead>
<tbody>
<tr>
<td>RiskLock()</td>
<td>Blocks the varying of the input in which the Lock function is included</td>
</tr>
<tr>
<td>RiskName(&quot;name&quot;)</td>
<td>Name for the input or output in which the Name function is included</td>
</tr>
<tr>
<td>RiskCategory(&quot;category name&quot;)</td>
<td>Category name for the category of inputs in which the input will be placed</td>
</tr>
</tbody>
</table>
# Table of Output Functions

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

<table>
<thead>
<tr>
<th>Output Function</th>
<th>Specifies</th>
</tr>
</thead>
<tbody>
<tr>
<td>RiskOutput(&quot;name&quot;, &quot;output range name&quot;, position in range)</td>
<td>Designates a cell as a TopRank What-If analysis output cell with name, output range name to which the output belongs, and the position in range. (Note: all arguments to this function are optional)</td>
</tr>
</tbody>
</table>
## TopRank Vary Functions

### RiskAutoVary

| Description | RiskAutoVary(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 RiskVary function. Note: The RiskAutoVary function is only entered automatically by TopRank. If you change argument values in a RiskAutoVary function via the Add Input window, the function will change to a RiskVary function. |

### RiskVary

| Description | RiskVary(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 that was used in the spreadsheet prior to entering the RiskVary function. |
| Examples | RiskVary(100,-10,10,0,8,"TRIANG") specifies a What-If input with a base value of 100, a -10% to +10% range, a percentage range type, 8 steps, and a triangular distribution across the min-max range. 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 will be used. |
| Guidelines | Maximum must be greater than Base. Base must be greater than Minimum. Range Type = 0 indicates a +/- percentage change from base case defined by minimum and maximum (e.g., -20% to +20%). Percentage is entered as an absolute percentage value (such as -20 instead of -0.2). Range Type = 1 indicates a +/- actual change defined by minimum and maximum (e.g., -150 and +150). Range Type = 2 indicates that the minimum entered is the actual minimum value in the range and the maximum entered is the actual minimum value in the range (e.g., 90 and 110). #Steps must be a positive integer. Distribution must be “Normal”, “Triang”, “Trigen”, or “Uniform”, with the distribution name surrounded by quotes. |
RiskVaryMulti

| Description | RiskVaryMulti(base, minimum, maximum, range type, #Steps, distribution) specifies an input variable for use in both a One-Way What-If analysis and a Multi-Way What-If analysis. The arguments to this function are identical to those of the RiskVary function. |

RiskVaryMultiTable

| Description | RiskVaryMultiTable(base, table) specifies an input variable for both a One-Way What-If analysis and 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 RiskVaryTable function. |

RiskVaryTable

| Description | RiskVaryTable(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 RiskVaryTable 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 is returned by the RiskVaryTable function during a What-If analysis and results are calculated at each of the returned values.

Guidelines

- Table values directly entered into the RiskVaryTable function must be entered as arrays with {} notation.
TopRank Property Functions

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

Property functions that are embedded inside TopRank function such as RiskVary and RiskOutput.

### RiskLock

<table>
<thead>
<tr>
<th>Description</th>
<th>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 an @RISK simulation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>RiskVary(100,-10,10,RiskLock()) stops the input corresponding to this RiskVary function from being varied in a What-If analysis.</td>
</tr>
<tr>
<td>Guidelines</td>
<td>None.</td>
</tr>
</tbody>
</table>

### RiskName

<table>
<thead>
<tr>
<th>Description</th>
<th>RiskName(&quot;Name&quot;) 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 that include results for the input.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>RiskVary(100,-10,10,RiskName(&quot;Price&quot;)) gives the name Price to the input corresponding to this RiskVary function. RiskVary(100,-10,10,RiskName(A10)) gives the name contained in the cell A10 to the input corresponding to this RiskVary function.</td>
</tr>
<tr>
<td>Guidelines</td>
<td>If a literal name is specified, it must be entered in quotes. Any valid cell references can be used to define a name.</td>
</tr>
<tr>
<td>Description</td>
<td>RiskCategory(&quot;Category Name&quot;) names the category in which the input will be placed. This name will appear in the category grouping in the TopRank Model window list.</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>
| Examples | RiskVary(100,-10,10,RiskCategory("Research Costs")) places the input corresponding to this RiskVary function in a category named Research Costs (along with other Research Cost inputs).  
RiskVary(100,-10,10,RiskCategory(A10)) places the input corresponding to this RiskVary function in a category named with the contents of the cell A10. |
| Guidelines | If a literal category name is specified, it must be entered in quotes. Any valid cell references can be used to define a category name. |
TopRank Output Function

