

CRITERIUM
DECISION
 **PLUS**

**The Complete Decision
Formulation, Analysis, and
Presentation for Windows**

Version 3.05

User's Guide

Tutorial

Credits

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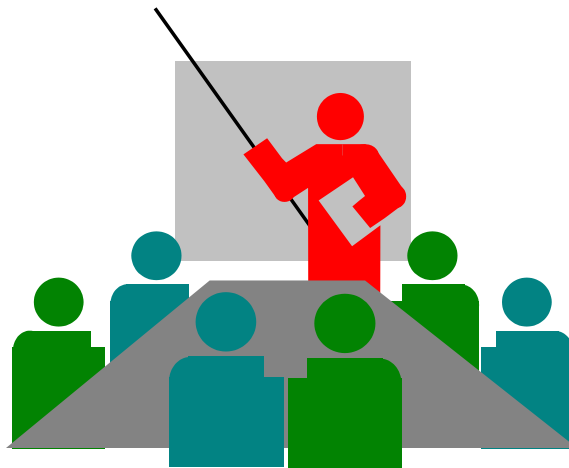
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Part I

Introduction



Using Criterium DecisionPlus

Congratulations on making a wise decision to purchase Criterium DecisionPlus. DecisionPlus is a decision management tool that can help you organize, complete and communicate complex decision-making tasks. Many decisions are tough and involve many different criteria against which various options or alternatives are compared. Tracking and rating the importance of that criteria and maintaining control of the decision problem are major challenges. DecisionPlus is specifically designed to help you make tough decisions easier: easier to formulate, easier to understand, and easier to communicate.

Assisting You in Making Decisions

DecisionPlus runs as a Windows application to assist you in making and presenting decisions. With DecisionPlus you list your criteria and alternatives directly onto the computer screen conveniently with the mouse and keyboard. Once you weight each of your decision criteria, DecisionPlus does the rest. In rationally choosing between alternatives, DecisionPlus synthesizes your inputs and presents the results in order of preference. You are still in control to accept the results and make the final decision.

What Benefits Do You Get from Using DecisionPlus?

Your experience with DecisionPlus builds power into your decisions by providing the following benefits:

- Speedier construction and elucidation of the decision.
- Deeper insight into factors affecting the decision.
- Confidence that all factors have been considered within the decision framework.
- Understanding of how sensitive the decision results are to judgments employed.
- Identification of criteria that are key in breaking an impasse (assuming no clear preference in alternatives occurs).
- Identification of the preferred alternative and how likely that alternative will remain the preferred one given uncertainty.
- Identification of information that would be most effective in producing an unambiguously superior choice if its uncertainty were reduced.
- A greater consensus and commitment from group members to a chosen course of action.
- Real-time presentations to persuade others of your recommendations



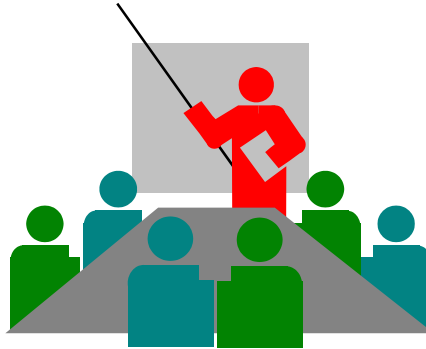
Chapter 1

Road Map to the User's Guide

In This Chapter

- Road Map to the User's Guide

Part I Introduction



Chapter 1 Road Map to the User's Guide

Our user's guide is divided into four parts. Each part is associated with a logo that will help you find your way easily throughout the guide. Under each part, we briefly describe chapter contents and identify the audience for each chapter.

Chapter 2 Requirements and Installation

This chapter describes the hardware and software requirements and the installation instructions you need to successfully run DecisionPlus. Everyone should read this chapter.

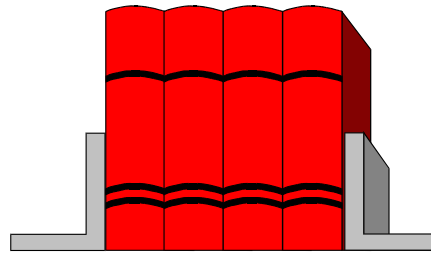
Chapter 3 Model Specifications

If you've used decision analysis before, you might find the specifications within DecisionPlus helpful. Information such as how many levels of criteria you can use, how many alternatives you can enter, and how many blocks you can have in any one model is found in this chapter.

Chapter 4 New Features in Version 3.0

Current users of Criterium DecisionPlus 2.x versions will find a comprehensive guide to the new features of version 3.0.

Part II Overview of Decision-Making with DecisionPlus



Chapter 5 Decision Analysis Techniques

This chapter introduces the Analytical Hierarchy Process (AHP) and the Multiattribute Utility Theory using the Simple Multiattribute Rating Technique (SMART). These decision-making techniques are incorporated into DecisionPlus. If you are familiar with these techniques, you may want to skip this chapter and go to Chapter 6.

Chapter 6 The Decision-Making Process

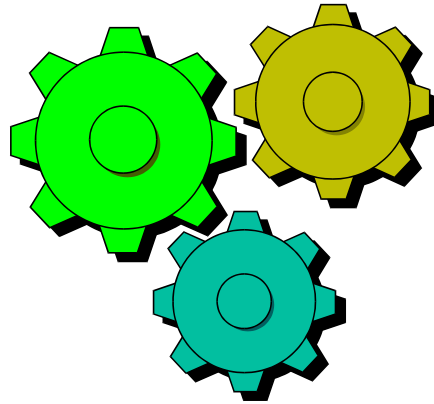
In this chapter we discuss how most people make decisions when working through complex decision problems. This Information reflects recent research on the decision process and is the basis for developing DecisionPlus.

Chapter 7 Using Criterium DecisionPlus

This chapter describes the functions discussed in Chapter 6 that are used in DecisionPlus. If you are unfamiliar with making structured decisions, or if you have used decision analysis before and want

background on how DecisionPlus synthesizes your inputs into preferences, this chapter provides help.

Part III Designing Your Own Decision Model



Chapter 8 Brainstorm the Problem

Here we show you how to get your thoughts about your decision down on canvas. You'll learn how to enter and save your own information and easily move your information around on the Brainstorm canvas. Your information does not have to be organized to use this program, but you will begin forming a light structure in this window.

Chapter 9 Build the Hierarchy

In this chapter we provide details for using all the techniques, features, and controls to build a decision hierarchy. You can generate a hierarchy automatically from your entries in Brainstorm or you can create it directly in the Hierarchy program. It's best to have your information at least lightly structured and have experience in using the Analytical Hierarchy Process (AHP) before creating the hierarchy.

Chapter 10 Weight the Criteria

You'll learn how to enter weights for each criterion you entered in your hierarchy. We discuss the different weighting methods and scales you can use and show you how you can create your own weighting scale.

Chapter 11 Select Uncertainty

We present more advanced techniques in assessing risk in this chapter. Once your criteria are weighted, the uncertainty in the risks may be characterized as probability distributions that are included in the results. We also present the Simple Multiattribute Rating Technique (SMART) in this chapter.

Chapter 12 Review the Results

Once you've weighted your criteria, you'll want to view the results of your work. This chapter covers several ways in which to look at results.

Chapter 13 Analyze the Results

Is your decision a reasonable one? This chapter helps you find the answer to this question by providing methods by which you can analyze your results. The advanced function of checking the contribution by uncertainty is also described in this chapter.

Chapter 14 Document the Results

To print your results, follow the steps in this chapter. We cover various ways you can print your results and create report formats.

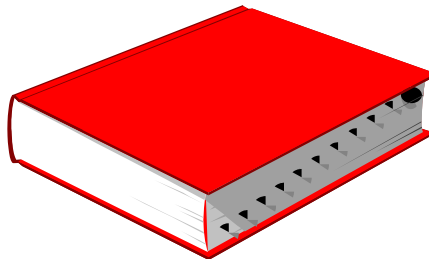
Part IV Tutorial for Creating a Decision Model



Chapter 15 Selecting a Vacation Book

In this chapter, we provide a tutorial using a simple model to make a decision using many of the features available in DecisionPlus. We assume you have no prior knowledge with decision making tools, and guide you through this process, providing you the information to enter.

Glossary, References, and Index



The glossary contains common Decision Analysis definitions, along with other terms used throughout this book. Also included are References and the Index.

Chapter 2

System Requirements and Installation

In This Chapter

- System Requirements
- Installing to Windows 95, Windows98 and NT 4.0
- Trouble with Installation
- Uninstalling Criterium DecisionPlus

Getting started: What is in the box?

You should find

- A User's Guide (what you are reading) *The Criterium DecisionPlus CD is in a jacket on the back inside cover of the User's Guide.*
- A Registration card (with your Serial Number on it) You can also register online, once the program is installed, by connecting to the internet, run CDP, select the Web Register item from the Help menu. Fill in and submit the registration form. You must register to obtain long term technical support.

System Requirements

The system requirements for this 32-bit Version of Criterium DecisionPlus are as follows:

- MS-Windows™ 95, Windows98™ or NT™ 4.0 (SP3 or higher), Windows2000™, WindowsXP™(See website for issues).
- Personal computer using an 80486 or higher CPU
- 16 MB of RAM (32 recommended).
- 14 MB of available disk space on the hard drive.
- One CD-ROM drive (3 1/2" diskettes available by request).
- VGA, Super VGA, or compatible video graphics adapter and monitor supported by the Windows operating system (color SuperVGA or higher resolution recommended).
- Mouse.

Installing to Windows 95™, Windows 98™ or Windows NT™ 4.0

To install DecisionPlus

1. Turn on your computer. Close any unnecessary applications (especially Microsoft Office applications).
2. Locate your CDP 3.0 CD-ROM on the inside back cover of the User's Guide.
3. Put the CDP 3.0 into your CD-ROM, give your CD drive a moment to power up. The CDP 3.0 install will start automatically. (If you have turned off auto start for CDs, use Explorer to locate and execute the setup.exe file on the CD.)
4. Follow the instructions on your screen until DecisionPlus is installed.
5. You must agree to the End User's License Agreement when asked by the software if you wish to complete the setup.
6. Finally, if the Setup program asks to reboot your machine, please do so. If the setup program indicated you needed to reboot your system, you will not be able to run CDP until you do.

To Start a Session with DecisionPlus

- Double-click the DecisionPlus Icon (the Green Tree), located in the Criterium DecisionPlus folder, which is open after the installation.

or, if you have closed that folder,

- Choose Programs from the Start menu, then choose the DecisionPlus submenu (assuming you did not change the default during setup) and then click the cdplus30.exe menu item. CDP will start.

Trouble with Installation

If you have any trouble with installing DecisionPlus, then

1. Access our technical support web pages at <http://www.infoharvest.com>.
2. Call technical support at (206) 686-2729. There is, of course, no charge for setup related problems. *You must provide your Serial Number (which you can find on the CD cover in the back of the manual and on the registration card) to the technical support person.* If you are asked to leave a voice message, give your name, Serial Number (on the CD cover in the back of the manual), telephone number and an account of your problem.

Uninstalling Criterium DecisionPlus

To uninstall CDP 3.0

1. Open control panel (from Start Menu, settings) and launch the Add/Remove program.
2. Select the Criterium DecisionPlus entry and click Add/Remove. In the ensuing dialog, choose to remove all shared components. All the application files and directories should be removed, unless the directories contain user created files, in which case those directories will be left.

Chapter 3

Model Specifications

In This Chapter

- DecisionPlus Model Specifications
- Windows Conventions Used in DecisionPlus

DecisionPlus Model Specifications

Entering information into DecisionPlus is easy, but somewhat different from entering information into other decision analysis tools. Below, we describe the specifications and conventions we use in creating our models.

If you have used decision analysis software before, you may want to know what model capabilities have been designed into DecisionPlus. We model decisions as hierarchies of criteria, and the specifications are as follows:

- 7 levels (including the goal level and the alternatives).
- Maximum of 500 blocks in the model (a block is a goal statement, a criterion, or an alternative).
- Maximum of 200 blocks on any level (not including the alternative level).
- Maximum of 50 subcriteria per criterion.
- Maximum of 200 alternatives (alternatives count against the 500 total blocks).

Windows Conventions Used in DecisionPlus

DecisionPlus runs in Microsoft Windows and we use standard Windows conventions. Because those conventions are already described in the Windows User's Guide, we refer you there for any needed brush-up or any new learning. We know that few people enjoy reading an entire manual, and fewer enjoy reading two, so we have provided a list of minimum conventions below that you should know. These terms are located in the Windows User's Guide glossary and index.

Active/Inactive Window	Mouse Action
Arranging Multiple Windows	Open Command
Buttons	Point and Click
Click	Pull Down Menus
Close Command	Print Command/Print Preview
Dialog Box	Print Setup
Double-click	Save
Drag and Drop	Save As
Exit Command	Scroll Bars
File	Select
Highlight	Sizing Windows
Maximize	Text Entering/Editing
Menu	Window
Menu Bar	
Minimize	

Chapter 4

New Features in Version 3.0

In This Chapter

- General Features
- Operating Systems
- Model Limitations
- Model Options
- User Interface Look and Feel
- Exporting Graphs to Other Windows Programs
- Help File Updates
- Brainstorm
- Hierarchy
- Ratings, Scales and Rule Dialogs
- Decision Scores (Results) Window
- Analysis Windows
- Reports Printing

1 General Features

1.1 Operating Systems

CDP 3.0 is a 32-bit software application. It runs on all the Windows PC 32 bit Operating Systems - Win95, Win98, NT 4.0, NT 5.0 (Beta).

CDP 3.0 will not run on Windows 3.0, 3.1 or Workgroup for Windows.

1.2 CDP 3.0 Model Specifications

Max Number of Alternatives :	200 (50 in CDP Version 2.0)
Max Number Goal + Criteria :	300 (160)
Max Total :	500 (160)
Max Number per Level :	200 (100)
Max Subcriteria per Criteria :	50 (20)
Max Super Criteria per Criteria :	10 (5)

1.3 Model Options

With CDP 3.0, you now have the ability to set default options (under the View menu in Hierarchy) that govern the behavior of many of the models, dialogs and the application itself. This is done through the Model Options.

The Model Options are for customizing CDP settings to your preferred defaults. Model Options are broken down into two categories.

Environment options and New Model options. Once options are set to your liking, they are generally not changed too often. If the default settings, when applied to particular model are not suitable, you can change the settings for just that model.

Environmental options are generally loaded with CDP, and are not usually saved with the model. (An exception would be the Best (High)

/ Worst (Low) labels used for scale extrema throughout CDP. But these labels too may be changed from the Assign Scales screen to affect just the current model.)

Examples of Environmental Options are whether Toolbars are visible or not, and whether lines connecting the Lowest Criteria in the Hierarchy to Alternatives are visible or not.

When an environmental option is set it is immediately (where appropriate) applied to the loaded model. However if that model is subsequently saved, and reopened in a session with a different configuration of Environmental Settings, these new settings will determine how the model appears.

Note: If you are in the Hierarchy window and wish to change the current block spacing, you can do so via the Options dialog. Be aware that when you click either of the Apply or OK buttons, all option settings in the Hierarchy View area will be applied to your current hierarchy model (not just the Spacing option you changed).

New Model options on the other hand, determine default values for options that are saved as changed for every model. Some examples would be the Page set up settings such as Header/Footer selections

A big addition to the Options is the ability to set fonts individually for Brainstorm, Hierarchy and Hierarchy in Situ Notes. The spacing of blocks in the Hierarchy may also be adjusted, allowing large models to be visually compressed. Some experimentation is required to find settings that work well on each computer system.

For more information on Options refer to individual chapters.

1.4 User Interface Look and Feel

Toolbars and Status Bars



Toolbars and a status bar have been added to the interface. The toolbar provides one click access to frequently used functionality, while the status bar provides key information such as whether the model is fully rated and fully connected. The Toolbar can be turned on and off through the Environment Options (see the section on Options, below).

Spell Checking

A spell checker has been added to the Hierarchy Notes Dialog. It allows you the spell check names and notes, and to build your own custom dictionary.

1.5 Updated Help Files

The Help files are being updated to take advantage of Windows 95 help system, including Microsoft's natural language query technology.

1.6 Exporting Graphs to Other Windows Programs

Hierarchy, Brainstorm, Contributions By Criteria, Scatter Plot - Export to Windows MetaFile

Use the Copy Graph to MetaFile from the Edit menu to copy an image of the hierarchy (regardless of size) to a file. This MetaFile will import well into Microsoft Word and other applications, and can be resized in situ.

1.7 Uninstalling CDP 3.0

You uninstall CDP 3.0 by going to control panel and choosing the Add/Remove program. Select Criterium DecisionPlus and click Add/Remove. In the ensuing dialog, choose to remove all shared components. The Application may or may not be removed depending on whether it contains user created files.

2. Brainstorm Window

2.1 Increased Size

Brainstorm can handle models of increased size (see Model Specifications and limitations above).

2.2 Options

A number of Options directly affect the appearance of the Brainstorm Screen. You can now set as environmental default values options such as Alternatives Visible, Confirm Drops and Font Size.

3. Hierarchy Window

3.1 Right Clicks

The Right Click event provides access to a broad range of functionality for the Hierarchy. By clicking your Right mouse button when over a block, you have direct access to all the menu items that are relevant to that Block type.

3.2 Connect All Alternatives, Show Missing Connections, Hide Connections to Alternatives

A number of new capabilities have been added to the Hierarchy View menu. See Hierarchy News section in chapter 9.

These three new items allow you to Fully Connect all Alternatives to all Criteria in the Lowest Level; to show, in lurid green, missing connections; and finally, to hide all connecting lines between the Lowest Criteria and the Alternatives. The latter, for large models, will greatly increase the speed at which the Hierarchy redraws itself.

3.3 Navigator

The Navigator no longer floats above the Hierarchy screen, but now arranges itself (docks) within the CDP application container. It will stay visible even if the Hierarchy window is minimized, so as to be a thumbnail guide for the other windows. For instance, if you open the Ratings Window in Hierarchy Weights mode, then choose different criteria to weight, the Navigator will show where in the model the current criterion lies.

The Navigator also shows a red rectangle corresponding to the present visible area of the Hierarchy. This helps orient you when traversing large models.

