Memorandum

To: Regional Technical Forum Market Analysis Subcommittee

From: Momentum Savings Modeling Team

Date: 7/29/16

Subject: Analytica reference material

This document provides helpful material for getting started with Analytica as well as links to more comprehensive Analytica tutorials and user guides. The team has organized information in the following sections:

- Downloads: How to download Analytica and reference documents
- Introductory Videos: Links to videos that provide a good first stop for background on how to use Analytica
- Users Guide Excerpts: Highlights from the comprehensive Analytica users guide for quick reference
- Useful Shortcut Keys: Table of shortcut keys in Analytica

Downloads

Visit this page to download and install Analytica. The Analytica Free 101 edition is free and will allow you to run the momentum savings models.

Tips and recommended documents:

- Check your system properties (Windows Button->Computer->System Properties->System Type) to figure out if you have 32- or 64-bit operating system
- Download the appropriate free version
- Extensive Tutorial Document:
    - http://downloads.analytica.com/ana/Tutorial4_6_1.pdf
- Extensive Users Guide:
    - http://downloads.analytica.com/ana/UserGuide4_6_1.pdf
- Chapters 1-3 of the tutorial are applicable to model reviewers

The team recommends 8GB of RAM to run the full model. Otherwise, you will only be able to analyze subsets of the full model (for example, one state at a time).

Additional information on computer needs from Lumina Decision Systems (maker of Analytica):

Computer needs

Windows OS: Analytica and ADE run on Microsoft Windows OS, including Windows 8, 7, Vista, Server, XP, Server 2003, 2008 and 2012.

Recommended RAM: It runs fine on a computer with 1GB RAM. With 32-bit Windows OS, Analytica (like most Windows applications) can use up to 3GB RAM out of 4GB RAM. For large models or large Monte Carlo sample sizes, it's helpful to have more RAM. In that case, we recommend a 64-bit Windows OS, with 8GB RAM or more.

The downloadable Analytica installer is under 24MB. When installed, it takes up to 55MB on your hard disk, including Analytica application, solver, documents, example models and libraries.

Screen size: It's helpful to have a large screen if you want to build or view large models, especially if you want also to see related documents or spreadsheets.

Macintosh: Sadly, Analytica does not run on Macintosh OS. But, it does run nicely on a Macintosh, using Parallels or VMWare to run Windows. (Max Henrion, the originator of Analytica and CEO of Lumina, runs it like that on his Macbook Air.)

Introductory Videos

The team recommends the following introductory videos from Lumina:

- Introduction to Analytica
  - https://www.youtube.com/watch?v=9s40FjHBm3E
- Getting Started with Analytica
  - https://www.youtube.com/watch?v=2rm6WTn2js0
- Analytica Tutorial Chapter 1
  - https://www.youtube.com/watch?v=GQV0dnDN0Q0
- Analytica Tutorial Chapter 2
  - https://www.youtube.com/watch?v=mpF4xcmKaao
- Analytica Tutorial Chapter 3
  - https://www.youtube.com/watch?v=scVOq29NMG4

User Guide Excerpts

The team has selected the following excerpts from the user guide to highlight key terminology and navigation features in Analytica.

Toolbar Introduction

The toolbar

The toolbar appears across the top of the Analytica application window. It contains buttons to open various views of the model, and to change between browse and edit modes.

Navigation toolbar The first five buttons on the toolbar open a window relating to the variable or the object selected in the active (frontmost) window:

Parent Diagram button: Click to open the **Diagram window** (page 15) for the module or model containing the object in the current active **Diagram**, **Object**, or **Result** window. It highlights the object you were viewing in the parent diagram. If you are viewing the top-level model, which has no parent, this button is grayed out. The keyboard shortcut is *F2*.

Outline button: Click to open the **Outline window** (page 341). The outline highlights the object you were previously looking at. The keyboard shortcut is *F3*.

Object button: Click to open the **Object window** (page 20) for the selected node in a diagram or the active module. The keyboard shortcut is *F4*.

Result button: Click to open a **Result window** (page 26) (table or graph) for the selected variable. This button is grayed out if no variable is selected. If you have selected more than one variable, it offers to create a compare variable that shows a result combining the values of all the variables. The keyboard shortcut is *Control+r* or *F5*.