**RiskOutput**

| Description | RiskOutput("cell name"," range name",position#) designates a cell or a range of cells as an output for a What-If analysis. All arguments are optional. If no argument is used, TopRank creates a name for the output from nearby cell labels.
A RiskOutput function is entered by adding it to the cell formula that is already present in the cell. For example, a cell containing the formula:  
=NPV(0.1,G1:G10)  
would become  
=RiskOutput()+NPV(0.1,G1:G10)  
when the cell is selected as an output (and an automatic name is created). |
|---|---|
| Examples | =RiskOutput("NPV")+NPV(0.1,G1:G10) designates the cell containing the NPV function as an output cell with name NPV.
=RiskOutput("Annual Profit",1)+C10-B10 designates the corresponding cell as the first cell in an output range named Annual Profit. This particular output will be named Annual Profit / 1. |
| Guidelines | If names are entered directly in the RiskOutput function, the entered output cell name and output range name must be enclosed in quotes. Names can also be included by referencing cells with labels in them.
Position# must be a positive integer >=1.
Note: All outputs added with TopRank will also be recognized when running a simulation with @RISK. |
Using @RISK Functions

@RISK’s probability distribution functions can 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 probability distribution are used in a What-If analysis. This provides the following functionality:

- You can describe variation in an input that cannot be precisely described by a Vary function.
- You can 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 Help Manual.

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, as in:

```
=RiskNormalMulti(100,10)
```

This identifies a normal distribution to include in a Multi-Way What-If analysis. Inputs can also be identified in the Model window table by right-clicking and selecting Multi-Way.

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

- RiskCurrentIter
- RiskCurrentSim
- RiskSimtable
Appendix A: Using TopRank with Other DecisionTools Add-Ins®

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
- **BigPicture®** — smart drawing in Excel

While the tools listed above can be purchased and used separately, they become more powerful when used together. 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.
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

Excelsior Electronics currently makes desktop computers. They are working on a laptop computer, the Excelsior 5000, and want to know whether the company will profit from this venture. They plan to build a spreadsheet model which spans the next two years. The model should take into account production costs, marketing, shipping, price per unit, units sold, and so on. The bottom line for the planning horizon is overall profit. Excelsior expects some initial setbacks on this venture, but as long as these setbacks are not too bad and profits are up by the end of two years, they will go ahead with the E5000.

The company executive first uses BigPicture to develop a “map,” where the various elements of the problem and their relationships are shown graphically. This map serves as a basis for a discussion of the problem from a high-level view, so that everyone understands the main issues.

Once a basic spreadsheet model of the problem is developed in Excel, TopRank is used on the model to identify the critical variables. The overall profit cell is selected as the critical output, and an automatic what-if analysis is run with TopRank. The results quickly show there are five variables (out of many more) that have the most impact on profit: price per unit, marketing costs, build time, price of memory, and price of CPU chips. Excelsior decides to concentrate on these five input variables.

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.

Research is performed to collect 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 entered into the model.

Once all the @RISK functions are in place, the profit cell is selected as an @RISK output cell, and a simulation is run. Overall, the results look promising. Although there will be losses initially, there is an 85% chance the company will make an acceptable profit. In fact, there is a 25% chance that the venture will generate even more revenue than had initially been assumed. Therefore, Excelsior 5000 project is given the go-ahead.
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 @RISK

The techniques of Risk analysis have long been recognized as powerful tools to help decision-makers successfully manage situations in the face of uncertainty. Their use has been limited because they have been expensive and cumbersome to use. In addition, they have substantial computational requirements. The widespread use of computers in business and science has offered the promise that these techniques can be used by all decision-makers.

That promise has been realized with @RISK (pronounced “at risk”), a system that brings these techniques to the industry standard spreadsheet package, Microsoft Excel. With @RISK and Excel, any risky situation can be modeled, from business to science to engineering. You are the best judge of your analysis requirements, and @RISK, combined with the modeling capabilities of Excel, allows you to design models that best satisfies these requirements. Any time you face a decision or analysis that involves uncertainty, you can use @RISK to gain insight into how the future might unfold.