3.4 Alternatives Ratings Window

A new dialog has been added that shows all the Ratings of an Alternative against the various Lowest Criteria. You can now enter data through this Window. To access the Alternatives Ratings window, simply double click any Alternative in the Hierarchy Window.

3.5 In-situ Notes

Goals, Criteria and Alternatives with notes have a small red triangle in the upper right hand corner of the Block that represents them on the Hierarchy canvas. If you let you mouse hover over the triangle, you will be able to read the first 500 characters of the note. This allows you to browse notes very efficiently. To see the full note, simply right click the block and choose Edit Names/Notes.

3.6 Toolbars

Toolbars can be hidden or made visible by checking the Toolbar item



in the View menu of the Hierarchy Window. You can have them appear with a text caption or not by checking the Show Toolbar Detail item in the same View menu.

3.7 Options

A number of Options directly affect the appearance of the Hierarchy Screen. You can now set as Environmental Default values such options as Suppress Lines to Alternatives, Block Spacing and Font type and size.

4. Rating the Hierarchy Model

Direct Tradeoffs – a major new approach to defining the weights of your criteria hierarchy

4.1 Tradeoffs

In previous versions of CDP, your choice of weights and scales uniquely determined a set of tradeoffs, and CDP represented these tradeoffs to you. The philosophy was that Tradeoff values gave values you could compare against industry standards, historical norms, etc. and validate (or otherwise) your preference weights.

In CDP 3.0 you can directly set the values for tradeoffs, and based on these values and the scales you have defined, CDP calculates the equivalent weights. It does this whether the model is a single layer model or a more complex multi-layer model. See chapter 10 for a complete discussion of weights and tradeoffs.

You select your technique for rating the criteria by clicking Weights or Tradeoffs menu item under Hierarchy Technique under the Model menu in the Hierarchy window. You select your technique for rating the alternatives SMART/AHP by clicking the SMART or AHP option under the model menu.

Now when you Double Click the Goal or a non-lowest level criterion, the Ratings screen opens up with the active tradeoffs listed. You can either directly rate all tradeoffs, or choose a minimal set of tradeoff pairs. A minimal set is the smallest set of tradeoffs whose values are sufficient to determine all other tradeoff's values. CDP helps you effortlessly select Minimal Sets and provides you with a measure of how inconsistent a tradeoff set is, the Tradeoffs Inconsistency Index.

4.2 Conversion From Weights to Tradeoffs

Models whose Hierarchy Method was set to Weights (e.g., all 2.0 Models), and which were completely rated, will have the weight values converted to equivalent tradeoffs if the user changes the Hierarchy (rating) Method to Tradeoffs. A suitable reference Lowest Criterion will be chosen by CDP and all tradeoffs set with respect to that criterion's scale unit.

4.3 Conversion of Tradeoffs to Weights

Conversely, setting the Hierarchy Method to Weights will convert a Tradeoff model's tradeoffs back to weights. However, this conversion will normalize the weights for each criterion to the scale width. CDP will attempt to normalize the weights in each rating set so as to preserve the value of the highest weight. So going from Weights to Tradeoffs, and back again, will generally preserve familiar (highest) weights.

4.4 Tradeoffs Analysis Window

The Tradeoff of Lowest Criteria Analysis window (which has existed since Version 1.0), allows you to recalculate Tradeoffs against different Reference Criterion for the highest scoring alternative. In a consistent model with linear value functions for all lowest criteria, tradeoff values shown should be consistent no matter which Reference Criterion is chosen.

Note: the Tradeoff of Lowest Criteria Analysis only updates itself when clicked. So if you change the tradeoffs in the Ratings screen with the Real-time Update option on, the decision score screen and Contribution by Criteria window will update with every change, but not the Tradeoff of Lowest Criteria Analysis screen.

4.5 Alternatives Ratings Window

A new dialog has been added that shows all the Ratings of an Alternative against the various Lowest Criteria. You can now enter data through this Window. To access the Alternatives Ratings window, simply double click any Alternative in the Hierarchy Window.

4.6 Equalize All Weights (Tradeoffs)

You can, in a single menu selection, unrate or equalize the Hierarchy weightings (tradeoffs) depending on whether you are using the Weights (Direct Tradeoffs) Hierarchy Rating Technique.

4.7 Decimal Places to Display in Ratings window (Weights Hierarchy Technique Only)

When entering numbers in the Numeric View in the Ratings Window, the number of decimal places displayed can be controlled from the Decimal Places item in the View menu. Numbers can be entered with up to 6 decimal places, this option setting only affects how they are displayed. This option can also be set as an Environmental Option.

5. Decision Scores (Results) Window

5.1 Hide Options button

Clicking this button will hide the various controls that set options for the Decision Scores window. This will significantly increase the available space for graphics, particularly useful when you have large numbers of Alternatives.

6. Analysis windows

6.1 Alternatives Scatter Plot Analysis Window

A new Analysis screen Called Alternatives Scatter Plot has been added and is accessible via the Analysis menu on the Hierarchy Form. It shows 2-D scatter plots and bubble graphs of the alternatives data. It also offers a contour map of decision lines. These graphs help you see correlations between criteria across alternatives, and between the ratings of alternatives and accumulated values such as the decision scores.

For a complete description, see the section on Alternatives Scatter Plot Analysis window in chapter 13.

6.2 Contributions by Criteria Analysis Window

The contributions by criteria analysis window now utilizes a new graphics engine. You now have a choice of 4 graph types: the original stacked bar chart, pie charts, radar charts and trend charts. Each chart type reveals different aspects of what is driving the decision scores of the alternatives. Use both the View and Options settings to tune the graphs to your needs.

7. Reports Printing

7.1 Printing for new and enhanced windows

In CDP 3.0 you can print Alternatives Ratings, the new Alternatives Scatter Plot, Tradeoffs Ratings and the enhanced Contributions screen.

7.2 Headers and Footers

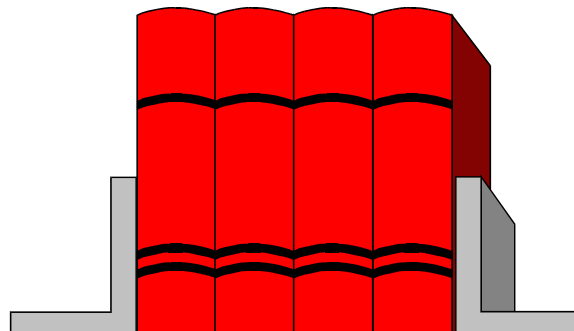
Headers and footers added to a report can be saved with the individual model. You can now add auto dates and Section Headings to headers and footers. You can use the New Model options settings to apply your specified Headers and Footers to each new model.

7.3 Cancel Button

A cancel button appears after clicking Print for reports, and can be used to stop long print sessions.

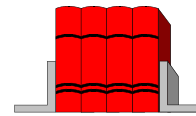
Part II

Overview of Decision-Making with Criterium DecisionPlus



The Making of A Powerful Tool

Incorporating decision analysis techniques, the decision-making process, and a specially designed graphical user interface makes DecisionPlus a powerful decision analysis tool. The next three chapters describe the development design and how you can put this power to work for you.



Chapter 5

Decision Analysis Techniques

In This Chapter

- Decision Analysis Background
- Analytical Hierarchy Process (AHP)
- Simple Multiattribute Rating Technique (SMART)
- Where to Find these Capabilities in DecisionPlus

Decision Analysis Background

We are all faced with decisions that affect our personal life, or with professional decisions that affect our job performance and financial well being. These decisions can be trivial or very complex depending on the problem or situation facing us at the time.

When faced with a decision, most of us rely on our experience or our intuition. We often seek advice from others in making our decision. Even the most mundane decision can be challenging if the outcome is very important in our lives.

Individual Decisions

Decisions are not often made in isolation even when they are made by individuals. For example, once a decision is made, one spouse must convince the other that buying the car was a good decision. Likewise, a manager must convince a boss or peers that their decision was a good one and explain the reasoning behind it.

Group Decisions

Many decisions involve a group of decision-makers that must reach a consensus on what should be considered in the decision and in the final results. So, the decision-making process is further complicated because working through the decision is a challenge, and because communicating it to others is equally challenging.

Research Findings

For a number of years, the academic community has researched theories and techniques that assist us in making good decisions. From this work, a number of approaches were developed that are implemented with the power we now have available in our personal computers.

DecisionPlus implements two primary decision-making methodologies currently being used by people, by companies, and by the government.

The two methodologies are the Analytical Hierarchy Process (AHP) and Multiattribute Utility Theory as implemented in the Simple Multiattribute Rating Technique (SMART). While there are deep similarities and differences between these two methodologies, the key difference between the two at the software level lies in the different rating techniques they use. In DecisionPlus, the choice of methodology is referred to as a choice between *rating techniques*. See our Reference section for a list of literature that discusses these techniques.

Analytical Hierarchy Process (AHP)

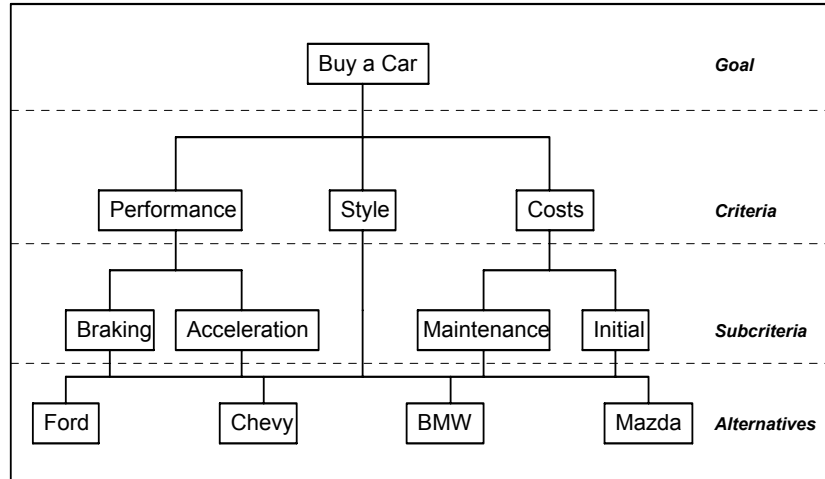
Making a decision involves considering a number of options or alternatives that can best satisfy an objective or a goal. One way to achieve this is to select from these alternatives when they are compared against one another with respect to a set of factors or criteria. The alternative that rates the highest becomes the preferred alternative when this comparison is made.

The Analytical Hierarchy Process (AHP), developed by Dr. Thomas L. Saaty at the Wharton School of Business in the 1970s, is a method of organizing information and judgments in selecting a preferred alternative. In making any decision, you must prioritize and group your decision criteria. In AHP, the most important criteria are grouped at the highest level with subcriteria grouped below which further define each parent criterion. Structuring the important elements to your decision is essential in the decision-making process.

Graphically, the decision problem can be constructed as a layered diagram starting with the goal, then showing the first level of criteria to be considered, followed by layers of subcriteria, and finally the alternatives. Such a diagram represents a hierarchy of elements (criteria and alternatives) that are to be considered in selecting the preferred solution.

A Decision Model Using AHP

The following diagram represents the decision to buy a car, applying AHP. You can see that the criteria to be considered in making this decision are *cost*, *performance*, and *style*. However, there are important subcriteria that should not be overlooked in this decision. The subcriteria, *acceleration* and *braking*, further define the factors to be considered under performance, as do the subcriteria, *initial* and *maintenance*, under cost. The alternatives that are available in making this decision are shown at the lowest level.



You should note that the subcriteria reflect a more detailed knowledge of the decision problem. In the diagram above, the *performance* criterion reflects our desire to consider this factor in our decision, whereas *acceleration* and *braking* further define exactly how we want to consider performance. Generally, the greater the subcriteria structure, the more knowledge or understanding of the problem we show. Assigning weights to the various criteria and subcriteria completes the decision model. At this point, mathematical calculation can be performed to determine the preference of the alternatives.

AHP has many advantages in assisting the decision-making process. Because it is graphical, it is easily understood by all involved in the decision. It forces discipline in structuring the problem and provides a

process that allows a complex decision to be broken into manageable parts. It allows integration of various criteria such as cost, technical performance, and style in the decision process and helps identify the most important element of the decision. When the decision results are printed, you have a record of how and why the decision was made. DecisionPlus allows you to use AHP to assist in selecting the preferred alternative. The next two chapters provide more detail in using our software in support of the AHP methodology. For more details about AHP, refer to Thomas L. Saaty's book, *Multicriteria Decision-making, The Analytical Hierarchy Process*. (See References).

Simple Multiattribute Rating Technique (SMART)

In decision-making there are methods other than AHP you can use to assist in making a decision. The Simple Multiattribute Rating Technique (SMART) is one such technique. It originates from the work done in Multiattribute Utility Theory (MAUT) by Ward Edwards in 1977.

When using SMART in decision-making, the decision problem is broken down into attributes, and single-attribute evaluations are constructed by means of value measurements. Somewhat like AHP, a value tree structure is created to assist in defining the problem. Values are determined for each attribute. Finally, aggregation of the model provides results facilitating comparison of the alternatives.

SMART provides a straightforward way of employing MAUT techniques. You can select elements that are simple and easy to apply, use the direct rating procedure for assessing single attribute values, and use additive aggregation in calculating the preferred alternative. You can use nonlinear functions in assigning values to the attributes.

Where to Find these Capabilities in DecisionPlus

DecisionPlus provides both capabilities to enhance your decision-making. For more details on using SMART, see section Choosing the Model Technique: SMART or AHP? in Chapter 10, Rate the Hierarchy. For more information about SMART, refer to Detlof von Winterfeldt and Ward Edwards's book, *Decision Analysis and Behavioral Research* (see References).

Chapter 6

The Decision-Making Process

In This Chapter

- Our Basic Approach to Making Decisions
- Define the Problem
- Select the Decision Group
- Identify Issues
- Develop the Decision Structure
- Judge the Importance of the Criteria
- Evaluate Alternatives
- Check Reasonableness
- Finalize the Decision
- Documentation
- Where to Find these Steps in DecisionPlus

Our Basic Approach to Making Decisions

When faced with a complex decision, we are often somewhat uneasy about working through the problem logically and making the best decision based on the available information and understanding of the issues. This section presents a process for working through the problem and shows how DecisionPlus uses this process to make this task easier.

Our general approach to making decisions can be described as a process of logical activities. Kenneth H. Mitchell and Edward A. Wasil identified these activities in their book, *“The Analytical Hierarchy Process, Applications and Studies,”* published by Springer-Verlag in 1989. The activities are described below.

Define the Problem

A clear statement of your decision problem must be formulated. The statement must imply choosing the best alternative to meet the objective (such as allocating resources, determining the best course of action). Not only must you identify the goal or objective, but you must also define the factors that are important or that can affect the decision.

Select the Decision Group

If you are making the decision alone, then selecting a group is unnecessary. However, even in this situation, you should be aware of the person or group that will be or wants to be invited to review the decision. An understanding of the reviewer’s knowledge and experience helps to communicate the decision results successfully.

In most organizations the decision-makers include management, technical staff, and consultants with expertise in the problem area. A key element in successful decision-making is selecting a group that collectively has the necessary expertise to apply to the decision. Your group should include all clients and stakeholders affected by the outcome. A consensus in the decision group should be achieved in the decision process in order for the final decision to have a better chance of being accepted.

Identify Issues

Once you assemble your decision group, your first task is to identify all the factors to be considered in the decision. Brainstorming at this stage often helps. This important task solidifies the group with a specific decision-making focus.

Develop the Decision Structure

In cases where you are using the AHP approach, creating a hierarchy of the problem is an essential step in the process. Building the hierarchy assists in organizing the problem and forces discipline in the decision-making process. Completing this step results in a clear understanding of the decision problem.

Steps in the logical generation of the hierarchy are:

1. Identify the goal.
2. Identify factors or criteria important in satisfying the goal.
3. Where appropriate, identify subcriteria under each criterion.
4. As the hierarchy expands down in subcriteria, the level of detail or understanding should increase. The lowest level is just above the alternatives level. This lowest level of criteria/subcriteria should

represent an attribute of the alternative that can be objectively evaluated.

Judge the Importance of the Criteria

After you generate the hierarchy, you can assign weights to the criteria. There are a number of ways you can do this. If quantitative data on the criteria are available, you can assign direct numeric values against an established range for each level in the hierarchy. Without data, you might have to compare criteria at a given level by what is known as pairwise comparison. Each criterion is subjectively compared with each other on the same level. At this time, you can determine that certain criteria have little importance in the decision and can be dropped from further consideration.

Evaluate Alternatives

Each alternative is now evaluated against the lowest criteria. You can decide at this time to drop or add alternatives.

Check Reasonableness

Once you determine the initial results, your decision group should review the outcome and analyze the results. This can be as simple as stepping back from the problem and thinking about it, to performing what is known as sensitivity analysis. The concern at this point is how robust are the decision results? What happens if you make small changes in the weights? If needed, your group can return to any point in the process, make modifications, and recalculate the results. By proceeding in this manner, your group can be confident that their decision is sound and stands up to audits by interested parties.

Finalize the Decision

Once you check the reasonableness for the results carefully, the decision-making group convenes to resolve any outstanding issues and to finalize their decision.

Documentation

Documenting the results is a very important step in the process. The results should be available for review by all clients and stakeholders. In addition, the decision is documented in case it becomes necessary to revisit the decision due to unexpected changes.

Where to Find these Steps in DecisionPlus

The next chapter describes how we incorporated these steps into DecisionPlus and how you will use the program.