Definition button: Click to view the definition of the selected variable. If the variable is defined as a probability distribution or sequence, it opens the function in the **Object Finder** (page 110); if the variable is an editable table (edit table, subtable, or probability table), it opens the **Edit Table** (page 178) window. Otherwise, an **Attribute panel** (page 20) or an **Object window** (page 20) opens, depending on the *Edit Attributes* setting in the **Preferences dialog** (page 54). This button is grayed out if no variable is selected. The keyboard shortcut is *Control+e* or *F6*.

Edit buttons These three buttons control your mode of interaction with Analytica. The shape of the cursor reflects which mode you are in:

Browse tool: Lets you navigate a model, compute and view results, and change inputs. It does not let you change other variables. See "Browse mode" on page 19.

Edit tool: Lets you create new objects, and move and edit existing objects. See "Creating and editing nodes" on page 45.

Arrow tool: Lets you draw arrows (influences) between nodes on a diagram. See "Drawing arrows" on page 47.

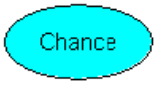
Classes of Variables and Objects

Note: The descriptions provided below are generalized and the model may not strictly adhere to the users guide definitions. This is especially true for decision nodes in the model, which often represent a user input, rather than a decision to make. Furthermore, the model often employs constant nodes to depict imported data in addition to fixed conversion factors. Lastly, the color scheme within the model may differ from the users guide.

Classes of variables and other objects

The shape of a node indicates the class of the variable or other object:

A rectangle depicts a ***decision variable*** — a quantity that the decision maker can control directly. For example, whether or not you take an umbrella to work is your decision. If you are bidding on a contract, it is your decision how much to bid.



An oval depicts a ***chance variable*** — that is an uncertain quantity whose definition contains a probability distribution. For example, whether or not it will rain tomorrow is a chance variable (unless you are a rain god). And whether or not your bid is the winning bid is a chance variable in your model, although it is a decision variable for the person or organization requesting the bid.

A hexagon depicts an ***objective variable*** — a quantity that evaluates the relative value, desirability, or utility of possible outcomes. In a decision model, you are trying to find the decision(s) that maximize (or minimize) the value of this node. Usually, a model contains only one objective.

A rounded shape (with thin outline) depicts a ***general variable*** — a quantity that is not one of the above classes. It can be uncertain because it depends on one or more chance variables. Use this class initially if you're not sure what kind of variable you want. You can change the class later when it becomes clearer.

An hourglass shape depicts a ***constraint*** — a relationship utilized when solving constrained optimization problems in the Analytica Optimizer edition. The constraint node appears on the toolbar only when using Analytica Optimizer. Optimization is covered in the *Optimizer user guide*.

A rounded node (with thick outline) depicts a ***module*** — that is, a collection of nodes organized as a diagram. Modules can themselves contain modules, creating a nested hierarchy.

A parallelogram depicts an ***index variable***. An index is used to define a dimension of an array. For example, *Year* is an index for an array containing the U.S. GNP for the past 20 years. Or *Nation name* is an index for an array of GNPs for a collection of nations. Indexes identify the row and column headers of a table, and the axes and key of a graph (see "Introducing indexes and arrays" on page 150).

A trapezoid depicts a ***constant*** — that is, a variable whose value is fixed. A constant is not dependent on other variables, so it has no inputs. Examples of numerical constants are the atomic weight of oxygen (16) or the number of feet in a kilometer. It is clearer to define a constant for each such value you need in a model, so you can refer to them by name in each definition that uses it, rather than retyping the number each time.