Why You Need Risk Analysis and @RISK

Traditional analyses combine single “point” estimates of a model’s variables to predict a single estimate of results. Estimates of model variables must be used because future values are not known with certainty. In reality, however, many things don’t turn out the way you planned. Maybe you were too conservative with some estimates and too optimistic with others. The combined errors in each estimate often lead to real-life results that are significantly different from estimated results. The decision you make based on your “expected” result might be an unwise decision, a decision you would not have made if you had a more complete picture of all possible outcomes. Business decisions, technical decisions, and scientific decisions all use estimates and assumptions. With @RISK, you can explicitly include the uncertainty present in your estimates to generate results with a wide range of possible outcomes.
@RISK uses a technique called “simulation” to combine all uncertainties you identify in your situation. You are no longer forced to reduce what you know about a variable to a single number. Instead, you can include all you know about the variable, including its full range of possible values and the likelihoods of their occurrence. @RISK uses all of this information, along with your Excel model, to generate a range of possible outcomes. It’s just as if you ran hundreds or thousands of “what-if” scenarios all at once. In effect, @RISK lets you see the full range of what could happen in your situation. It enables you to “live” through your situation many times, each time under a different set of conditions with a corresponding set of results occurring.

All this added information might sound like it would complicate your decisions, but in fact, one of simulation’s greatest strengths is its power of communication. @RISK provides results that graphically illustrate the risks you face. This graphical presentation is easily understood by you, and it is easily explained to others.

So when should you use @RISK? Any time you perform an analysis in Excel that involves uncertainty, you can and should use @RISK. Applications in business, science, and engineering are practically unlimited, and you can build on your existing base of Excel models. Consider the decisions and analyses you make every day. If you have ever been concerned with the impact of risk in these situations, you have just found a good use for @RISK!

**@RISK Modeling Features**

As an add-in to Microsoft Excel, @RISK links directly to Excel to add Risk analysis capabilities. The @RISK system provides all the necessary tools for setting up, executing, and viewing the results of Risk Analyses. And @RISK works in a style you are familiar with: Excel-style menus and functions.

@RISK allows you to use functions to define uncertain cell values as probability distributions. @RISK adds a set of new functions to the Excel function set, each of which allows you to specify a different distribution type for cell values. Distribution functions can be added to any number of cells and formulas throughout your spreadsheet model, and they can include arguments, possibly cell references and expressions, that allow extremely sophisticated specification of uncertainty. To help you assign distributions to uncertain values, @RISK includes a graphical window where distributions can be previewed and added to formulas.
The probability distribution functions provided by @RISK allow you to specify nearly any type of uncertainty in cell values in your model. For example, a cell containing the formula =RiskNormal(100,10) will return samples during a simulation drawn from a normal distribution with mean 100 and standard deviation 10. These distribution functions are invoked only during a simulation. In normal Excel operations, they show a single cell value, just as in Excel without @RISK.

All distributions can be truncated to allow only samples within a specified ranges of values within the distribution. Also, many distributions can be specified with alternate percentile parameters instead of the distribution’s traditional parameters.

@RISK has sophisticated capabilities for specifying and executing simulations of Excel models. Both Monte Carlo and Latin Hypercube sampling techniques are supported, and distributions of possible results can be generated for any cell or range of cells in your spreadsheet model.

High resolution graphics are used to present the distributions of outputs from your @RISK simulations. Histograms, cumulative curves, and summary graphs for cell ranges all lead to a powerful presentation of results. All graphs can be displayed in Excel for further enhancement and hard copy. An essentially unlimited number of output distributions can be generated from a single simulation, allowing for the analysis of even the most complex spreadsheet models.