Chapter 7

Using DecisionPlus

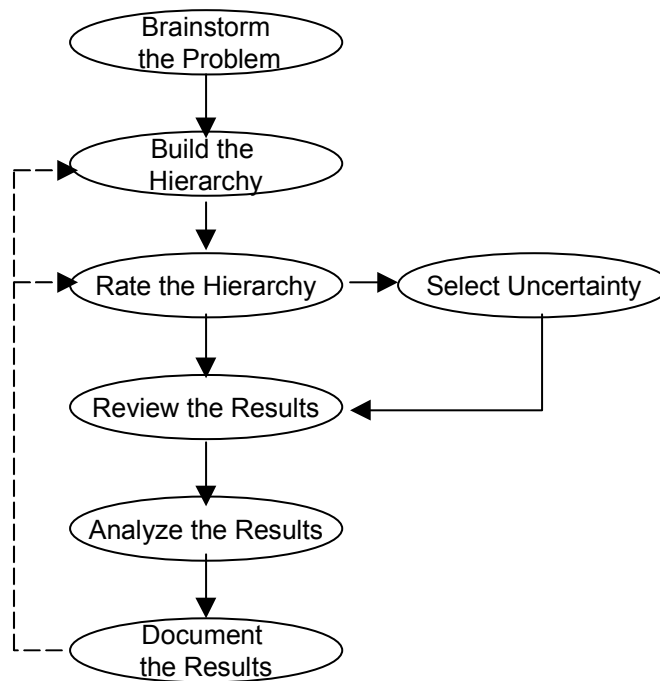
In This Chapter

- The Decision Process
- On-line Help with the Decision Process
- Brainstorm the Problem
- Build the Hierarchy
- Rate the Hierarchy
- Select Uncertainty
- Review the Results
- Analyze the Results
- Document the Decision
- Where to Go from Here

The Decision Process

DecisionPlus supports the basic approach described in Chapter 6. The functional capability included in DecisionPlus makes your decision-making much easier. It does the hard work and lets you do the part people do best—apply brain power to the problem.

Below is our process diagram showing the process that DecisionPlus supports. It is essentially the general process to decision-making discussed in Chapter 6, minus purely people-intensive activities (such as selecting the decision group, or reflecting on the decision).



Process Diagram

On-line Help with the Decision Process

DecisionPlus offers unique, on-line Help with the decision process. From any major window, the decision Process Diagram can be accessed by holding down the Shift key and pressing the F1 function key (Shift+F1). The decision activity supported by the window you are in is highlighted within the process diagram; a brief description of the purpose of the activity is presented, as well as notes on what to do next, and on what you have just done. Each section is hypertext enabled, to bring you directly to the next or previous activities, or to detailed information in the regular Help files.

We hope this parallel Help system for the decision process will help direct users who are new to such a structured decision methodology through the entire process, and explain to those who have experience with decision methodologies how DecisionPlus structures the decision process.

Brainstorm the Problem

The first three steps in the decision process are to define the problem, select the decision group, and identify the issues. DecisionPlus's brainstorming capability (shown as the first circle in the Process Diagram) assists you in defining the problem and identifying the issues. This allows you to concentrate on the task at hand and to maintain status on completed work. It also enhances your thinking process by freely facilitating reflection and association of thoughts. During the Brainstorm session, you start with a clean canvas and conclude with the goal, important criteria, and alternatives identified. After working with Brainstorm, you will probably discover that you can apply this capability in any situation where a topic is being

discussed or “brainstormed” by a group. You don't have to use Brainstorm only when working on a decision problem.

Build the Hierarchy

The next step, of course, is to build the structure or hierarchy. If you use Brainstorm to initiate your decision-making process, you can have DecisionPlus automatically build the hierarchy for you. If you already have the problem well defined, you may choose to build the structure directly in the Hierarchy session. In either case, DecisionPlus's mouse-driven interface makes it easy for you to work the problem. You can add, delete, or move items easily in the hierarchy.

Rate the Hierarchy

Judging the importance of your criteria and scoring your alternatives is next.

We term judging the importance of your criteria as weighting the criteria. To determine the weights, you are actually still in DecisionPlus's Hierarchy session even though the process of weighting is a separate task. Now you must decide what weighting method you will use. This will depend on the problem, the information available, and the preferences of the decision-maker. In any case, we allow you to select either the direct comparison or pairwise comparison method.

DecisionPlus allows you to enter and view each weight in three ways. They are the numeric view, the verbal view, and graphic view. Each view has a corresponding scale. You can create new verbal and numeric scales. You can make full pairwise comparisons by rating criteria one against another within its rating set or by using an abbreviated pairwise comparison that rates only subsets of all such pairs.

You then rate the alternatives against those criteria, again by assigning values with respect to numeric, verbal or graphic scales. If you use the SMART methodology, you can define a function to determine the effective value of such ratings. The next chapter provides all the details needed to use any of the above capabilities.

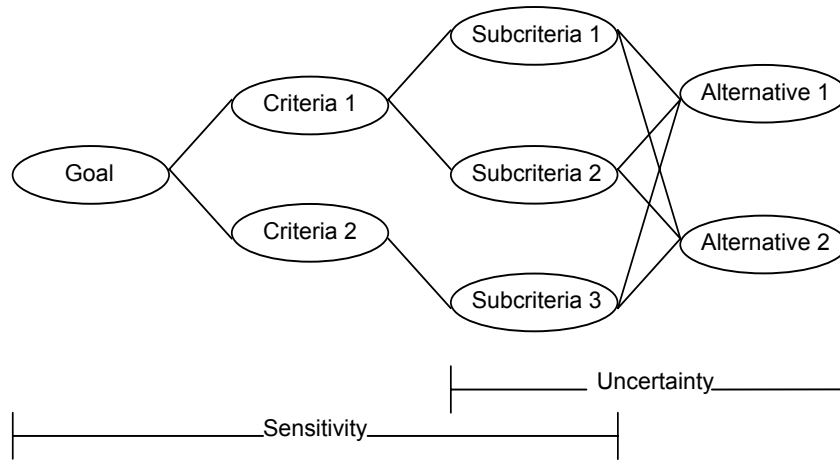
Select Uncertainty

This step may be considered a refinement of the basic decision process, and you may wish to return to it later when you are more familiar with how DecisionPlus structures decisions.

In many decisions, there are unknowns in the values available to decision-makers. This becomes more obvious at the lower levels of the hierarchy where there is a greater understanding of the problem. In the real world part of the problem, this uncertainty manifests itself as risks in the decision-making process.

To determine the risk, you must ask the question, “How does this uncertainty affect the robustness of my decision?” You can answer this by analyzing the uncertainty in your information and including it in the decision-making process. DecisionPlus provides a capability to characterize this uncertainty in your data as “probability distributions.” The results of the process are then expressed as distributions of the preferences amongst alternatives instead of as discrete values of preference.

We offer the following diagram to clarify how we apply sensitivity analysis (see the next section) and uncertainty in DecisionPlus. As you can see from the diagram, sensitivity analysis considers the sensitivity of the results to the weightings of all subcriteria with respect to their parent criteria. Uncertainty, on the other hand, is applied only to the lowest criteria, the criteria with respect to which the alternatives are directly rated. This is because when you have many levels of detail, the criteria decompose and those at the lowest level reflect a more quantitative understanding of the problem. Criteria at higher levels are more abstract and subjective.



Analysis Diagram

Refer to Part III for details on how to include uncertainty in your decision.

Review the Results

The next step is to review the results. DecisionPlus calculates in real time. That is to say, it continually calculates the results as you enter the weights so that if you change a value you can immediately see the results. You can view the results as discrete values, “decision scores”, representing the preferences of the alternatives, or you can request a “contributions screen.” This screen shows the contribution to each alternative preference based on the criteria at a given level in the hierarchy. DecisionPlus shows this as a stacked bar histogram with bars representing the contribution from each criterion.

Analyze the Results

Checking for reasonableness and robustness of the decision is a very important part of the process. DecisionPlus investigates the reasonableness of the decision through a Tradeoff Analysis and the robustness of the decision through a Sensitivity Analysis.

A key feature of difficult decisions is that they involve conflicting criteria - you want solutions that are cheap but of high quality. The tradeoff analysis shows you quantitatively how you are trading off one lowest criterion against another. The values of these tradeoffs will help you understand if the preferences you entered are leading to a reasonable decision.

The sensitivity analysis determines how sensitive the decision is to changes in the relative importance assigned to criteria. When you initiate Sensitivity Analysis, DecisionPlus shows you a list of weights of subcriteria with respect to their parent criteria with a metric that measures the sensitivity of the result when you change the value of that weight. DecisionPlus prioritizes the list in order of “most critical” to “least critical.” This way, you can focus on the criteria that can influence the decision the most. After this session you should know if the preferred alternative is robust and if you can be confident of your final decision.

Document the Decision

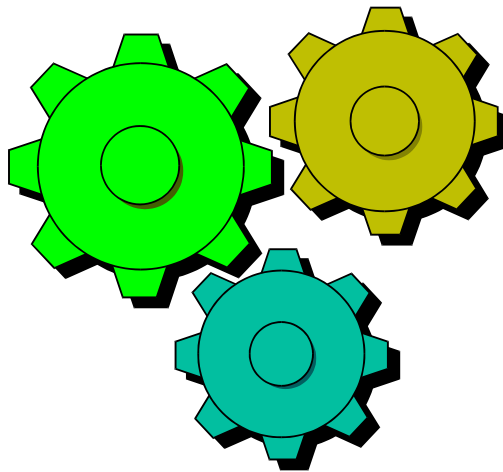
The last, but equally important part of the process is to document the decision. DecisionPlus provides complete report generation for your work. You can be confident that the why and how of your decision is available for peer, boss, client, or stakeholder review. And, most importantly, you can return to the decision if events dictate that the process be revisited.

Where to Go from Here

You now have a choice as to where to go in the documentation. You can go to Part IV, Tutorial for Creating a Decision Model, for a tutorial on a making a decision with DecisionPlus, or you can go to Part III, Designing Your Own Decision Model for the details on using DecisionPlus. If you are new to decision-making using software tools, you might prefer to go through the tutorial first. The tutorial leads you step by step through the process of creating a sample decision model and selecting the preferred alternative.

Part III

Designing Your Own Decision Model



Building Your Own Decision Model

Are you in the right place and are you prepared to begin Part III? To determine your needs, go through the checklist below.

- Prepared to design your own model?*

Part III instructs you in entering your own information to design your decision model. You should have a goal in mind (for example, select a college), at least two alternatives from which to choose (Harvard or Yale), and some ideas about what considerations you think should be included in satisfying that goal (curriculum, location, cost).

- New to decision analysis?*

If you are new to decision analysis methods or software, you may want a quick overview before you begin this section. Turn to Chapter 5, Decision Analysis Techniques and Chapter 6, Decision-making Process and Chapter 7, Using DecisionPlus.

- New to decision analysis terminology?*

With any new method or new software you'll find new terms. Refer to the Glossary at the back of this manual.

- New to Microsoft Windows?*

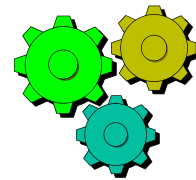
We refer to many screen and mouse functions that are standard in Microsoft Windows and are already well documented in their user's guide. If you are unfamiliar with Microsoft Windows conventions, review your Windows manual or have

it close by. See Chapter 3, Model Specifications, for a list of Windows conventions we use.

How Much Detail is in Part III?

We cover all options on all windows. That means we'll cover some options you won't want or need to use. We've added plenty of subheadings to aid you in scanning for functions you need.

If you don't have enough information about your own decision problem to proceed, you might try the tutorial in Part IV where we provide you the information to create a small decision model.



Chapter 8

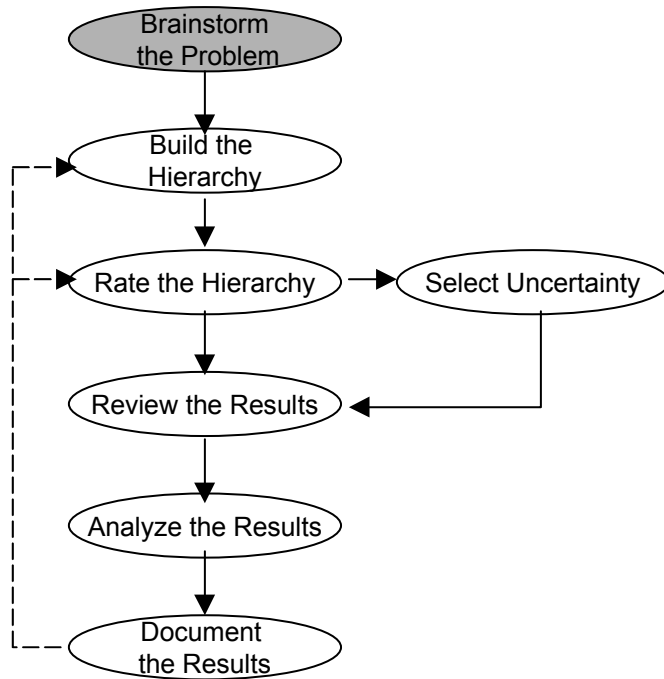
Brainstorm the Problem

In This Chapter

- Brainstorming as Part of the Decision Process
- Brainstorming on Canvas
- Displaying the Brainstorm Window
- Entering Your Decision Goal
- Entering Your Alternatives
- Entering Your Criteria
- Pasting Tables of Data to Brainstorm
- Selecting Multiple Blocks of Criteria
- Grouping Your Criteria Blocks
- Connecting Criteria to Create Parents and Children
- Connecting Criteria to Your Goal
- Collapsing and Expanding Families
- Cleaning Up Your Canvas
- Storing Criteria in the Recycle Bin
- Retrieving Criteria from the Recycle Bin
- Finding Blocks on the Canvas
- Printing the Brainstorm Window Contents
- Viewing your Brainstorm Profile Dialog
- Brainstorm Menu Commands
- Brainstorm Window Toolbar
- What's Next

Brainstorming as Part of the Decision Process

Where are you? You are in the shaded part of the Process Diagram below:



Process Diagram

Brainstorming on Canvas

Often, when organizing your thoughts about a critical decision you wonder where to start. You take out a pencil and a sheet of paper, a new Pink Pearl eraser, and begin scribbling and erasing your thoughts about what you really want. After several attempts, you find you didn't start your draft far enough down the paper and have run out of room in the top left corner. "Well," you think, "I guess I should have thought this through a little more before I started my draft." You crumple up the paper, shoot for the wastebasket hoop, and take out a new sheet of paper.

The beauty of DecisionPlus' Brainstorming is that your thoughts don't need to be organized before you start, outside of knowing what your goal is and what your choices are. You don't need paper, pencil, eraser, or an empty wastebasket. You don't even have to know how much room you'll need to draft your ideas. The Brainstorm window allows you to get your thoughts on canvas and aids you in organizing them.

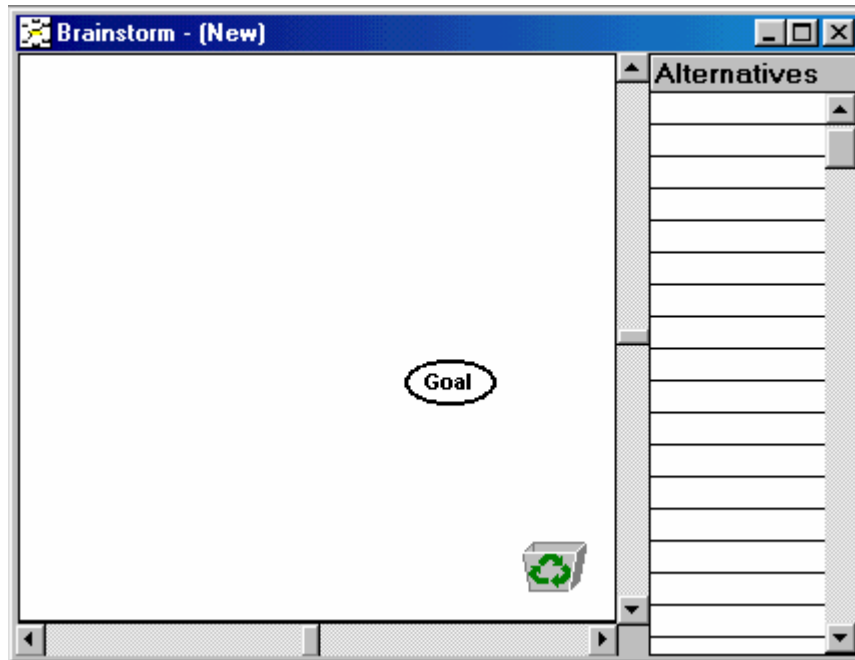
Note: Brainstorming is optional. If you are familiar with decision analysis software and have a decision framework or hierarchy already in mind, you may prefer to enter your decision model directly in the Hierarchy window. However, in the Brainstorm window you have the advantage of moving your criteria around freely until you've created the best representation of your ideas before using the system to create a hierarchy for you.

Displaying the Brainstorm Window

1. To open a new Brainstorm file, double-click your DecisionPlus icon. DecisionPlus automatically starts a new brainstorming session for you.

2. Or, if you already have DecisionPlus running, and have neither a Hierarchy nor Brainstorm file open, select New Brainstorm from the File menu.

The Brainstorm window, as shown below, automatically opens a new file temporarily named “New” and displays a template showing you where your goal and choices (alternatives) go.



3. To open an existing brainstorm file, select Open from the File menu to display a list of .bst files. Select the one you want. The Brainstorm window displays your file.

Brainstorm Window Description

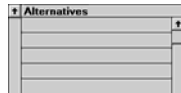
The Brainstorm window has two parts, side by side. The left part looks like a canvas that you'd sketch on. On the right is a long gray rectangle with many horizontal empty rectangles. In the middle of the canvas is a circle with the word "Goal" inside, and in the lower right corner, a recycle bin. You can adjust the size of or scroll the Brainstorm window as instructed in your Windows User's Guide (see Chapter 1, Road Map, for a list of Windows terms).



The goal circle appears in the center of the Brainstorm canvas. Your decision goal name goes here. The goal circle, and anything entered on the canvas, turns gray when you put your cursor on it. As you'll see later, this indicates that you are working with or doing something to that block. You can move the goal circle anywhere on the canvas by using the Windows drag and drop feature.



The recycle bin in the lower right corner of the canvas temporarily stores ideas you prefer to work with at a later time. You cannot recycle the goal or alternatives. However, you can store groups of ideas in the recycle bin. Storing items is easy. You just drag them to the bin in the lower right corner of the canvas. When you're ready to retrieve items from the recycle bin during the same session, open the recycle bin window, drag the items out of the recycle bin onto the canvas, and close the recycle bin. (See "Storing Criteria in the Recycle Bin" later in this chapter.)