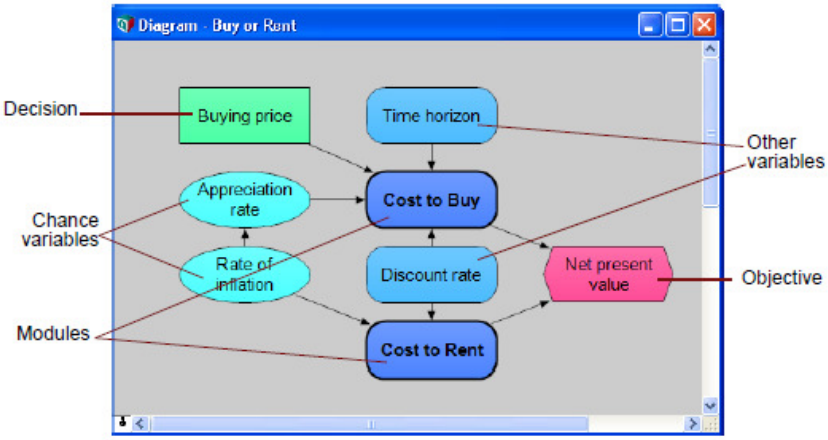
A shape like an arrow tail depicts a ***function***. You can use existing functions from libraries, and define new functions to augment the functions provided in Analytica. See Chapter 21, "Building Functions and Libraries."

This node is a ***button*** — when you click a button (in browse mode), it executes its script to perform some useful action. You can use buttons with any edition of Analytica, but you need Analytica Enterprise or Optimizer to create a new button (see "Creating buttons and scripts" on page 407).

Influence Diagrams

Diagram window

When you open a model, it shows a **Diagram** window. This window usually shows an ***influence diagram***, like this.

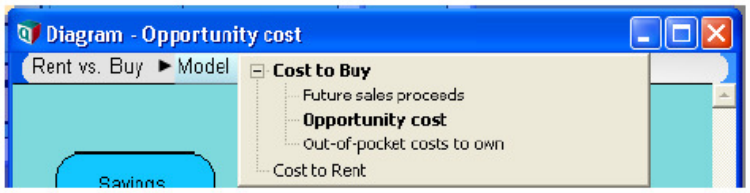


Each ***node*** depicts a variable (thin outline) or module (thick outline). The node shape and color tells you its class — decision, chance, objective, module, and so on. The arrows in a **Diagram** window depict the ***influences*** between variables. An influence arrow from variable `A` to variable `B`, means that the value of `A` influences `B`, because `A` is in the definition of `B`. So, when the value of `A` changes, it can change the value (or probability distribution) for `B`.

In the diagram above, the arrow from `Buying price` to `Cost to buy` means that the price of the house affects the overall cost of purchasing it. The influence diagram shows the essential qualitative structure of the model, unobscured by details of the numbers or mathematical formulas that can underlie that structure. For more on using influence diagrams to build clear models, see Chapter 7, "Creating Lucid Influence Diagrams."

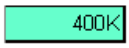
If you check the *Show module hierarchy* box, the top of the active **Diagram** window displays the module path down to the current module:

You can jump to any parent or ancestor module by clicking on its name in the strip. When you click on an arrow, a tree menu displays other modules at that level and enables you to quickly navigate directly to any other module in the model:

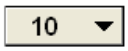


Input/output nodes

Viewing input nodes



An input field lets you see a single number or text value. Click in the box to edit the value. If it's a text value, you must put matching quotes around it (single or double).



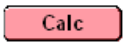
A pull-down menu lets you choose from a list of options. Press the menu to see the list.

Click the **List** button to open a list of values, usually defining an Index. To change a value, click in its cell. For more about lists, see "Editing a list" on page 171.

Click to open an edit table showing an editable array with one or more dimensions displayed as a table. For more, see "Editing a table" on page 178.

Click to view and edit a probability distribution in the **Function Finder**. For more, see "Probabilistic calculation" on page 250.

Viewing output node values



Click the **Calc** button to compute and display the value of this output variable. When computing is complete, it shows a number in this node, or, if it's an array, it changes to the **Result** button and opens a **Result** window showing a table or graph. See Chapter 3, "Result Tables and Graphs" for more.

The **Result** button shows that an array has been calculated. Click it to open a **Result** window showing a table or graph. See Chapter 3, "Result Tables and Graphs" for more.

Opening module details

To see the structure of the model, double-click the module **Model details**, to display its diagram window (see "The Object window" on page 20).