The options available for controlling and executing a simulation in @RISK are among the most powerful ever available. They include:

- Latin Hypercube or Monte Carlo sampling
- Any number of iterations per simulation
- Any number of simulations in a single analysis
- Animation of sampling and recalculation of the spreadsheet
- Seeding of the random number generator
- Real-time results and statistics during a simulation
@RISK graphs a probability distribution of possible results for each @RISK output cell. @RISK graphics include:

- Relative frequency distributions and cumulative probability curves
- Summary graphs for multiple distributions across cell ranges (for example, a row of time series values)
- Statistical reports on output distributions
- Probabilities for target values in a distribution
- Export of graphics as Windows metafiles for further enhancement

Execution time is of critical importance because simulation is extremely calculation intensive. @RISK uses advanced sampling techniques for the fastest possible simulations.
Using @RISK with TopRank

What-If analysis is often the first analysis performed on a spreadsheet model. Its results lead to a further refinement of the model, additional analyses, and ultimately, a final decision based on the best possible model. 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 the important inputs in your model. You can then focus on these important inputs and better estimate what their values could be. Usually, however, there are several of these important uncertain inputs, and, in reality, they could all vary at the same time. To analyze an uncertain model such as this, you need Risk analysis with 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 probability distributions 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 +/− variation. A probability distribution shows both the range of possible values 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 output values from your model, and the likelihood of any output value occurring.

The simple +/− 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 \texttt{RiskVary(100,-10,+10)}, using a default Uniform distribution and a default range type of +/− percentage, is sampled like the @RISK distribution \texttt{RiskUniform(90,110)}. VaryTable functions from TopRank are sampled as \texttt{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. If you’re wondering whether to use TopRank or @RISK, the best answer is that you can benefit from using both of them.

The Similarities

Both @RISK and TopRank are add-ins for analysis of spreadsheet models. By using special spreadsheet formulas, both programs explore how uncertainty affects your model and the decisions you base on this model. Also, 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 to determine which inputs are uncertain, and which distribution functions best describe the uncertainty.

TopRank defines uncertainty in your model by using Vary functions. Vary functions are simple—they define possible input values without assigning probabilities to these values. There are only two basic Vary functions in TopRank: Vary and VaryTable.

TopRank can automatically identify input cells in your model every time you select an output. You don't need to know which cells are uncertain or important; TopRank can identify these cells for you.

**Calculations**

@RISK runs a Monte Carlo or Latin Hypercube simulation. For each iteration (or step), every @RISK input distribution in the spreadsheet model takes on a new value determined by its probability distribution function. To run a thorough analysis, @RISK runs hundreds or thousands of iterations.
In contrast, during a TopRank 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 analyze the effects of many inputs.

For each output defined, @RISK produces a probability distribution for each output. The distribution describes which values an output (such as profit) could have, as well as how probable these values are. For example, @RISK might indicate that there is a 30% chance that your company will not make a profit next quarter.

For each defined output, TopRank indicates which inputs have the largest effect on the output. For example, TopRank might indicate that your company's profit is most sensitive to sales volume, and that when the sales volume is only 1000 units, you will lose $1 million.

The most important difference between the two add-ins is that @RISK analyzes how the combined uncertainty of all inputs affect the outputs. TopRank only indicates how an individual input (or a small group of inputs) affects an output. So, while TopRank is faster and easier to use, @RISK provides a more detailed and comprehensive analysis of the problem. **We strongly recommend using TopRank first to determine which inputs are the most important. Then you can use @RISK to run a comprehensive analysis of your problem.**

In summary, TopRank identifies the most important inputs in your model. A TopRank What-If analysis can be used on its own to help make better decisions. But for the most thorough analysis, you should use TopRank to identify the most important inputs in your model, and then use @RISK to define uncertainty in those inputs and run a simulation. TopRank can help you guide your @RISK analysis by defining uncertainty in only the most important inputs, making your simulation faster and more compact.
Introduction to PrecisionTree™

Palisade’s PrecisionTree add-in is a decision analysis add-in to Microsoft Excel. It enables you to 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 whether 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. And you can do all of this in an Excel spreadsheet.
PrecisionTree Modeling Features

As an add-in to Microsoft Excel, PrecisionTree links directly to Excel to add decision analysis capabilities. PrecisionTree 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 is no limit to the size of tree you can define. You can design a tree that spans multiple worksheets in an Excel workbook. PrecisionTree reduces the tree to an easy-to-understand report right in your current workbook.

PrecisionTree allows you to define 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.

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.

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.

PrecisionTree’s decision analyses give you straightforward reports, including statistical reports, risk profiles, and policy suggestions. Also, decision analysis can produce more qualitative results by helping you understand trade-offs, conflicts of interest, and important objectives.