To the right of the canvas is a gray column named Alternatives. This is where you enter the choices you have available in attaining your goal. You can enter up to 50 alternatives. You can turn off the Alternatives column to give yourself more canvas space to work on.

To Close the Brainstorm Window

1. From the File menu, select Close.

2. Or, from the Document Control menu (the hyphen to the left of File), select Close.

To Close DecisionPlus

1. From the Control menu (the hyphen in the extreme upper left corner), select Close.
2. Or, from the File menu, select Exit.

Entering Your Decision Goal

Your decision goal is what you expect to accomplish after entering, weighting, and analyzing your decision criteria.

Note: Use the Microsoft Windows conventions for typing text.

To Edit the Goal

1. Click once inside the goal circle to select it. A selection box with “handles” appears around it.
2. Click once on the word “Goal” to enter the edit mode.
3. Type the name of your goal (such as Buy a Car).
4. Click outside the goal circle, or press ENTER.



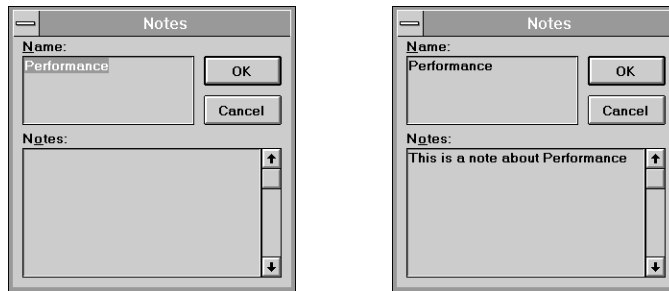
If your goal name is particularly long, it may extend beyond the canvas display. If this is the case, you can either turn off the Alternatives display by selecting Alternatives from the View menu, or you can adjust the size of the view from the Zoom command on the View menu. Alternatively, you can move the goal anywhere on the canvas.

To Enter Notes about Your Goal

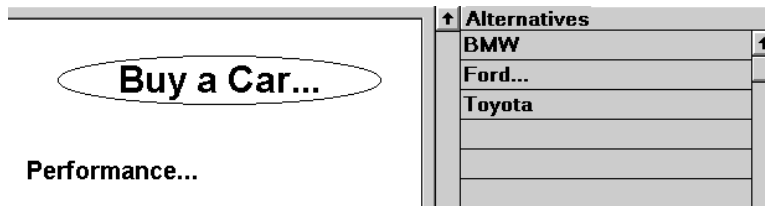
You can enter notes for the goal during the Brainstorm process.

Note: Notes are especially handy if you have a lot of criteria that might make you forget why a criterion was important or how it relates to other criteria. You can enter notes about your goal, criteria, or alternatives by using the menus or by using the mouse as described below.

1. Select the goal.
2. Press CTRL+N, or select Block Notes from the Edit menu. The Notes dialog box displays. Your goal name is highlighted in case you want to make a change.
2. TAB to or click in the Notes area.
3. Type in your text.
4. Select OK or press ENTER.



Three dots now appear following your criterion name to indicate notes are attached. In the following illustration, dots appear after the goal, a criterion, and an alternative.



Entering Your Alternatives

Your alternatives are the choices you have in satisfying your goal (such as selecting a BMW, Ford, or Toyota). You want to select the best alternative, of course. You'll most likely be thinking of your alternatives as you enter your criteria since most of your alternatives have many of these features. You can enter up to 50 alternatives.

To Enter Your Alternatives

1. Click any gray rectangle in the list of alternatives.
2. Type your first alternative.
3. Press ENTER.

You are set up automatically in the next gray rectangle to enter your second alternative. Repeat steps 2 and 3 until you have entered all your alternatives.

To correct any mistakes, click on the alternative you want to correct and use the standard Windows text editing techniques to edit.

Alternatives	
	↑

Alternatives	
BMW	↑
Ford...	
Toyota	

To Enter Notes about Your Alternatives

1. Double-click an Alternative to display the Notes dialog box. (See "Enter Notes about Your Goal" for an illustration.)

If you are currently editing an alternative, double-clicking does not work. In this case, click any other alternative, then double-click the alternative you want again. You can also press CTRL+N, or select Block Notes from the Edit menu.

2. TAB to or click in the Notes area.
3. Type your notes.

4. Select OK or press ENTER.

To Edit or Delete an Alternative

1. Single-click on the alternative you want to change.
2. To change the name, use the Windows text editing techniques.
3. To delete the name, select the text and press the DELETE or the BACKSPACE key.
4. Select OK or press ENTER.

To Change the title "Alternatives"

You can change the title of the Alternatives list box (e.g., to "projects" or "Tasks").

1. Choose [Alternatives Name](#) from the [Options](#) menu. The standard Notes dialog appears and you can enter the new name and any pertinent notes. (If you later generate a Hierarchy, this information will become the name and notes for the Alternatives Level.)

To Save Your File

Following common Windows practice, we suggest saving your file at this point.

1. Select Save or Save As from your File menu.
2. Select a directory and enter a filename.
3. Select OK.

Your file is saved with an extension of *.bst*.

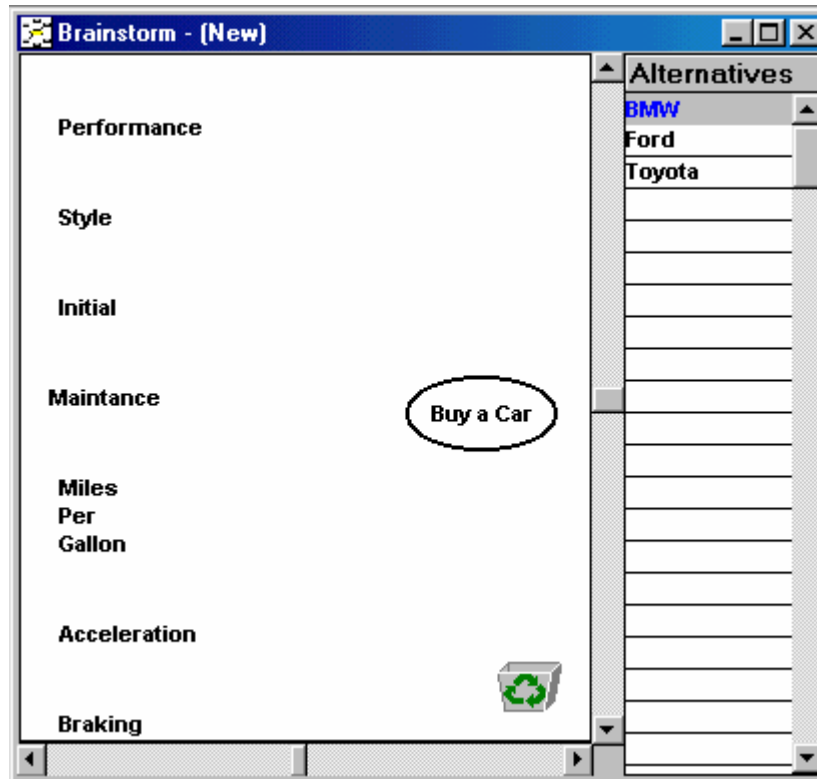
Entering Your Criteria

Criteria are what you think is important to consider in making your decision. You'll have main criteria (such as, Performance, Cost,

Maintenance) and subcriteria (such as service, fees, restrictions for Maintenance). In fact, you can add up to seven levels of criteria, including the goal. The Brainstorm canvas provides you a free-form method of entering these criteria. You can enter criteria one at a time as they pop into your head and rearrange them on the canvas later, or you can enter a group of related ideas, group them and connect them to your goal before entering another group.

To Enter Criteria

1. Double-click anywhere on the canvas outside the decision goal circle. A block appears with the cursor blinking inside.
2. Enter a criterion that you believe is important to consider about your decision.
3. Press ENTER to accept your criterion and to display another empty block.
4. Repeat steps 2 and 3 listing ideas as you think of them, until you have listed all your criteria. They do not have to be ordered.
5. When you have finished, click outside the rectangle. Using this method, your Brainstorm window should look similar to the one below.



You can double-click anywhere on the empty canvas to create an empty block for new criteria.

Sizing Your Criteria

Sometimes the names of your criteria are larger than the default block size. You can adjust the size of any criterion block, or the goal block.

1. Click on any block to select it.
2. Position the mouse cursor over any of the handles of the selection box.
3. Click and drag the handle to size the block.

4. Release the mouse button to finish the size adjustment.

Note: If at any time you decide you do not want to work with some of the criteria you've entered, you can delete them or store them in the Recycle Bin and retrieve them later. (See "Storing Criteria in the Recycle Bin" in this chapter.)

Enter Notes about Your Criteria

1. Click the criterion block you want to select. The Notes dialog box displays. (See "Enter Notes about Your Goal" for illustration.)
2. Press CTRL+N, or select Block Notes from the Edit menu.
3. TAB to or click in the Notes area.
4. Type your notes.
5. Select OK or press ENTER.

Reminder: Save your file often

To Edit Criteria

1. Click once on the block. A selection box appears around the block.
2. Click once on the name to highlight it.
3. Type a new name, or use the standard Windows text editing techniques to edit the text.
4. Click anywhere outside the block, or press ENTER.

To Delete Criteria

1. Click once on the block you want to delete.
2. When the box appears around the block, press the DELETE key. Or, select Delete Selection from the Edit menu.

Pasting Tables of Data to Brainstorm

Pasting Tables of Data to Brainstorm

A **Paste Special** menu item has been introduced to the Brainstorm window's **Edit** menu. This menu command permits the pasting of a table of data, consisting of criteria names, alternative names, and ratings, into a brainstorm. This is helpful if you have to incorporate spreadsheet data into your Brainstorm file. The pasted data is used to create Brainstorm blocks and alternatives. The rating values are retained and when the brainstorm is converted into a hierarchy, the rating data is transferred and may be viewed from the rating screen.

Restrictions on Data Format

The spreadsheet data must be organized in a tabular format with either alternative names as column headings and criteria names as row headings or vice versa. (Column headings to appear at the top of the columns as opposed to the bottom - likewise for row headings which must appear on the left, not the right.) The rest of the matrix contains rating data, which must be numeric. e.g.

criteria/alts	alt 1	alt 2	alt 3
cri 1	2.0	3.1	1.3
cri 2	106	190	155

To import tabular data to Brainstorm

1. Open any spreadsheet that, usually by a simple Copy command, places Tab Delimited String (See Glossary) tables onto the Clipboard, and create or locate a table of data that fits the above description.
2. Select the table (Including criteria and alternative names) and copy it to the clipboard.

3. Open Criterium and select the Paste Special menu option from Brainstorm's Edit menu. The Paste Special dialog box displays.
4. Indicate whether the rows represent criteria and the columns alternatives or vice versa by selecting the appropriate option button and pressing OK. The alternatives and criteria from your spreadsheet now appear in the Brainstorm window.
5. Delete, add notes, connect, add additional criteria as you would in any brainstorming session.
6. Select the [Generate Hierarchy](#) menu item. In the Hierarchy, double click one of the pasted criteria to display the Criterion Rating screen - you should see the ratings you copied from your spreadsheet program.

Missing or Unavailable Data

If some of the information in your spreadsheet is unknown, make sure you leave those cells blank - when you get to the hierarchy, they will read as "UnRated".

Saving and Printing Pasted Data

If you Save a Brainstorm file with such pasted data, the data is stored with the file and is available when next you open the file. To print the data, check the Print Pasted Data option on the Brainstorm Notes print item.

Note: The data imported into Brainstorm this way can not be "hot linked" to a source application.

Selecting Multiple Blocks of Criteria

There are two ways you can select multiple blocks:

- To select many blocks at random, hold down the CTRL key while clicking on the blocks you want. Each selected block appears with a box around it. To unselect a block from the multiple selection,

hold down the CTRL key and click again on the block you don't want.

- To select a block and all of its children hold down the shift key while clicking on a block. All children are selected immediately (see “Connecting Subcriteria to Criteria” later in this chapter).

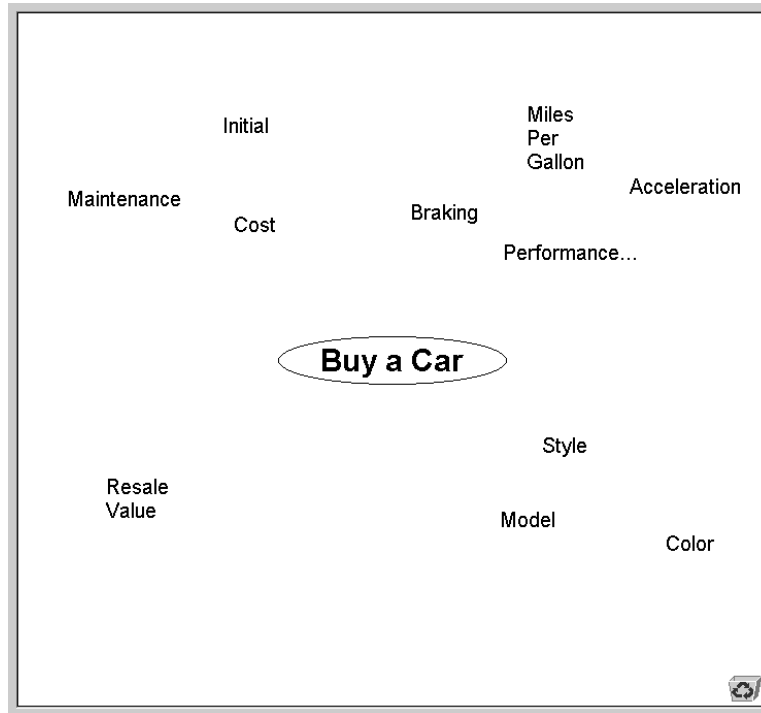
You can now apply menu options and mouse options to all blocks selected at once. Actions you can make to the selected blocks are deleting, moving them around the canvas, or moving them to the Recycle Bin (See “Storing Criteria in the Recycle Bin” later in this chapter.)

Grouping Your Criteria Blocks

Once you have enough criteria blocks on the canvas, you can group similar criteria by dragging them to different areas of the window. This process is done solely by dragging blocks around the canvas with your mouse. No menu selection is necessary.

1. Point to the block you want to move and drag the block to the area you want. You can select multiple blocks to move (see preceding steps in Selecting Multiple Blocks of Criteria).

- Repeat until you feel the grouping is finished.



Connecting Subcriteria to Criteria

With similar criteria grouped, you can start connecting related ideas to create subcriterion-criterion relationships. In Brainstorm, a parent can have up to 50 children. However, if you are going to generate a Hierarchy file from your Brainstorm file, you should limit the number of children to 20, because this is the limit in Hierarchy.

- Determine which criteria are subcriteria of a criterion. For instance, Miles Per Gallon, Acceleration, and Braking are all subcriteria of Performance. Therefore, Performance is a parent of the other three blocks.

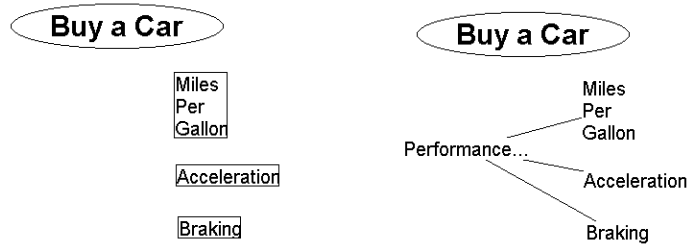
2. In order to link subcriteria to their parent criterion, drag each subcriterion block to a criterion block. When the block you are dragging to turns gray, the connection has been made. You cannot connect multiple blocks in Brainstorm.
3. Release the mouse button and a line connects the two blocks. If no lines appear, select Connecting Lines from the View menu.

To Create Parents for Ungrouped Criteria (Orphans)

For any group of blocks without parent criteria, you can use the Group command to create a parent. Some criteria may not have children in Brainstorm.

1. Click the first block.
2. Hold down the CTRL key.
3. Click the next related blocks one at a time (CTRL key still down). Boxes appear around the selected blocks.
4. Release the CTRL key. Boxes should remain around the selected blocks.
5. From the Edit menu, select Group.
6. In the Notes dialog box that appears, type a parent name (in our example, we grouped Miles Per Gallon, Acceleration, and Braking under Performance).
7. Enter notes if needed. (See “Enter Notes about Your Goal” earlier in this chapter.)

8. Select OK or press ENTER.



Connecting to Off-screen blocks

For large models, the block to which you wish to connect or disconnect another block may be off screen. To make such a connection

1. Select and drag the block you wish to connect to the edge of the Brainstorm canvas (where the white background meets the gray border) in the direction of the off-screen block to which you wish to connect.
2. Keeping the mouse key depressed, position it over the narrow, gray, three dimensional border edge. The canvas will start to scroll and the drag shadow of your block will flash on and off.
3. When your target block comes in view, release the mouse. A line connects the blocks.

Connecting Criteria to Your Goal

At any point after you've entered criteria, you can connect criteria to your goal. You can always disconnect items you want to change. Below are steps to connect groups to the goal.

To Connect Groups to the Goal

1. Drag the highest level criterion, the group parent, to the goal (in our example above, we drag Performance) The entire family remains intact. When creating any connection, always drag the intended child on top of its intended parent.
2. When the goal turns gray, the connection has been made. Release the mouse button.

Your group returns to its original position, but now has a line connecting it to the goal. If no connecting lines appear, select Connecting Lines from the View menu. The parent appears in large gray letters and its children appear in slightly smaller green letters.

For each level below the goal, a different color and size are used to aid you in differentiating relationships between blocks.

To Disconnect Groups

Now that you've connected your groups, you can disconnect them in the following way.

1. With any two connected blocks, drag one onto the other.
2. When the second block turns gray, release the mouse button. The connecting line disappears and your disconnected block name is in small black letters.

Note: Any blocks that are not connected to the goal, directly or indirectly, appear in small black letters. These blocks are not part of your decision model until they are connected to your goal block.

Collapsing and Expanding Families

Collapsing families is a good way to free up canvas space to enter more criteria. When a family is collapsed, a plus (+) sign precedes the parent name and the descendants are hidden.

To Collapse Families

- Double-click the block you want to collapse. Or, click once on the block and select Collapse from the Edit menu.