Numeric Suffixes

Suffix characters

Suffix is Analytica's default format. It uses a conventional letter after each number to specify powers of 10: 12K means 12,000 (*K* for kilo or thousands), 2.5M means 2,500,000 (*M* for Mega or millions), 5n means 0.000,000,005 (*n* means nano or billionths). Here are the suffix characters:

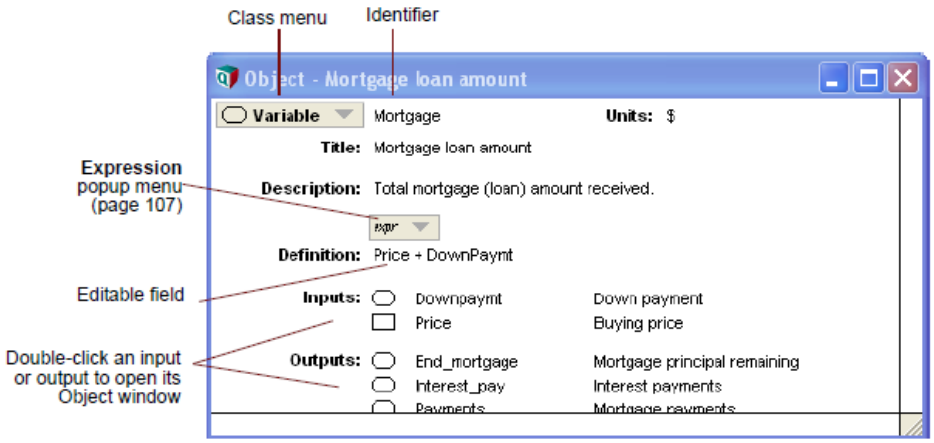
Power of 10	Suffix	Prefix	Power of 10	Suffix	Prefix
			10^{-2}	%	percent
10^{3}	K	Kilo	10^{-3}	m	milli
10^{6}	M	Mega or Million	10^{-6}	µ or u	micro (mu)
10^{9}	G or B	Giga or Billion	10^{-9}	n	nano
10^{12}	T	Tera or Trillion	10^{-12}	p	pico
10^{15}	Q	Quadrillion	10^{-15}	f	femto

Tip Note the difference between "M" for Mega or Million and "m" for milli (1/1000). This is the only situation in which Analytica cares about the difference between uppercase and lowercase. Otherwise, it is insensitive to case (except when matching text values).

Attributes of a Variable

The Object window

The ***Object window*** shows the attributes of an object. All objects have a class and identifier — a unique name of up to 20 characters. A variable also has a title, units, description, definition, inputs, and outputs.



To open an Object window

Here are some ways to open the **Object** window for an object **x**:

- Double-click **x** in a **Diagram** window.
- Select **x** in its **Diagram** window and click the **Object** button in the navigation toolbar.
- Double-click the entry for **x** in the **Outline window** (page 341).
- If a **Result** window for **x** is displayed, click the **Object** button in the navigation toolbar.
- Double-click **x** in the **Inputs** or **Outputs** list of a variable in an **Object** window.