All analysis results are reported directly in Excel for easy customization, printing, and saving. There is no need to learn a whole new set of
formatting commands because 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. You can perform one-way and two-way sensitivity analyses, and generate tornado graphs, spider graphs, strategy region graphs, and more.

If you need more sophisticated sensitivity analyses, PrecisionTree links directly to TopRank, Palisade’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 that follow the node. Subtrees can be copied and pasted to other parts of the tree, saving you the repeated re-entry of the same subtree structure.

**Utility Assessment**

PrecisionTree contains lets you apply built-in utility functions to a decision tree. These encode your attitude toward risk and are especially useful when large amounts of money are at stake. You can even create your own utility functions.
Using @RISK with PrecisionTree

@RISK is a perfect companion to PrecisionTree. @RISK allows you to quantify the uncertainty in the values and probabilities that define your decision trees and thereby 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.

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 output 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:

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 mean $22900 and standard deviation $50000, or the @RISK distribution RiskLognorm(22900,50000).
To use this function in the oil drilling model, you 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 will look:

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.

But, what about the decision to Drill or Not Drill? If the expected value of the Drill node changes, the optimum decision could change from 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

Suppose you want to know how much it would be worth to learn which uncertain outcome will occur before having to make a decision. In decision analysis, this is called the value of perfect information. PrecisionTree can calculate this value easily. You simply “flip” the tree so that uncertainty is resolved first and then the decisions are made.
Appendix A: Using TopRank with Other DecisionTools Add-Ins®

Introduction to BigPicture™

The BigPicture add-in is the newest addition to Palisade’s DecisionTools Suite, introduced in version 7. BigPicture is a smart drawing program, developed to compete with other “mapping” software on the market. However, unlike other mapping software, BigPicture is totally integrated with Excel, and this provides several important advantages discussed below.

BigPicture is aptly named. Its main purpose is to provide a map, or diagram, of the elements of a problem, along with relationships among these elements, so that decision makers can understand and discuss the problem from a high-level view. This was the original intent of BigPicture, and it remains its primary goal, but the developers of the add-in took advantage of its integration with Excel to provide a wealth of smart features not available in other mapping software.

BigPicture for High-Level Maps

Suppose a company faces an important acquisition decision. There are several directions the company could go, and each involves a number of trade-offs based on monetary and non-monetary outcomes. BigPicture allows the company to “map” the decision alternatives and possible ramifications, and this map can then be the basis for a high-level discussion.

Here is a possible map to get the discussion started.

This map resides in an Excel worksheet, and it consists basically of Excel shapes, but it is much “smarter” than a collection of shapes you could draw with Excel tools only. For example, the plus signs to the right indicate that the map can be expanded in this direction. Here is one possible expansion:
The advantage of being able to expand or contract a large map should be obvious. It lets the decision makers focus on one part of the decision process at a time.
Linking to Cell Data

Each shape in a BigPicture map (the rectangles and ovals) is called a **topic**, and any type of information can be entered in a topic. You can type in this information, just as with regular Excel shapes, but a big advantage of BigPicture is that you can cell-reference this information. In other words, the text in a topic can be linked to values or formulas in any Excel cells, even those in a different worksheet. Here is an example:

All of the number in this map reference cell formulas in a “calculations” section of the workbook. If the data in this section change, the map will update automatically.
Free-Form Maps

BigPicture maps can be very structured, as in the above travel cost map, where everything “flows” from left to right and topics are lined up nicely. In fact, this structure can be created automatically by BigPicture, so that you don’t need to waste time lining up and resizing shapes. However, BigPicture also allows you to create “free-form” maps, where you can arrange topics and connectors to suit your needs. This is especially useful for showing the elements of a typical @RISK model, such as the following:

In this case, the color-coding was performed manually to indicate the different types of variables in the model.

If you are using such a map to explain a model to an audience, it might be nice to show the map in a step-by-step manner, explaining each step along the way. BigPicture lets you do this by creating slide shows. Each “slide” is a partial map, where you can decide exactly which topics to include, and it can be accompanied by a text box explaining that step. For example, here is the third step for this map:
Org Charts

As mentioned earlier, the original intent of BigPicture was to create maps of the type shown so far. But it evolved to include much more, specifically, data analysis. One example of this is its ability to create organization charts from tables of employee data. The table should include a row for each employee with any relevant data, including whom this employee reports to. Then BigPicture can create an org chart from this table automatically. Here is an example:

This chart not only shows the organization’s structure, but it shows calculations performed on the table data. Specifically, it shows the total salary of a supervisor and all the employees who report directly or indirectly to that supervisor.
An org chart is relevant for data with natural “parent/child” relationships. BigPicture includes similar maps, called linkes maps, for other parent/child data in a non-org chart context.