Note: If the block you double-click on has no children, the Notes dialog box appears.

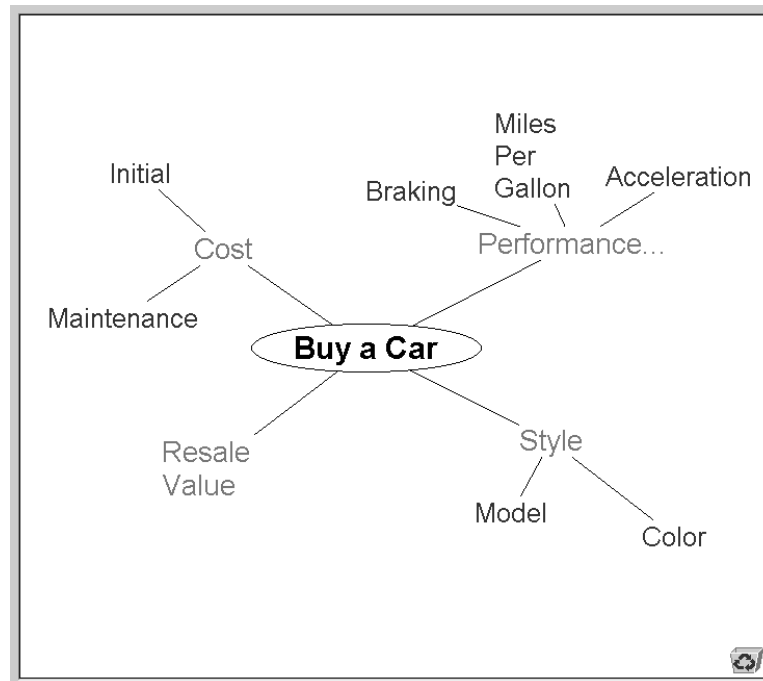
To Uncollapse (or Expand) Families

- Double-click any block that has a plus (+) sign preceding its name. Or click once on the block and select Expand Family from the Edit menu.

Note: If you delete a block that has collapsed children, its children are also deleted. Similarly, if you drag a block with the collapsed children to the Recycle Bin, its children are also moved.

Cleaning Up Your Canvas

Your connections may not have come out as neatly as ours. That's because we rearranged ours before we took the picture. Although you don't need to have a neat arrangement of blocks before creating your hierarchy, you may want to view or print your work.



To Rearrange Your Criteria

- Drag the blocks to arrange them in the window.

Note: If you drag a block with children, its children move with it.

Storing Criteria in the Recycle Bin

If you entered criteria on the Brainstorm canvas that you decide you want out of the way for now, you can store them temporarily in the Recycle Bin located in the lower right corner of the window. You cannot store the Goal or Alternatives in the Recycle Bin.

Recycle Bin Window Description

The Recycle Bin is another canvas, but has limited menus to perform some manipulation of criteria you place there. You can retrieve items from the bin during the same session by dragging them back onto the Brainstorm canvas.

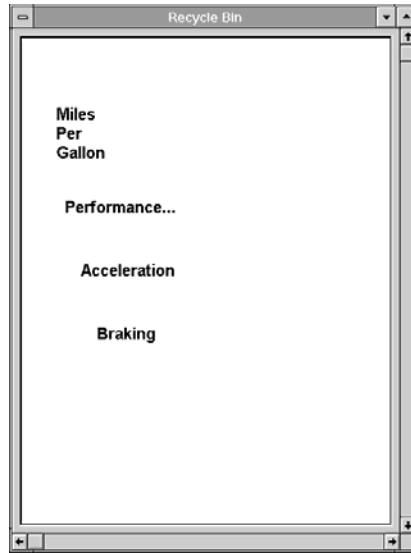
To Move Criteria to the Recycle Bin

1. Drag a block or an entire connected group of blocks to the recycle bin.
2. When the Recycle Bin is highlighted, release the mouse button. If the bin contains information, it appears with paper in the top.



- When you drag connected criteria to the Recycle Bin they become disconnected. But, because they are not connected to your goal in the Recycle Bin, they display in small black letters.

- Any items remaining in the Recycle Bin are deleted when you end the current session. However, you can use the Recycle Bin to move blocks from one Brainstorm file to another (see below).



Retrieving Criteria from the Recycle Bin

There are two ways to retrieve criteria from the Recycle Bin. You can move criteria blocks back onto the current Brainstorm canvas, or you can move them from the current Brainstorm file to another. The Recycle Bin works similarly to the Clipboard in Windows because it stays open as long as Brainstorm is running. When you open a Hierarchy file or close DecisionPlus, the Recycle Bin closes.

To Display the Recycle Bin

- Double-click on the Recycle Bin icon at the bottom right corner of the Brainstorm window, or select Recycle Bin from the View menu.

To Move Criteria to Current Brainstorm Canvas

1. Click and drag the items back onto the Brainstorm canvas.
2. To close the Recycle Bin, select Close from the Control Menu

To Move Criteria to Another Brainstorm File

1. After placing criteria in the Recycle Bin, select the Brainstorm file you want from the Open command on the File menu.
2. If you made any entries since the last time you saved your current Brainstorm file, a message prompting you to save your file displays. Select Yes or No. Your Brainstorm file closes and the one you selected opens.
3. When your other Brainstorm file displays, click on the Recycle Bin to open it.
4. Click and drag the items onto the Brainstorm canvas.

To Close the Recycle Bin

- Select Close from the Control Menu.

Finding Blocks on the Canvas

If your Brainstorming grows to a size that doesn't all fit in the window at one time, you may not recall where some of your criteria was entered. You can have DecisionPlus find the block for you.

1. Select Find Block from the Edit menu. The Find Block dialog box appears.
2. In the Text to Search For box, type any string of characters you want searched.
3. Select Find. In the Blocks Found area, a list displays all blocks with names containing the string.
4. Select the item you want from the list.

5. Select OK.

The selected block is centered on your canvas and flashes three times.

Printing the Brainstorm Window Contents

See Chapter 14, Document the Results, for instructions on how to print your Brainstorm results.

Viewing the Brainstorm Profile Dialog

The Brainstorm Profile provides a statistical view of your Brainstorm Model, as well as some information regarding its disk file.

To view the Brainstorm Profile

1. In the Brainstorm window, choose [Profile](#) from the [View](#) menu. A message dialog appears containing the information described below.

Model Profile information

- Number of Alternatives
- Number of Blocks - Total Number of Blocks in Brainstorm - including both Goal and Criteria
- Number of Orphaned Branches - Branches not connected to the Goal
- Deepest Level in Brainstorm - Number of Levels in the deepest Branch
- Number of Criteria with Pasted Data - see the section Pasting Tables of Data to Brainstorm earlier in this chapter

- Number of Alternatives with Pasted Data

Save Profile information

The Date Model Last Saved is useful in determining whether you have the latest draft of a model. The Version information may be useful given InfoHarvest's frequent updates of DecisionPlus.

- **File Name** - Name of disk file
- **Date Model Last Saved** - Date file last saved
- **Version in which Model Last Saved** - Version of DecisionPlus under which the model was last saved.

To Close the Brainstorm Profile

1. In the Profile dialog, click the **OK** button. This is the only action available to you.

Brainstorm Menu Commands

Many of the functions described earlier can be performed using the menu options. Below is a list of all the menus and options on the Brainstorm window.

File (See Microsoft Windows User's Guide for details.)

New creates a new Brainstorm file.

Open opens an existing Brainstorm file.

Close closes the active (current) Brainstorm file.

Save saves the active (current) file.

Save As saves the active file under another name.

Print Preview shows how your document will look when it is printed.

Print sends your document or selected pages to the printer. The Print option displays a dialog box so you can select options for the way you want your document to print and allows you to select a printer and select printer-specific options. (See Chapter 14, Document the Results.)

Exit closes DecisionPlus.

Edit

Undo undoes your last action.

Paste Special this menu command permits the pasting of spreadsheet data, consisting of criteria names, alternative names, and ratings, into a brainstorm. The pasted data is used to create Brainstorm blocks and alternatives. In addition, rating information is retained and when the brainstorm is converted into a hierarchy, the rating data may be viewed from the rating screen. See Pasting Tables of Data to Brainstorm in this Chapter.

New Block creates a new block by first displaying a block information box. You can name the block and enter notes about the block. (See “Enter Notes About Your Criteria” earlier in this chapter.)

Delete Selection deletes selected items from the canvas.

Clear Canvas deletes all blocks on the canvas. Acts the same as creating a New file if you have not saved this file yet. Asks you if you want to save any previous changes.

Select Family selects entire family below the selected parent.

Select All selects all blocks on the canvas.

Group associates two or more selected criteria with a common parent, making them children and siblings. (See “Grouping Your Criteria Blocks” earlier in this chapter.)

Ungroup (orphan children) breaks the connection between the selected parent and its immediate children. Although those

children remain connected to their own children, they are no longer descendants of that parent.

Orphan breaks the connection between the selected block and its parent.

Expand Family uncollapses descendants of the selected block (see *Collapse*).

Collapse hides descendants of selected parent. Collapsed families are identified by the plus sign (+) preceding the parent name. Collapsing families frees up canvas space.

Tip: To collapse families, you can also press CTRL+SHIFT+F8 or double-click a block that has descendants.

Find Block allows you to go directly to an identified block. See “Finding Blocks on the Canvas” earlier in this chapter.

Block Notes provides an information box to change the block name or notes for the selected block.

Tip: You can press CTRL+N to get the Notes. You can also double-click on a block if it has no descendants.

Move to Front moves crowded or partially hidden block from behind another block.

Move to Back moves a block that it is partially blocking another block to the back.

View

Alternatives displays or hides the Alternatives column.

Recycle Bin displays the Recycle Bin window where you can retrieve stored criteria or perform limited functions on stored criteria.

Confirm Drops a toggle display confirming your connection of subcriteria to criteria.

Alternatives' Name allows you to change the title "Alternatives" to a more specific title for your alternatives, such as “Projects”, “Books” or “Hires.” Also lets you add notes describing the

type of Alternatives (see To Change the Title "Alternatives" in this Chapter).

Zoom resizes the display of your document to 25%, 50%, 75%, normal, or to fit to screen.

Connecting Lines a toggle to show or hide lines connecting the family trees.

Profile displays statistics on the model, and version and date information on the file.

Show Toolbar displays toolbar with select commands at top of screen. Uncheck to hide the toolbar.

Show Toolbar Detail. Adds brief written descriptions of toolbar items to the toolbar display.

Model

Options

Environment brings up the Options Dialog letting you set the display defaults for the program.

New Model brings up the Options Dialog letting you sets defaults for a new Brainstorm model when it is first created. These settings can then be modified to suit the particular model, and are then saved with that model.

Generate Hierarchy converts your Brainstorm to a more structured decision Hierarchy model, where criteria and alternatives can be rated.

Help

Contents brings up the Help Topics window which gives you a table of contents for program commands, menu options, using Criterium DecisionPlus for decision making, and decision theory concepts.

Search allows you to search the help file for specific terms.

Decision Making provides you with an overview of where you are in the structured decision making process.

Web Home Page connects you to the InfoHarvest, Inc. homepage on the web.

Web Technical Support connects you to the InfoHarvest, Inc. technical support page on the web.

Web Updates connects you to the InfoHarvest, Inc. CDP update page on the web.

Web Register connects you to the InfoHarvest, Inc. CDP on-line registration page on the web. It is important to take the time to register your software with your unique serial number so that InfoHarvest, Inc. can alert you to future upgrades and other Criterium DecisionPlus news.

About CDP displays CDP version, the registered user's name and serial number.

The Brainstorm Window Toolbar

The Brainstorm window has its own specialized toolbar.



The basic icons, left to right, are:

1. New Brainstorm icon. Asks if you wish to save current brainstorm, then creates (empty) new one.
2. Open Brainstorm icon. Asks if you wish to save current brainstorm, then opens the file browse dialog.
3. Save Brainstorm icon. Saves the current brainstorm model. If new, unsaved, opens Save As file dialog.
4. Print Icon. Brings up the Print Dialog window.
5. The Print Preview icon. Brings up the Print Preview of your current window.



6. Hierarchy Icon. Creates the Decision Hierarchy from the current Brainstorm file. If the Brainstorm file is unsaved, you will be prompted to save it. Then the Hierarchy window is created and opened.
7. Group icon. Creates a new parent block for any and all selected blocks. It presents the Notes dialog to you so you can enter the

name of the group, then creates that block and joins the selected blocks to it as child blocks.

8. UnGroup icon. Breaks all links in a connected group.
9. Undo icon. Restores decision model to previous state after a major editing action.
10. Options icon. Opens the default Options dialog.
11. Help icon. Brings up context sensitive online Help.

Hiding Toolbar icons and/or text

Checking the menu item Show Toolbar on the View menu determines whether the toolbar is visible or not. If the toolbar is visible, checking the Show Toolbar Detail determines whether text labels appear under each toolbar icon.

What's Next?

Once you've created your model in Brainstorm, you can generate a hierarchy. The next chapter, Chapter 9, *Build the Hierarchy*, describes how to generate and fine tune your hierarchy. You will always have this brainstorm file from which you can create as many hierarchies as you want. You can update any brainstorm file, or save it as a new file and update the new file. Chapter 14, *Document the Results*, describes how to print specific results from your decision model.

Chapter 9

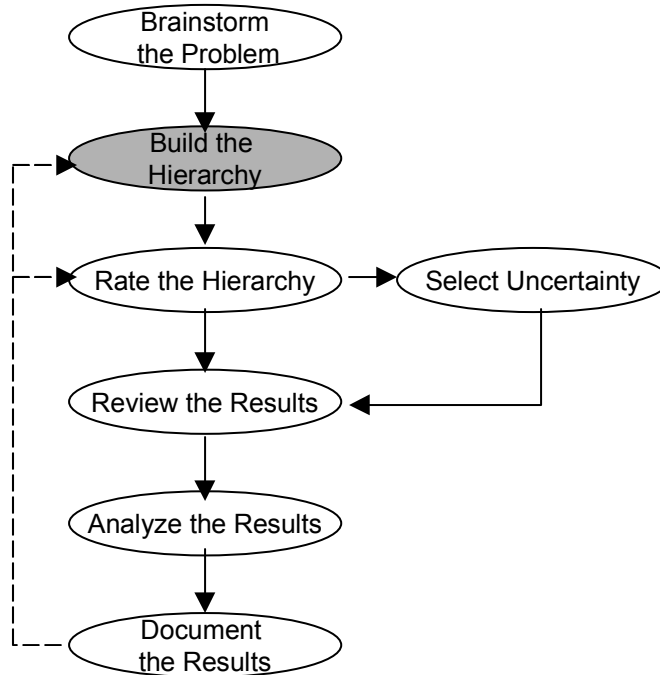
Build the Hierarchy

In This Chapter

- Building the Hierarchy as Part of the Decision Process
- Structuring Your Decision Model
- Displaying the Hierarchy Window
- Modifying a Hierarchy Structure
 - Editing Your Decision Goal
 - Editing Your Criteria
 - Inserting, Adjusting and Deleting Levels
 - Entering New Criteria
 - Connecting Your New Criteria
 - Saving Your New Hierarchy File
 - Entering Your Alternatives
 - Working with Blocks
 - Working with Branches in Hierarchy
- Viewing the Hierarchy Model
 - Using Navigator to View Large Models
 - Enhanced Decision Hierarchy Views
 - Viewing the Hierarchy Profile
 - Viewing the Information Window
 - Viewing Your Model in Spreadsheet Format
- Printing the Hierarchy Window Contents
- Group Decision Making
 - Creating a multi-voiced decision model
 - Linking Models
- Hierarchy Menu Commands
- Hierarchy Window Toolbar
- What's Next?

Building the Hierarchy as Part of the Decision Process

Where are you? You are in the shaded part of the Process Diagram below:



Process Diagram

Structuring Your Decision Model

The Hierarchy window helps you build and maintain the hierarchy of your decision model and rate the criteria. You can use your model from the Brainstorm window, or if you are familiar with decision analysis and with building decision models, you can create a new Hierarchy file and enter data directly into this window.

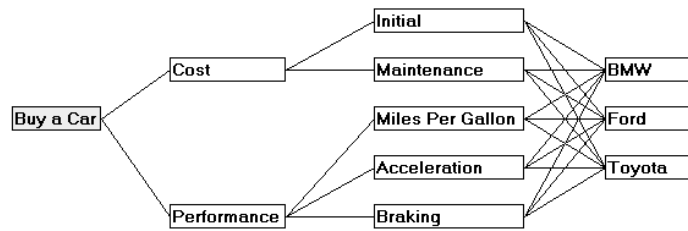
AHP or SMART

Before you begin in Hierarchy, you should think about whether to use the Analytical Hierarchy Process (AHP) or the Simple Multiattribute Utility Technique (SMART) in structuring your decision model. Certainly once you have entered your goal, criteria, and alternatives, and **before you begin rating**, you should choose which technique would be best for your decision. The section “Choosing the underlying model Technique: AHP or SMART” towards the end of this chapter will help you understand these techniques and to decide which to use. DecisionPlus uses SMART as its default technique, whether the hierarchy is created from a Brainstorm model or directly in the hierarchy window, unless you load a file previously saved using AHP.

Since the default technique in the Hierarchy program is SMART, it is the one presented first in this chapter.

Levels of Criteria

In Hierarchy, you begin working with levels of your decision model. The hierarchy window builds your decision model beginning with your decision goal. It continues with up to six levels of criteria, the middle blocks of a decision hierarchy (the first is your highest level criteria, and the last is your lowest level criteria). It finishes with your alternatives, the choices from which you are trying to select. You have the flexibility of adding and deleting levels of criteria as needed.



In this part of the decision process, branches of criteria, subcriteria, and connected alternatives are created automatically when you generate a hierarchy from a Brainstorm file. But you can also create these relationships directly in the Hierarchy window.

Displaying the Hierarchy Window

The first step in building your hierarchy is to display the Hierarchy window.