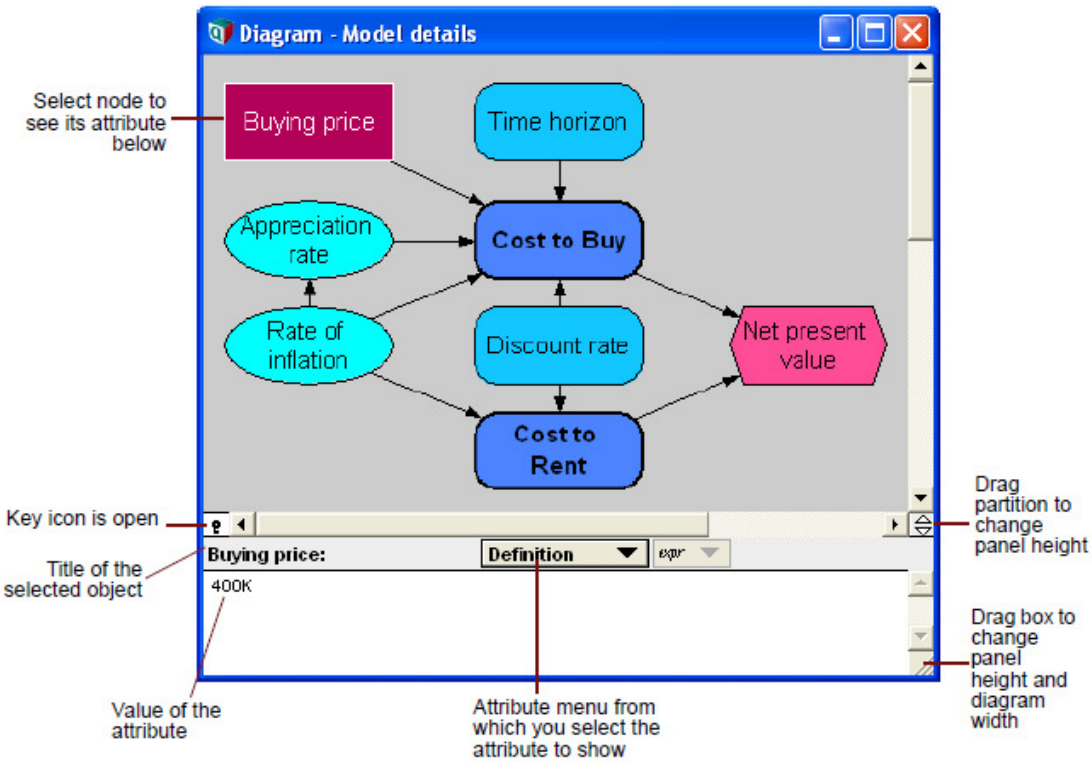
Returning to the parent diagram

Click the **Parent Diagram** button in the navigation toolbar to see the diagram that contains this node, with the node highlighted.

Attribute Panel

The Attribute panel

The ***Attribute panel*** offers a handy way to rapidly explore the definitions, descriptions, or other attributes of the variables and other nodes in a **Diagram** window. You can open the panel below the diagram, and use it to view or edit any attribute of the node you select. It shows the same attributes that you can see in the **Object** window, and often several other attributes.

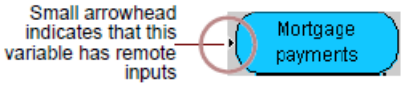


Click the key icon to open the **Attribute** panel. Here are things you can do in this panel:

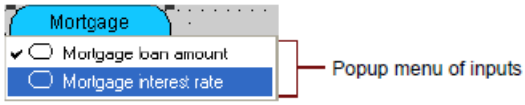
- Select another node in the diagram to see the selected attribute of a different object.
- Click the background of the diagram to see the attributes of the parent module.
- Select another option from the **Attribute** menu to see a different attribute.
- To enter or edit the attribute value, make sure you are in edit mode, and click in the **Attribute** panel, and start typing. (Not all attributes are user-editable.)

Seeing remote inputs and outputs

When a variable has a Remote input — that is, it depends on a variable in another module — a small arrowhead appears to the left of its node. Similarly, if it has a remote output, a small arrowhead appears to its right. Press on the arrowhead to quickly view and navigate influences between nodes in different diagrams (modules).



To see a list of the inputs (or outputs), remote and local, press the arrowhead on the left (or right) of the node.