Data Maps

If you have used Excel pivot tables to “slice and dice” data, that is, to break down data by categories, you will love BigPicture’s data maps. They do essentially what pivot tables do, but in a more graphical format. This is a feature, maybe the feature, that definitely sets BigPicture above competing mapping software.

As with an org chart, a data map requires a data set in an Excel worksheet. Each column of this data set should correspond to a variable. Some variables will be categorical, representing categories you want to break down by, and others will be numeric. You define the categorical variables and numeric variables to be used in the map, including statistical summary measures of the numeric variable to be shown, and BigPicture does the rest. Here is an example of a company’s sales, broken down by region and product:
In this case, each topic on the right represents all products in a given type. By expanding one of these, you can see a table for the product type broken down by country:

Or broken down by product:
Appendix B: Recommended Readings

This 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


Technical References to Sensitivity Analysis


## Appendix C: Glossary of Terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
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<tr>
<td><strong>@RISK</strong></td>
<td>Risk analysis add-in for Excel from Palisade Corporation (pronounced “at risk”)</td>
</tr>
<tr>
<td><strong>Base Case</strong></td>
<td>The value of a model input before a sensitivity analysis is run (a “best guess”)</td>
</tr>
<tr>
<td><strong>Critical Inputs</strong></td>
<td>The model inputs that have the largest effect on one or more outputs</td>
</tr>
<tr>
<td><strong>Critical Combinations</strong></td>
<td>The combinations of model inputs in a Multi-Way What-If analysis that have the largest effect on one or more outputs</td>
</tr>
<tr>
<td><strong>Continuous Distribution</strong></td>
<td>A probability distribution where any value in a continuum in a range is possible</td>
</tr>
<tr>
<td><strong>Cumulative Distribution</strong></td>
<td>Form of a probability distribution that lists “less than or equal probabilities”</td>
</tr>
<tr>
<td><strong>Deterministic Model</strong></td>
<td>A model with no explicit uncertainty</td>
</tr>
<tr>
<td><strong>Discrete Distribution</strong></td>
<td>A probability distribution where only a finite number of discrete values are possible</td>
</tr>
<tr>
<td><strong>Input</strong></td>
<td>Any constant in a spreadsheet model that is varied systematically in a TopRank What-If analysis to see its effect on one or more outputs</td>
</tr>
<tr>
<td><strong>Multi-Way Group Size</strong></td>
<td>Number of inputs being varied together in a TopRank Multi-Way What-If analysis</td>
</tr>
<tr>
<td><strong>Multi-Way Sensitivity Analysis</strong></td>
<td>A type of TopRank What-If analysis where several inputs are varied simultaneously to see their combined effect on one or more outputs.</td>
</tr>
<tr>
<td><strong>One-Way Sensitivity Analysis</strong></td>
<td>The usual TopRank What-If analysis, where one input at a time is varied, and the others are kept at their base values, to see the effect on one or more outputs.</td>
</tr>
<tr>
<td><strong>Output</strong></td>
<td>A “bottom-line” value of interest in a spreadsheet model, where inputs are varied systematically in a TopRank What-If analysis to see their effects on it</td>
</tr>
</tbody>
</table>
**Risk Analysis**
A general term that describes any method used to study and understand the risk inherent to a situation of interest

**Spider Graph**
A graph resulting from a What-If analysis with a line (or curve) for each input, showing how an output changes as the input changes through its range

**Tornado Graph**
A graph resulting from a What-If analysis with a bar for each input (or combination of inputs) with length equal to the range of output values when the input is varied through its range and the other inputs are kept at their base values

**Vary Function**
A generic term for the functions used by TopRank to indicate how inputs will be varied in a What-If analysis

**VaryTable Function**
A type of Vary function, indicates that a table of values will be used in a What-If analysis for that input

**VaryMulti Function**
A type of Vary function used identify inputs to be included in a Multi-Way What-If analysis.

**What-If Analysis**
Any method used to determine how one or more outputs will change when one or more inputs change through specified ranges
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