Generating A New Hierarchy File from Brainstorm

1. From the Brainstorm window, after you've entered your goal, criteria, and alternatives, select Generate Hierarchy from the View menu.
2. If the Brainstorm file is not yet saved, you will be asked do you wish to do so. Choose OK to do so, No to continue without saving, and Cancel to return to Brainstorm. Either of the first two choices will result in the closing (and saving, if requested) of your Brainstorm file.
3. The Notes dialog window appears, and you will be asked to enter a name for the Hierarchy model, and any notes you care to add. You can enter, for example, the name or purpose of the model or

choose Cancel to make this dialog disappear (and add the name and notes later - see Model Notes).

Refer to the section on “Hierarchy Window Description” for a general description of the window. Then turn to the section on “Modifying a Hierarchy Structure” later in this chapter for steps in editing your hierarchy.

Creating New Hierarchy File Directly in Hierarchy

1. Close the Hierarchy or Brainstorm window that is open, by choosing Close from the File menu.
2. From the DecisionPlus window, select New Hierarchy from the File menu. The Hierarchy window, containing a simple hierarchy with a Goal, a single Criterion and an Alternative, all connected, will appear.

Refer to the section on “Hierarchy Window Description” for a general description of the window. Then turn to the section on “Modifying a Hierarchy Structure” for instructions on creating a hierarchy.

Opening Existing Hierarchy Files

1. From the DecisionPlus window, or the Brainstorm window (be sure any open Brainstorm file is saved), select Open from the File menu and select a hierarchy file with the extension *.cdp*.

To Close the Hierarchy Window

- From the File menu, select Close.

Hierarchy Window Description

The Hierarchy window has a column or *level* format that holds up to seven columns and headings for the levels in your model. The model name appears at the top on the window Name Bar. You can insert blocks of criteria by double-clicking anywhere on the window, but they are confined to level. To size a block in Hierarchy, size the entire level (see below).

Working With Levels You can select an entire level by clicking once on its heading. When the heading is selected, it and all blocks in that column are highlighted. You can also select blocks under headings individually. Highlighted items are ready for action by mouse, by shortcut keystrokes, or by drop-down menus. For example, you can adjust the column widths by dragging either edge of a column heading left or right. (You are in drag-mode when your cursor becomes a two-headed arrow.)

Goal Level	Level 2	Level 3	Level 4	Level 5	Level 6	Alternatives
------------	---------	---------	---------	---------	---------	--------------

Attaching Notes You can attach hidden notes about the model, a level, or a block. If you already entered notes about criteria in *Brainstorm*, those notes are transferred into *Hierarchy*, but the criteria names are no longer marked with three dots as they were in *Brainstorm*.

Entry Limitations CDP limits you to one goal and 50 alternatives. In addition, you are limited to 160 blocks per decision model. Within these limits, you can have up to 100 blocks of criteria under any heading to the right of the goal. For example, if you have 50 alternatives and one goal, you can have only 109 blocks distributed under levels 2-6. See Chapter 3.

Hierarchy Window at First Glance When you create your decision model in the *Hierarchy* window rather than in the *Brainstorm* window, the window first appears nearly blank. Initially, only three level types appear on the Name Bar: Goal Level, Level 2, and Alternatives. If you like, you can replace these headings with something more appropriate to your decision goal.

When you generate your hierarchy from a *Brainstorm* file, your window first displays the data provided from the *Brainstorm* file and the parent and child levels are already connected for you. Usually, there are two or more levels between the Goal and the Alternatives.

Goal Level In *DecisionPlus*, this is the first level of your decision hierarchy. This is what your decision model is all about (such as Buy a Car). Your decision model is set up to satisfy this goal.

Level 2 Under this heading is your first level of criteria, the children of your Goal. At this level, you consider these criteria major considerations toward your decision (such as Performance, Cost, and Style). The Goal can have only twenty immediate children.

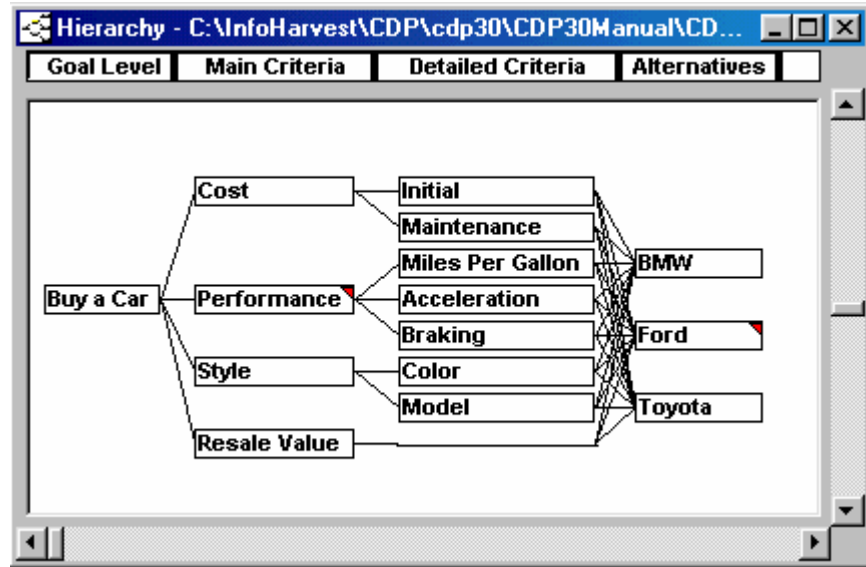
Additional Levels Your major considerations (in Level 2) toward your decision can be broken down into lower levels of criteria, called subcriteria (i.e. Performance can be broken down to Acceleration and Braking). You can add four more levels, Levels 3-6, for a total of seven levels. Higher level criteria that are connected to subcriteria are known as parents of the subcriteria. The subcriteria connected to a criterion are known as children of the criterion. A parent can have only twenty immediate children, and a child may have up to twenty parents.

Alternatives In order to satisfy your goal, you must choose from two or more alternatives (such as BMW, Ford, or Toyota). You list those alternatives in this column. You can enter as many as 50 alternatives. Each alternative can be connected with as many as 100 criteria. A criterion can be connected with as many as 50 alternatives.

Modifying a Hierarchy Structure

When you generate a Hierarchy file from the Brainstorm window, the hierarchy is built automatically based on the brainstorm model, including attached notes. You can modify the Hierarchy file by adding levels, blocks, notes, and alternatives. However, changes here do not update your original brainstorm file. They are two separate files. You can use the original brainstorm file to create other hierarchy files.

If you have generated a hierarchy from the Brainstorm model in Chapter 3, your new Hierarchy decision model looks similar to that illustrated below.



Saving Your New Hierarchy File

The first thing to do is save your hierarchy file before you begin working with it.

1. From the File menu, select Save.
2. In the directory of your choice, name your file. Your file is saved with the extension *.cdp*.

Note: You can access your old Brainstorm file at any time. The changes you make in Hierarchy do not affect the Brainstorm file.

Editing Your Decision Goal

Sometimes when you see your hierarchy you decide you want to make some changes. That's easy to do in Hierarchy. You can add levels, delete levels, add blocks, move blocks, delete blocks, add alternatives,

add notes, and edit anything that was entered in Brainstorm. There is no particular order to the levels in which you should make changes; however, we begin from left to right, from goal to alternatives.

Note: Any criteria that you left disconnected in Brainstorm do not show up in Hierarchy. If you reopen that Brainstorm file, the orphaned criteria are still on the canvas where you left them. If you want to include them in your Hierarchy, you need to do so manually - see “To Edit Your Criteria” in the following pages.

To Edit Your Goal

You can change the name or notes for your goal by using the Block Notes option on the Block menu or by following the steps below.

1. Click once on the goal block to highlight it.
2. Click once again on the goal block to highlight the goal name.
3. Type your new goal name.
4. Press ENTER or click outside the block.

To Enter or Edit Notes about Your Goal

If you want to enter or edit notes at the time you change your goal name, you can do both in the Notes dialog box.

1. Click once on the goal block to highlight it.
2. Press CTRL+N, or from the Block menu, select Block Notes. The Notes dialog box displays with the goal name highlighted.
3. If the goal name is correct, TAB to or click in the Notes area.
4. Type or change your notes.
5. Select OK or press ENTER.

Editing Your Criteria

To Edit Your Criteria

1. Click inside the block.
2. Click inside again to highlight the block name
3. Type a new criterion name.
4. Click outside the block or press ENTER.

To Enter or Edit Notes about Your Criteria

You can edit your criteria names and notes at the same time in the following way.

1. Click once on the block to highlight it.
2. Press CTRL+N, or from the Block menu, select Block Notes to display the Notes dialog box.
3. Type a new criterion name if needed.
4. TAB to or click in the Notes area.
5. Type or edit your notes.
6. Select OK or press ENTER.

To Delete Your Criteria

1. Highlight the block
2. Press the DELETE key, or from the Block menu, select Delete Block, or from the Edit menu, select Delete Selection.

Inserting, Adjusting and Deleting Levels

To Insert a Level

1. On the Name Bar, click once to highlight the level where you want another level inserted. The entire column under that level is highlighted.
2. From the Level menu, select Insert Level. A column of yellow empty blocks is inserted to the left of the level you initially highlighted.
3. You can name your new level and begin entering criteria names in the empty blocks.

Inserted levels copy the structure of the highlighted column. When Alternatives is the highlighted column, the inserted level copies the structure of the column to the left of the alternatives.

To Edit Level Name or Enter Notes

1. Click once on the level name to highlight it.
2. From the Level menu, select Level Notes.
3. Type a new level name if needed.
4. TAB to or click in the Notes area.
5. Type your notes.
6. Select OK or press ENTER.

To Change Level Widths

1. Place the mouse cursor at the edge of the level whose width you want to change and the cursor will change to the shape of a two-headed arrow.
2. Drag the level edge to the desired width.

Usually you will want to adjust the level widths so that the blocks within the level snugly accommodate their own name's text. DecisionPlus allows you to do so.

1. From the View menu, choose Resize Level Widths. The widths of all levels are set to the width of the longest block name in that level.

To Delete a Level

1. On the Name Bar, click once to highlight the level you want to delete. The entire column under that level is highlighted.
2. Press the DELETE key, or from the Level menu, select Delete Level, or from the Edit menu, select Delete Selection.

Entering New Criteria

The first thing to do before you can enter new criteria is to provide a space for them. You can do that by adding blocks in any column.

To Add New Blocks

1. Double-click in an empty space above or below a block to add a block. This method produces a new block with "Name #" highlighted.
2. Type your criterion's name.
3. Click outside the block or press ENTER.

To Edit Your Criteria

1. Click inside the block to highlight it.
2. Click inside again to highlight the current criterion name.
3. Type your new criterion name.
4. Click outside the block or press ENTER.

If you need new blocks in which to type more criteria, see “To Add New Blocks” above.

To Enter Notes about Your Criteria

You can enter your criteria names and notes at the same time in the following way.

1. Click once on the block to highlight it.
2. Press CTRL+N, or from the Block menu, select Block Notes to display the Notes dialog box.
3. Type a new criterion name if needed.
4. TAB to or click in the Notes area.
5. Type your notes.
6. Select OK or press ENTER.

To Delete Your Criteria

1. Highlight the block
2. Press the DELETE key.

Connecting Your New Criteria

Connecting and disconnecting blocks is easily performed using your mouse. To connect two blocks, do the following.

1. Drag the block you want to the block you want to connect it to.
2. Release the mouse. The blocks are connected by a line.

As you see, the steps involved are the same as for Brainstorm, but with the difference that there is no directionality in hierarchy connections. When making a connection, there is no difference between dragging a criterion onto a subcriterion and dragging a subcriterion onto a criterion.

Furthermore, in the hierarchy, a criterion can be a subcriterion to more than one criterion. For example, if you have a model that lists Minimizing Cost as one criterion and Maximizing Sales as another criterion, Quality Control can be a subcriterion of both.

To Connect Lowest Criteria to Alternatives

Before you begin connecting your lowest criteria to your alternatives, it is important to remember that each lowest criterion that you want included in the decision scores must be connected to each alternative. Rather than connecting one at a time and trying to keep track of your connections, follow the steps below.

1. Click once on the column heading Alternatives to highlight all alternatives in the column.
2. Point to one highlighted alternative and drag it to the block you want connected. Although it appears only one block is being dragged, they all are being dragged.
3. Release the mouse button when the mouse pointer is in the block you want connected. All the Alternatives will be connected

To Disconnect Goal, Criteria, and Alternatives

- Repeat the processes above: drag a connected block onto one of the blocks to which it is connected. The connecting line between the two will be removed.

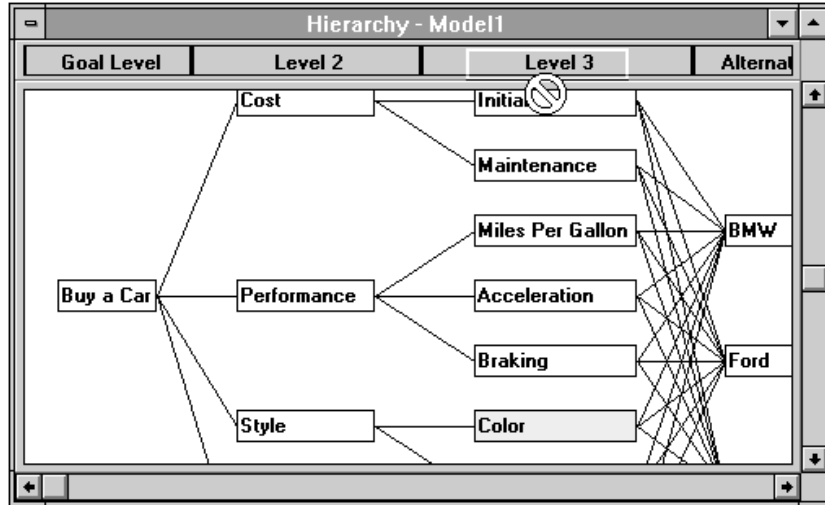
Connecting to Off-screen blocks

For large models, the block to which you wish to connect or disconnect a block may be off screen. You make such a connection as follows.

1. Select and drag the block you wish to connect to the edge of the Hierarchy canvas (where the white background meets the gray border) in the direction of the off-screen block to which you wish to connect.

2. Keeping the mouse key depressed, position it over the narrow, gray, three dimensional border edge. The canvas will start to scroll and the drag shadow of your block will flash on and off.

Note: The scroll edge is narrow. If you move the mouse icon too far over the edge, the mouse icon will change to a “No Go” ring, and no scrolling will occur (see image below).



3. When your target block comes in view, release the mouse. The blocks are connected by a line.

Saving Your New Hierarchy File

1. From the File menu, select Save.
2. In the directory of your choice, name your file. Your file is saved with the extension *.cdp*.

Entering Your Alternatives

To Enter an Alternative

1. Click inside the block “Alternative 1” to highlight the block.
2. Click inside the block again to highlight the block name.
3. Type your own alternative name.
4. Click outside the block or press ENTER.

To create more blocks in which to type more alternatives:

1. Double-click in an empty space above or below a block to add an empty block. New blocks display initially with the “Name #” highlighted.
2. Type your alternative.
3. Click outside the block or press ENTER.

To Enter Notes about Your Alternatives

If you have notes about all your alternatives before you begin entering alternatives, you can enter your alternative names and notes at the same time in the following way.

1. Click once on the alternative to highlight it.
2. Press CTRL+N, or from the Block menu, select Block Notes to display the Notes dialog box.
3. Type a new alternative name if needed.
4. TAB to or click in the Notes area.
5. Type your notes.
6. Select OK or press ENTER.

To Edit an Alternative

1. Click once on the Alternative.

2. Click again on the alternative name to highlight it.
3. Type your new alternative name.
4. Click outside the block, or press ENTER.

To Delete an Alternative

1. Highlight the block
2. Press the DELETE key, or select Delete Selection from the Edit menu, or select Delete Block from the Block menu.

Working with Blocks

The following topics apply to your Hierarchy model whether you generated it from Brainstorm or created it directly in Hierarchy.

Moving a Block

You can move criteria blocks anywhere within the criteria block levels. You cannot move them to the Alternative or Goal level, and you cannot move Alternative blocks to a criterion or to the Goal level. You cannot move the Goal.

1. If the block you want to move is connected to other blocks, disconnect them using the same steps you used to connect them.
2. Click and drag the block to the position you want.

Selecting Multiple Blocks

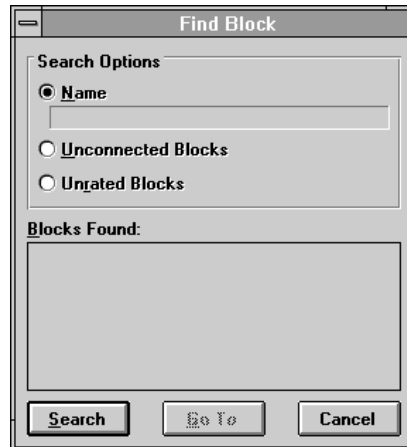
When you have several blocks to which you want to apply a similar function, you can select all of them and apply that function at one time.

1. Click on one block to highlight it.
2. Press the CTRL key and click on the next block.
3. Repeat step 2 until all the blocks you want are selected.

When all the blocks you want are selected, you can use a block function from the Hierarchy menu, or use a mouse or keystroke function.

Finding Blocks

1. Select Find Block from the Edit menu. The Find Block dialog box appears.



2. If you wish to search by name, make sure the Name option is clicked. In the Name text box, type any string of characters you wish to search for in the names of the Blocks (for example, you can type Main for Maintenance).

If you wish to search for all unconnected blocks, click the Unconnected Blocks option.

If you wish to search for all unrated blocks, click the Unrated Blocks option.

3. Click Search. In the Blocks Found area, a list displays all blocks that satisfy the search condition set in step 2 above.
4. Select the block you want from the list.
5. Select Go To.

DecisionPlus locates and centers the block on your window. It is highlighted and flashes three times.

Duplicating Blocks

You can add new blocks that take on the same connections as another block in the Hierarchy.