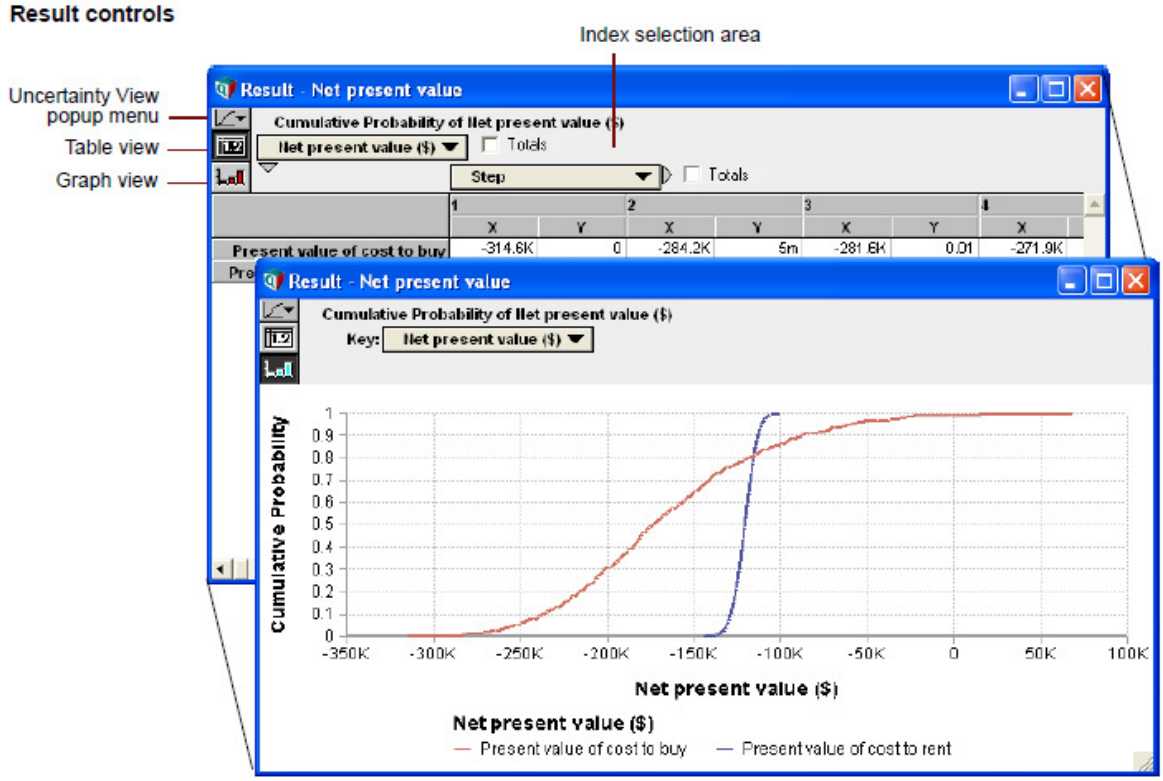


To jump to a remote input or output, select it from the list and stop pressing. It opens the **Diagram** window containing the remote variable, and highlights its node.

Result viewing options

There are many options for viewing results. Note that in the uncertainty view menu, only the “Mid value” is valid for the momentum savings models at this time.

Result controls



To open a Result window

Click the variable node in its influence diagram to select it, and do one of these:

- Click the **Result** button in the toolbar, or press key *Control+r*.
- Select **Show Result** from the **Result** menu.
- Select an **uncertainty view** option, such as **Mid Value**, **Mean Value**, or **Cumulative probability**, from the **Result** menu.
- In the **Attribute** panel below a diagram, select **Value** or **Probvalue** from the **Attribute** menu, and click the **Calc** or **Result** button.

To open a **Result** window for an output node, simply click its **Calc** or **Result** button.

Result controls

The ***Result controls***, in the upper-left corner of the **Result** window include these controls:

Press the **Uncertainty View** popup menu (page 29), to select how to display an uncertain quantity.

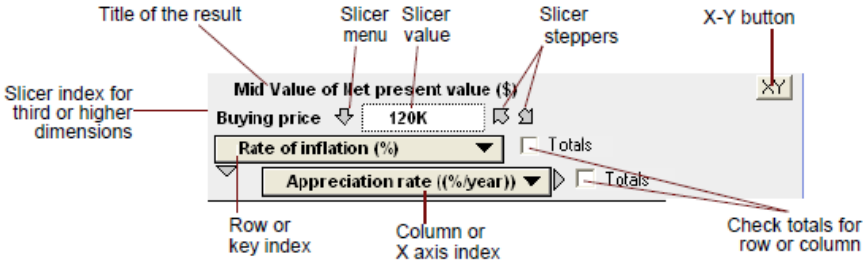
Click this button to display the result as a **table**.

Click this button to display the result as a **graph**.

Toggle between the table and graph views using the **Table View** and **Graph View** buttons.

Index selection

The **Index selection** area is the top part of a **Result** window. For a table, it shows which index goes down the rows, and which goes across the columns. For a graph, it shows which index is on the X axis (and sometimes Y axis) and which is in the key. For either view, if the array has too many dimensions to display directly, it also shows ***slicers*** that select the values of the extra indexes. Each control has a popup menu to let you exchange indexes and rearrange (***pivot***) the view.



The index selection area of a graph or table contains these items (example variables and indexes in the following text refer to the figure above):

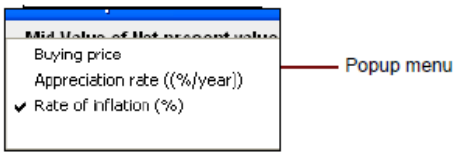
Title Shows the uncertainty view (mid, mean, etc.), the title of the variable, and its units, e.g., `Mid Value of Costs of buying and renting ($)`.

Slicer index The title, units, and value of any index(es) showing dimensions not currently displayed in the table or graph.

Slicer menu Press for a popup menu from which you can change the slicer value for the results displayed.

Slicer stepper arrows Click or to cycle up or down through the slicer values.

Row or key index Shows the title of the index displayed down rows for a table, or in the color key for a graph. Press to open a menu from which you can select another index.



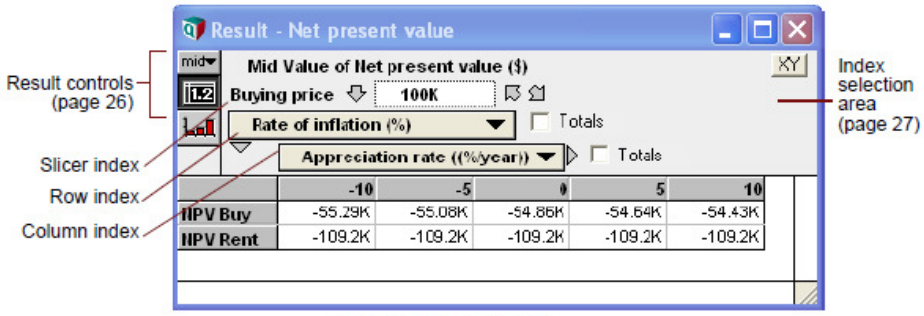
Column or X axis index Shows the title of the index displayed across the columns for a table, or along the X (horizontal) axis for a graph. Press to open a menu from which you can select another index.

XY button Click XY to plot this variable against one or more other variables, or to plot one slice of this variable against another slice. See "XY comparison" on page 95.

Totals checkboxes Check a box to show row or column totals the table view. If you check *Totals* for an index and then pivot it to be a slicer index, "Totals" becomes its default slicer value. This lets you show total values over the slicer index in the graph or table.

Viewing a result as a table

Toggle to table view If a result window shows a graph, click on the top-left to switch to table view.



Three-dimensional table

The index display options depend on the number of dimensions in the variable.

Row index (down) Use this menu to select which index to display down the rows of the table. Select blank to display a single row.