1. Select the block you want to duplicate.
2. Select Duplicate Block from the Block menu.

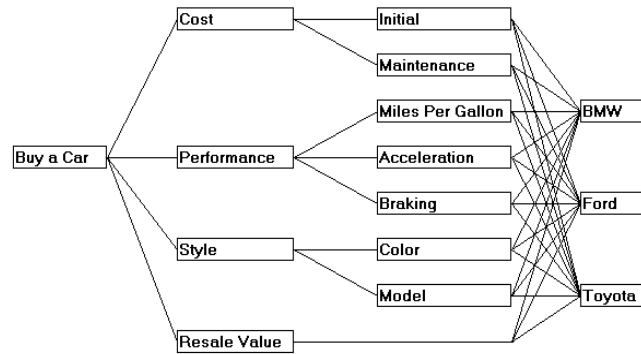
A block appears above or below the highlighted block with the same connections as the highlighted block. You see the word “Name” and a number after it, highlighted. The numbers start at 0 and increase by 1 for each new block you add to this hierarchy. This numbering process is meant to give the block a unique identification, but for your own clarification, you should enter a name as soon as possible, or at least before closing the file. The numbering process for new blocks starts again at 0 in your next session.

Arranging Blocks

After adjusting and fine tuning your model, it may be suffering from post-moving blues, with connecting lines crossing unnecessarily and blocks just a little off center. DecisionPlus rearranges your model neatly for you. You can select this option any time and several times.

1. From the Model menu, select Arrange Blocks.

The model will display with each criterion centered before its subcriteria and some spacing between blocks.



Working with Branches in Hierarchy

The ability to copy, move or delete entire branches of the decision hierarchy is a powerful editing capability of DecisionPlus. For instance, if a group can agree on the structure of the model, but two factions can not agree on the weights, you can duplicate the main body of the model, tag each duplicate with the name of a faction, and have each faction independently weight their own submodel. Differences between the two can then be seen directly using the existing analysis windows and the new tagging feature.

Selecting a Branch in Hierarchy

You can select an entire branch or submodel of the decision hierarchy in the following way.

1. Holding down the Shift key, click the block at the head of the branch (nearest to the Goal) to select it.

All the subcriteria of the head criterion will be selected, and their subcriteria, all the way to the alternatives, will be selected (indicated by a yellow highlight). The alternatives themselves are not highlighted, as they are not considered part of the branch.

Duplicating Branches in Hierarchy

You can create entire new submodels that take on the same connections as the original submodel. Any connections between blocks belonging to the branch (be they to criteria in other branches or alternatives) will be faithfully duplicated. Each duplicated criterion will have the same scales, weights, connections, value functions and uncertainty distributions (if it is a lowest criterion) as the original.

1. In the Hierarchy Window, select the branch you want to duplicate (see *Selecting a Branch in Hierarchy*, above).
2. Select the Duplicate Branch window from the Block menu.

The head block of the duplicate branch is left in an edit state after duplication, with the same name as the original highlighted. You should immediately type in a new name to distinguish it from the original branch. If, however, that new head block is drawn off-screen, it will not be highlighted when you scroll to it. It is advisable to edit the name, as there may be no other way to tell the original and duplicate branches apart.

Note 1: DecisionPlus will attempt to give the duplicated branch the same shape as the original, but if the original branch was entangled with other criteria and their connections, the results may not be beautiful.

Note 2: You can not duplicate the entire decision model. If you selected the Goal as the head of the Branch, a warning message will appear when you attempt to duplicate it.

Deleting a Branch in Hierarchy

You can delete entire submodels (branches) from the Decision Hierarchy.

1. In the Hierarchy Window, select the branch you want to delete (See *selecting a Branch in Hierarchy* above).
2. Choose Delete Branch from the Block menu or press the Delete key.

Viewing the Hierarchy Model

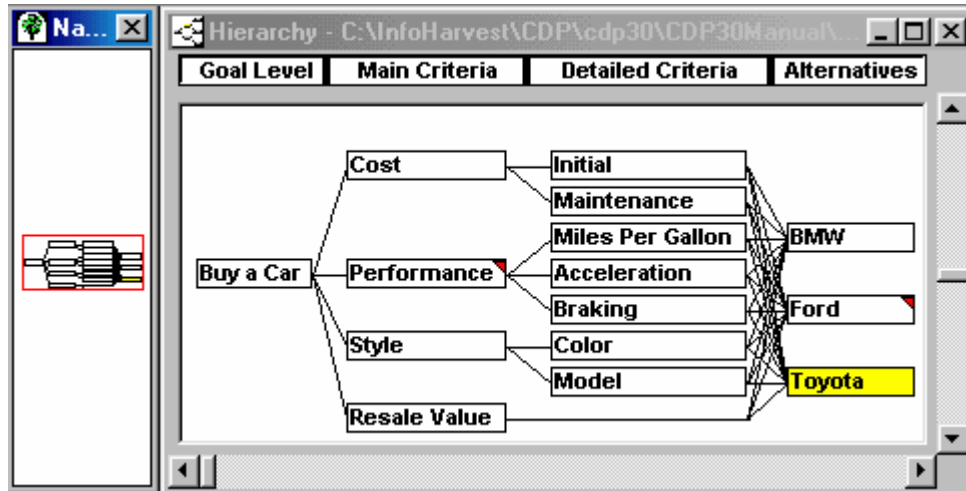
Even for models of moderate complexity, the Hierarchy structure becomes large and intimidating. In order to keep you firmly in control of the decision model you are creating, DecisionPlus provides you with many different ways to view the model. The Navigator allows you to move rapidly about a large hierarchy. Enhanced Decision Hierarchy Views allow you to understand the state of the model - are all criteria rated and connected and how important are they in the over all model? The Hierarchy Profile provides statistics on the model, the Information window gives an overview of the identity of criteria and alternatives, and the Spreadsheet Format allows you to view the underlying values in the model.

Using Navigator to View Large Models

Your decision model could become large enough that you can't see all of it on the screen. Displaying Navigator shows you the big picture of your decision model in a small version. You can also use the Navigator to locate your model if it has scrolled off the window.

To Display the Navigator

1. Select Navigator from the View menu. A small window entitled Navigator appears at the lower left corner of your window.
2. To close Navigator, select Close from the Navigator's control menu, or reselect Navigator from the View menu.



The Navigator window displays block images with no block names. You'll see a highlighted block that corresponds to the block you have highlighted in your Hierarchy window. You can size Navigator to fit the entire screen, or to fit in any corner of your Hierarchy window. In Navigator, you can click on a block or an area and your hierarchy model shifts to center that block or area in your Hierarchy window.

To move to a different block of your model, or shift the center of the Hierarchy window to a different part of your model,

- Click on the block or area you want in the Navigator window. The Hierarchy window centers around the block or area you clicked.

Enhanced Decision Hierarchy Views

The basic hierarchical representation of the decision model may be enhanced by the addition of Accumulated Weights, Unrated Blocks and Disconnected Blocks. Each of these effects, which are implemented as overlays of the basic graphical structure, gives insight on the state of the model.

Accumulated weights

Checking the Show Accumulated Weights item in the View menu shows the accumulated weight of each block (criterion and alternative) in the block, preceding the name. (For more information on weighting criteria, see chapter 10). Level widths are automatically adjusted to allow for these accumulated weight values. The accumulated weights are dynamically maintained as the Hierarchy is edited. If the hierarchy becomes disconnected in the course of editing, the accumulated weights will be incalculable, and will show as "#####" in the Block Name.

Unrated Blocks

By clicking on Show Unrated Blocks in the View menu, blocks whose subcriteria or alternatives have not been completely rated are colored Green.

Disconnected Blocks

By clicking on Show Disconnected Blocks in the View menu, criteria which are not connected to the Goal and to at least one alternative are colored Red. In either case, if the only such Blocks are off-screen, CDP asks if you wish the canvas to scroll so you can see such a block.

Viewing the Hierarchy Profile

The Hierarchy Profile provides a statistical view of your Hierarchy Model, as well as some information regarding its disk file.

To view the Hierarchy Profile

1. In the Hierarchy window, choose Profile from the Model menu. A message dialog appears containing the information described below.

Model Profile information

- Name of the Model - The Name of the Hierarchy Model. The symbols "" appear if no name has been given.
- Decision Analysis Technique - AHP or SMART
- Number of Lowest Criteria - Number of Lowest Criteria (Attributes) in the model.
- Number of Blocks - Total Number of Blocks in the Hierarchy. Can not exceed 160 in all - see Model Specifications and limitations in Chapter 3.
- Number of Uncertainty distributions - How many individual uncertainty distributions have been assigned.
- Number of Levels in the Hierarchy - Number of levels can not exceed 7.
- Number of user defined Numeric Scales
- Number of user-defined Verbal Scales
- Number of user-defined Pairwise Comparison Scales
- Number of Rules
- Number of Links to Subordinate Models - How many other hierarchy models are linked to this one.

Save Profile information

This information is useful in determining whether you have the latest version of a decision model. The Version information may be useful given InfoHarvest's frequent updates.

- File Name - Name of disk file

- Date Model Last Saved - Date file last saved
- Model Last Saved in Version - Version of DecisionPlus under which the model was last saved.

To Close the Hierarchy Profile

1. In the Profile dialog, click the OK button. This is the only action available to you.

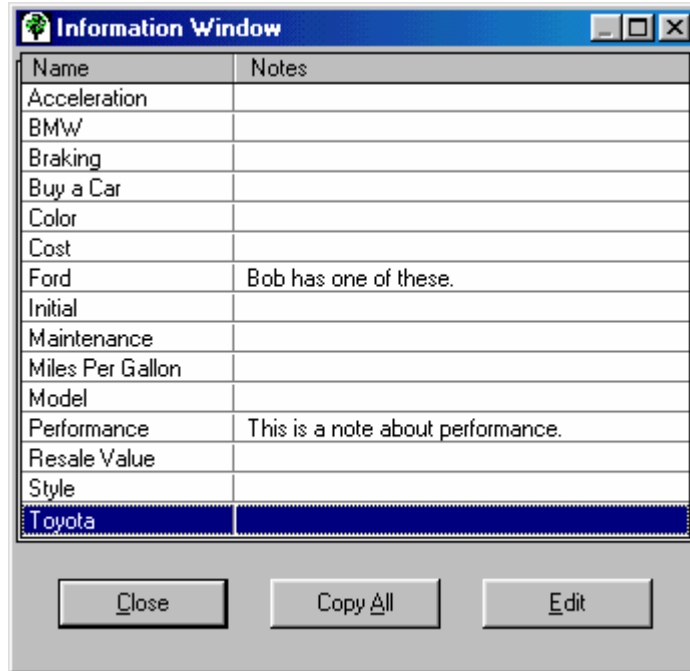
Viewing the Information Window

The Information window allows you to view, edit and export all the names and notes of Goal, Criteria and Alternatives. Many times during the creation and analysis of your decision, your understanding of the meaning of the goal, criteria and alternatives will grow and change. If returning to a model at a later time, it is important that you, as well as others, can fully apprehend the decision model and its outcome. Therefore, it is a very good practice to maintain the name and notes associated with those entities at all times.

The Information window, accessible from most windows in DecisionPlus, provides support in doing just that.

To View the Information window from Hierarchy

1. In the Hierarchy window, from the Model menu, select Information.



Most of the Information window is taken up by a list box with two columns, the first showing the name of each block, the second showing the start of the corresponding notes (if any). The blocks are sorted alphabetically by name, with no regard as to whether they are criteria or alternatives.

To Edit Names and Notes

1. In the List box, click and line to select it.
2. Click Edit to bring up the Notes dialog, and edit your name and or note directly.

Tip: You can open the Notes dialog directly by Double Clicking any line in the List box.

To Copy all Names and Notes to the Windows Clipboard

1. Click the Copy All button. A Tab delimited table of Names and Notes is copied to the Windows Clipboard from where it can be pasted to your spreadsheet or wordprocessor.

To Close the Information window

1. Click the Close Button

Viewing Your Model in Spreadsheet Format

You can put your model information in spreadsheet format and print a copy of it.

Viewing Your Model in Spreadsheet Format

In addition to the usual graphical representation of the hierarchy model, you can also put your model information into a spreadsheet format. You can review and edit the values of (direct) weights and ratings directly, see the associated priorities, print, cut and paste data to and from the spreadsheet, and Link to external spreadsheets.

At this point, we have not weighted your criteria, so there are no numerical values to see. The cells that are reserved for weights say “unrated” until you enter ratings. You may want to revisit this section after you have rated your model (see Chapter 10).

To View Your Model in Spreadsheet Format

There are two different spreadsheet views available to you.

Hierarchy Data

1. In the Hierarchy window, from the View menu, select Hierarchy Data.

The Goal criterion appears in the upper left of the spreadsheet, and the subcriteria and its rating set are stacked in the column once removed to its right. Before the name of each subcriterion appears the present

weight of that subcriterion with respect to its parent criterion. Immediately to the right, the name of the first subcriterion is repeated, and the weights and names of its subcriteria are recorded. Scrolling to the extreme right, you will see columns of ratings for each Alternative against the lowest criteria (attributes).

Hierarchy Priorities

1. In the Hierarchy window, from the View menu, select Hierarchy Priorities

The spreadsheet appears as before, but with an additional column of numbers to the right of each column of weights and ratings. The values in these new columns give the relative importance or priority of your judgments in terms of DecisionPlus's internal scale, which runs from 0 to 1 and is independent of the scale you assigned to the parent criterion. Studying these numbers will help you understand how DecisionPlus consistently compares values defined on diverse scales against each other.

Editing Data

Whether in Data or Priorities view, the values of weights and ratings may be changed, but the names and relationships of criteria may not be altered. If a rating set has been weighed using Direct Comparison, the cells in which the weights and ratings appear are white, indicating they can be edited, while all other cells are gray and can not be edited. If you click on a cell that you are not able to modify, you'll get a message that this cell cannot be changed directly. Note that if you enter a cell by clicking inside it, scale information for the relevant criterion is displayed at the top of the data sheet.

If a rating set has been weighed using Pairwise Comparison or Abbreviated Pairwise Comparison, the word "Pairwise" appears instead of a numerical value, and is grayed. Whether the Direct Comparison method was used or not, Double Clicking the weight cell will open the standard Ratings window. Cells that are reserved for weights that you have not yet evaluated say "unrated " until you enter ratings.

Printing the Spreadsheet

To print the spreadsheet simply choose Print from the File menu. The options "Weights and Ratings only" and "Weights, Ratings and Priorities" correspond to choosing Hierarchy Data or Hierarchy Priorities in the data sheet.

Return to Graphical View

You can return to the usual graphical view of the Hierarchy as follows.

- 1 From the View menu, choose Hierarchy Graph.

To Copy from the Hierarchy Spreadsheet

Using the Windows clipboard, data may be copied and pasted between the Hierarchy spreadsheet and any other spreadsheet. In particular, the Ratings of all alternatives with respect to all lowest criteria or attributes may be copied from another application to DecisionPlus in a single action. You can copy information from the Hierarchy spreadsheet as follows:

1. In the Hierarchy window, from the View menu, select Hierarchy Data (or Hierarchy Priorities).
2. Using the mouse, select any block of cells by clicking the mouse in a cell lying at one corner of the desired block, then holding down the mouse drag till you are inside the cell at the opposite diagonal of the block, then release.
3. Choose Copy from the Edit menu.
4. Change to the target application (spreadsheet or word processor) and use that application's Paste facility to paste a Tab Delimited (see Glossary) table of data.

To Paste to the Hierarchy Spreadsheet

You can paste information from another spreadsheet or word processor table to the Hierarchy spreadsheet as follows.

1. In the source application, select the relevant cells, which must contain only numerical data.

2. In the source application, Copy the relevant cells. This places the information in the Windows Clipboard.
3. In the Hierarchy window, from the View menu, select Hierarchy Data.
4. Using the mouse as described above, select the block of cells to which you wish to paste the data.
5. From the Edit menu choose Paste. This copies the information from the Windows Clipboard to DecisionPlus.

Not all pastes are equal

The paste command will only succeed if

- There is suitable numerical data in the Windows Clipboard
- The shape and number of cells selected in the source application exactly matches that of the block you selected in DecisionPlus.
- The selected cells in the Hierarchy Spreadsheet do not contain any grayed cells (you can not edit any cell that is grayed.)

If any of these conditions is not met, a message to that effect will be displayed.

In addition, if numerical values in a cell exceed the upper and lower bounds of the scale defined for that criterion, you will be asked is it OK to "clip" the value to that of the closest bound, or would you prefer to Cancel the entire Paste operation.

Note: DecisionPlus does not check that you are pasting data related to a criterion in the source application to corresponding cells for the same criterion in the spreadsheet. A good way to ensure that the ordering of alternatives and lowest criteria in the source application matches that in DecisionPlus's Hierarchy Data view is to first copy the Hierarchy spreadsheet

to the other application (use Select All from the Edit menu), fill the data in that application, then paste back to DecisionPlus.

To Create a DDE Link to the Hierarchy Spreadsheet

You can create a "hot" DDE link (see Glossary) from another spreadsheet or word processor table to the Hierarchy spreadsheet. This means that if data in the source application changes, the changes will be automatically forwarded to DecisionPlus, and all calculations updated. A block of cells containing ratings information of alternatives, may be imported from a spreadsheet that supports DDE links into the Data View of the Hierarchy.

1. In the source application, (e.g. Excel), select the relevant cells, which must contain only numerical data.
2. In the source application, Copy the relevant cells. This places the information in the Windows Clipboard.
3. In the Hierarchy window, from the View menu, select Hierarchy Data.
4. Using the mouse to select the corresponding block of cells, make sure that the dimensions and ordering are exactly the same as for the cells in the source application.
5. From the Edit menu choose Paste Link. This copies the information from the Windows Clipboard to DecisionPlus, and creates a link between the source application and DecisionPlus. Information on that Link (source application, topic, time of update) is automatically placed in the Notes of the Goal. A message is posted indicating the successful establishment of the link.

Note: See "To Paste to The Hierarchy Spreadsheet above for conditions on acceptable data for pasting.

Note: Only one "live" link is supported at a time.-Creating a new link will destroy the existing link - a message will be posted to that effect.

Note: If a model is closed, the link must be recreated by hand when the model is next loaded - information on the last link (time and date, name of file) may be found in the Notes of the Goal block.

Printing the Hierarchy Window Contents

At any time, you can print the graphical contents or notes of your Hierarchy model. Some options, although available all the time, won't produce useful information until you enter information later in Ratings and Rules, discussed in the following chapters. See Chapter 14, Document the Results, for steps on printing your Hierarchy information.