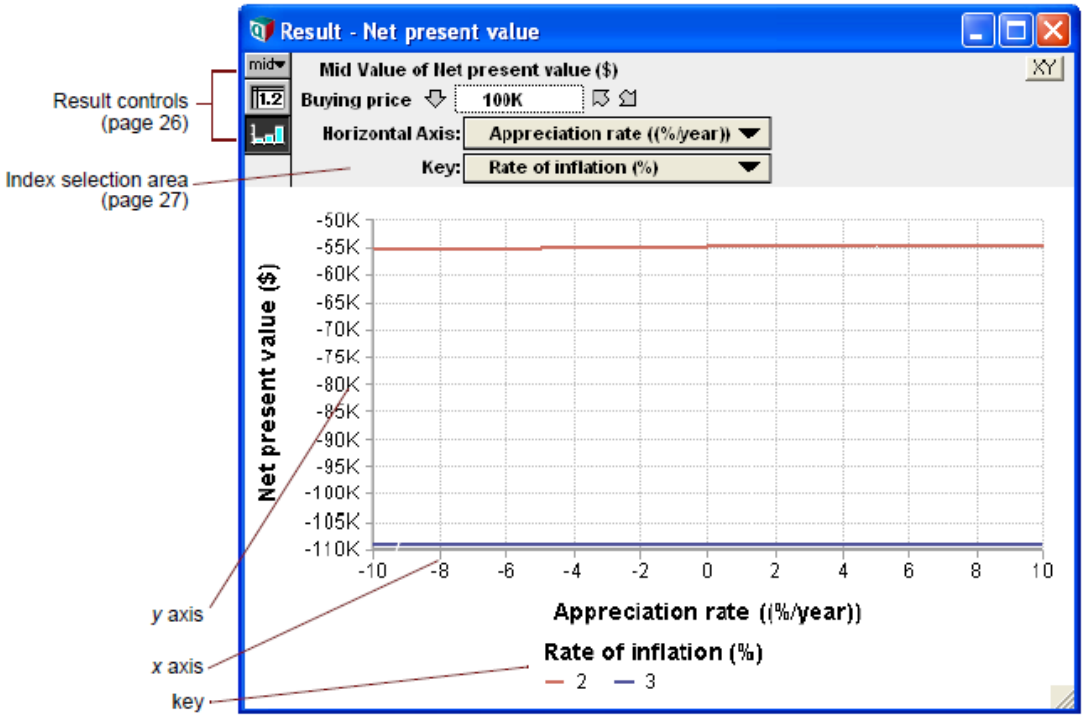
Column index Use this menu to select which index to display across the columns of the table. Select blank to display a single column.

Slicer index(es) If the array has more than two indexes, the extra index(es) are shown as **Slicer** menus. The table shows values only for the slice (subarray) setting the slice index to the shown slicer value. Open the slicer menu and select a different slicer value, or click or to step through the slicer values.

Formatting numbers To specify the format for the numbers in a table or along the Y (usually vertical) axis of a graph, show the graph and select **Number Format** from the **Result** menu, or press *Control-b*. The **Number format dialog** (page 78) offers many options, including currency signs, dates, and Booleans.

Viewing a result as a graph

Toggle to graph view If a result window shows a table, click on the top-left to switch to graph view.



The **y** axis, usually vertical, plots the values of the variable. The **x** axis, usually horizontal, shows the value of a selected index. The index display options depend on the number of dimensions in the variable.

X axis If the array has more than one index, use this menu to select which index to display along the **x** axis (usually horizontally).

Key index If the array has more than one index, use this menu to select which index to display in the key, usually showing each value by color.

Slicer index(es) If the array has more indexes than you can assign graphing roles (such as **x** axis or key), the extra indexes are shown as **Slicer** menus, as in a table view. The graph shows values only for the slice (subarray) setting the slice index to the shown slicer value. Open the slicer menu and select a different slicer value, or click or to step through the slicer values.

To reorder slicers If the graph has more than one slicer index, you can reorder the slicer indexes simply by dragging one up or down.

Graph setup options There is a rich variety of ways to customize the graph, including line style (lines, data points, symbols, barcharts, stacked bars, thickness, transparency), axis ranges, log or inverted axes, grid and tickmarks, background colors, and font color and size. To change these settings, open the **Graph Setup dialog** (page 85) and do one of the following:

- Select **Graph Setup** from the **Result** menu.
- Double-click anywhere on a graph in the **Result** window.

Useful Shortcut Keys

Shortcut Key	Function
CTL + R or F5	After selecting an object by clicking on it once, use this shortcut to show the results for that variable

CTL + W	Closes the current window, whether it's a result window, an object window, or a diagram window
F4	After selecting an object by clicking on it once, use this shortcut to open the object window
F2	If an object window is open, use this shortcut to take you to the influence diagram for that object
F3	Opens the outline window, allowing you to see where you're at in the navigation hierarchy
F6	After selecting an object by clicking on it once, use this shortcut to view the definition of the object
CTL + B	After opening the result window for an object, use this shortcut to change the number format of the results
CTL + F	Allows you to search for a particular object identifier or title
CTL + C	After highlighting values from within a results table, this allows you to copy the results to the clipboard
CTL + V	Pastes the values saved to the clipboard to an external document like Excel or Word
F1	Opens the user's guide as a PDF file