Group Decision-Making

DecisionPlus supports three approaches to Group Decision-making. Bear in mind that DecisionPlus is a *not* a group-ware product, i.e., DecisionPlus can not accept simultaneous inputs from multiple participants.

Facilitated, Consensus Group Decisions

The basic approach is to run DecisionPlus on a large overhead screen in a group meeting room. A facilitator keys in all information to the system while leading the meeting. The facilitator needs considerable knowledge of DecisionPlus and the decision process it supports. Other participants need no knowledge of DecisionPlus or decision analysis.

The facilitator walks the group through brainstorming, rating the model, analyzing the outcome, and refining the model. Because brainstorming is an inclusive process, it rarely poses difficulties as long as the facilitator can type quickly. Scoring the alternatives and analyzing the results are also, in general, straightforward.

Bringing a heterogeneous group to consensus regarding the relative importance (weight) of the various criteria is usually the greater challenge. However, bringing the group through the brainstorming, scale creation and hierarchy structuring steps often allows people to better understand the fears and concerns of others. In addition, the structured nature of the model tends to focus discussions on the relevant issues, enabling consensus weighting more often than might be expected.

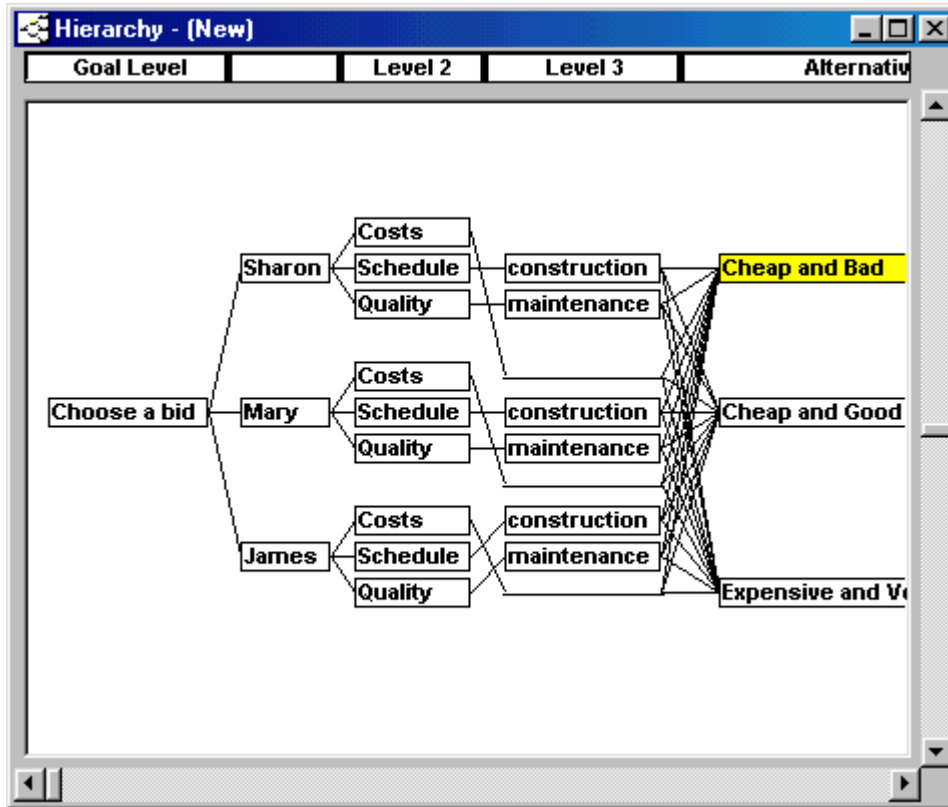
Facilitated Multi-Voiced Group Decisions.

At times consensus in weighting can not be achieved or there might be reasons why the various groups or individuals should have their inputs directly recorded. In this case a *multi-voice* decision model can be very effective. The structure and scales of the model are first agreed upon by all. Then the entire model is duplicated within itself (see below), with each distinct voice given its own copy to rate as it sees fit. The voices are combined usually with equal weight, so that they essentially vote on the outcome.

Distributed Group Meetings

In some cases the difficulty in achieving consensus in the decision group arises not from contention so much as from differing areas of expertise. In that case you may want to create completely separate models that individual groups, e.g., engineering, financial, etc., would rate. The individual models may then be *linked* as described in the section “Linking Models” below.

Creating a multi-voiced decision model



When analyzing multi-voiced models, the Tag Level Functionality (see the section “Viewing Contributions by Criteria” in Chapter 13) will allow you tag each criterion name with name of the appropriate voice (e.g., Engineering, Admin., etc.). The Contributions by Criteria analysis will help you understand differences between the voices and how they affect the over all decision scores.

To create a multi-voice decision model, proceed as follows:

1. Brainstorm and generate a hierarchy in the usual manner (no consideration to voices).

2. Score all alternatives and assign scales to all criteria. (See chapter 10 for more information on scoring and scaling alternatives).
3. Select the Level immediately to the right of the Goal level, in this example it is labeled “main criteria”, by clicking the Level Bar where it says “main criteria.” From the Level menu, choose Insert Level. A new level appears between the “main criteria” level and the Goal level. Click the Level bar of the new level twice and type “Voices”.
4. Each criterion in the “main criteria” level has a corresponding criterion in the Voices level. Select all but one of the criteria in the Voices level, and delete them by pressing your Delete key. Click the remaining Block twice and enter a name of one of the Voices, e.g., James.
5. Connect all criteria in the “main criteria” level that are not connected to the remaining block in the “Voices” level (in this case, “James” is the remaining block), and connect them.
6. Branch Select the single Voices Block, “James”, by holding down the Shift key when selecting the block. Choose Duplicate Branch from the Block menu. Repeat as many times as there are voices less two. Name each block in the Voice level, e.g., Mary, Sharon etc.
7. Have the various voices independently weight their branches.
8. When you open any results or analysis window, immediately select Tag Level from the Analysis menu, and choose the Voices level. It will then be clear with which submodel a given criterion or weight is associated.

Linking Models

When the decision problem involves the expertise of other group members, you can partition the problem and assign them to the groups. For example, when the decision problem involves financial, engineering, and management issues, instead of working the entire problem with the whole group, you can have each department work their respective issues. Once their part of the model is constructed and rated, you can integrate it into the master model.

DecisionPlus provides a linking capability. You can link other models and aggregate the results into one decision score. The results of your master model are aggregated by including the results of the linked model into the master model at the criterion level where you locate the link block.

Note: Uncertainty results are not transmitted through links.

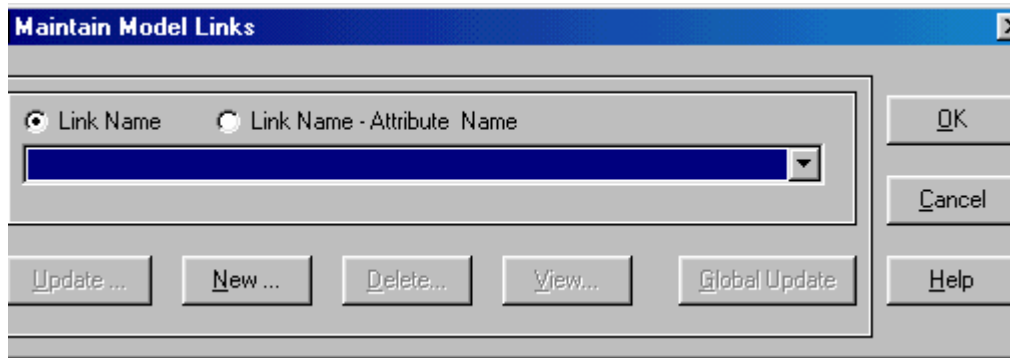
To Link Other Models

1. First create a new block in the model on which you are working, to create a linking point. In the Hierarchy window, double-click on a blank space in the hierarchy to create a “Link to Blocks” block.

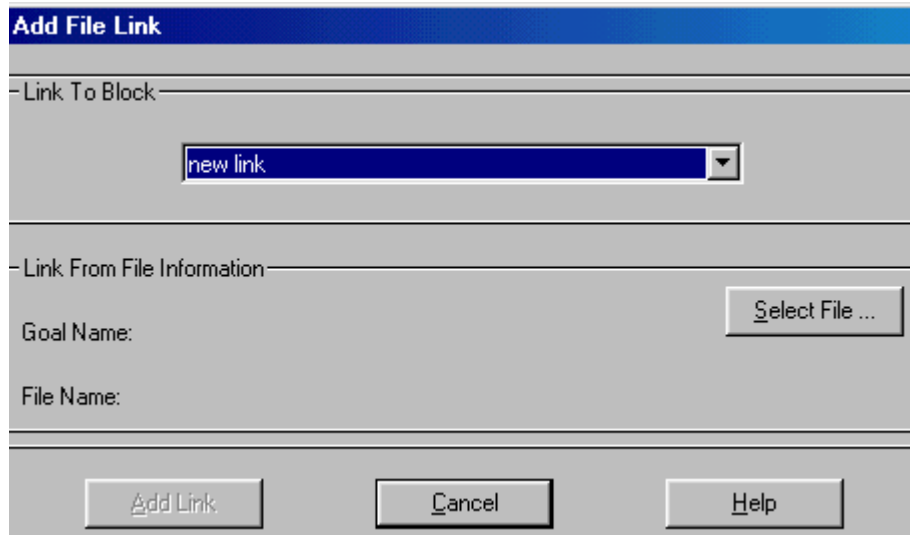
The block can be at any level in the master model, but you should decide where the appropriate place is before you create it. A new block appears with the word “Name” and a number highlighted. You can type in any name you want.

2. Select Link Block from the Block menu. A message appears “No links on file. To establish a link, select New.”

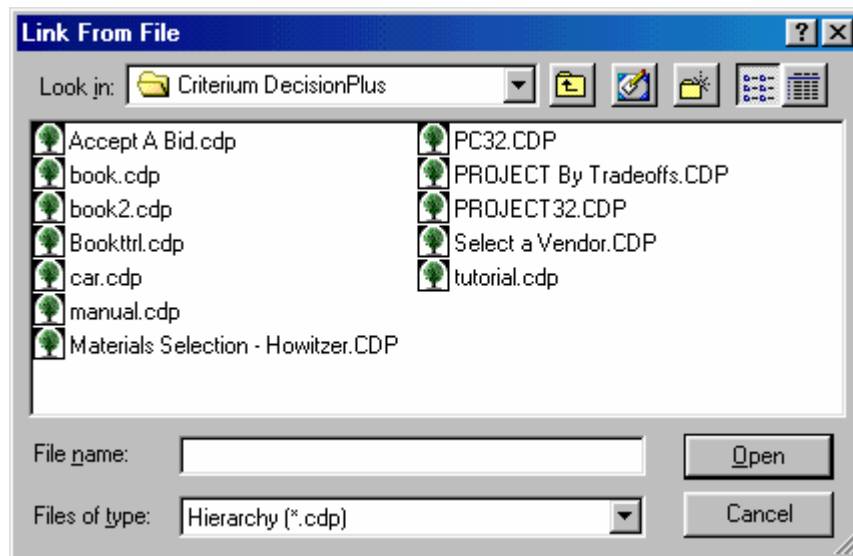
3. Select OK. The Maintain Model Links window appears.



4. Select New to display the Add File Link window. Select your "Link to Blocks" block from the Link to Block list box.

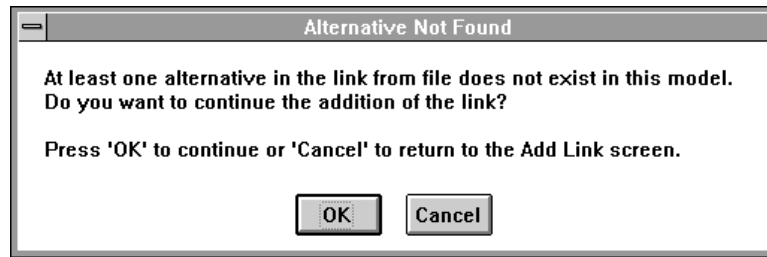


5. On the Add File Link window, click the Select File button to display a list of files.



6. From the Link From File window, select the filename of the file you want to link.
7. On the Add File Link window, click the Add Link button.
After you select the Add Link button, two messages may appear.

If you are linking models that are dissimilar, where at least one alternative in the new model does not already exist in the master model, you see the message below.



If you choose OK, all un-matched Alternatives in the linked model will be added to the current (Master) model.

When the link is complete, the new "Link to Blocks" block you added is no longer available and you see the message below. You would need to create a new "Link to Blocks" block in the Hierarchy window to link another model.



On the Maintain Model Links window, select OK to link the file, or select Cancel to cancel the link. Assuming you choose OK, you will see that your Link Block is now connected to all the Alternatives, and it has a new name: "Link - *Link Goal Name*", where *Link Goal Name* is the name of the Goal of the linked model. You may change that name if you wish.

To Connect Your Linked Model

- To complete the link, click and drag your linked block to the appropriate criterion level.

To Update Linked Models

If models that are linked to the master model have been updated, you can bring those updates into your master model in one of two ways. You can update a single linked file, or update all files linked to the master model.

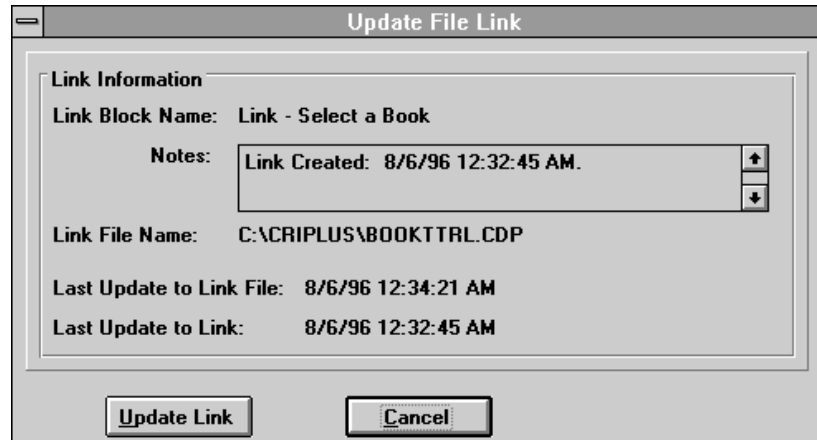
Updating a single linked file

1. Select Link Block from the Block menu to display the Maintain Model Links window.
2. From the Link to Block list box, select the linked block whose updates you want included.

Note: In addition to listing links by Goal name of the linked Model, you can choose to list them both by Goal name and the name of the Link block in the Master Model. This is useful if you have edited the names of the Link criteria in the Master model to make them more identifiable.

To have the Model Link List in the Maintain Model Links dialog show linked Criterion names also:

1. Click Link Name - Criterion Name option
3. Select the Update button. The Update File Link dialog appears.



4. If the Last Update to Link File is later than the Last Update to Link, date (as it is above), the information in your current (master) file is out of date and you should Click the Update Link button.

Unable to Access “Link from” File

In step 3 above, clicking the Update button on the Maintain Model Links dialog, you may encounter the message titled Unable to Access "Link from File." A common cause for this error is that the linked file has been moved or is otherwise unavailable. A file browse button is added in the Update File Link dialog above to allow you to manually locate a valid copy of the linked file.

4. Click OK to close message. You will find yourself in the Update File Link dialog.
5. Click the Find File button. A standard Browse dialog appears.
6. Locate the file and press OK. The link will immediately update.

Updating all linked files

1. Select Link Block from the Block menu to display the Maintain Model Links window.
2. Select the Global Update button.

To Delete Linked Models

- In the Hierarchy window, select the blocks one at a time and press the DELETE key, or select Delete Selection from the Edit menu, or select Delete Block from the Block menu.

To Edit Linked Models

You can change the ratings of the linked files, or delete and add alternatives. Follow the editing steps for the appropriate topic in this chapter.

Hierarchy Menu Commands

Many of the Hierarchy window functions described earlier using the mouse can also be performed using the menu options. Below is a list of all these menus and options.

File (See Microsoft Windows User's Guide for details.)

New Hierarchy Creates a new Hierarchy model. Asks you to save current model, if unsaved.

Open Opens an existing hierarchy file. Hierarchy files have a .cdp default extension.

Close Closes the active (current) file. Asks to Save, if unsaved.

Save Saves the active (current) file.

Save As Saves the active file under another name.

Print Preview Shows how the hierarchy model will look when it is printed.

Print Sends your document or selected pages to the printer. The Print option displays a dialog box so you can select options for the way you want your document to print. (See Chapter 14, Document the Results.) The print option allows you to select a printer and select printer-specific options.

Export to Excel Exports the structure and ratings data of the current Hierarchy active file to Excel. CDP attempts to locate the Excel program file on your computer. If unable, it will open a file Browse dialog and enlist your help.

Export to Text File Exports the structure and ratings data of the current Hierarchy active file to a text file. CDP opens the save file dialog.

Exit Exits DecisionPlus. Asks to save current file, if there is unsaved data.

Edit

Undo Undoes your last edit action.

Copy Visible Hierarchy to Clipboard Screen Captures the visible portion of the hierarchy diagram to the clipboard for export to other applications. Usually the Paste Special menu item in those application will let you paste a bitmap to that application.

Copy All of Hierarchy to Metafile Allows complete graphics transfer to other applications. CDP saves *all the* hierarchy structure to a Windows Metafile. CDP opens the Save File As dialog so you can save the windows metafile it generates. Usually an Insert Picture menu item in other applications will let you import the high quality graphic.

Delete Selection Deletes selected block.

Find Block Goes to the identified block.

Note: The following two menu items are available when the Hierarchy is in Graph view only.

Delete Selection Deletes selected block.

Find Block Goes to the identified block.

Note: The following menu items are only available when the Hierarchy is in Data or Priorities view.

Copy Copies data in selected spreadsheet cells to Windows Clipboard.

Copy All of Hierarchy to Metafile Copies all data in file for use in other applications. See above.

Paste Pastes data in Windows Clipboard to selected spreadsheet cells.

Paste Link A block of cells containing ratings information of alternatives, may be imported from a spreadsheet that supports DDE links into the Data View of the Hierarchy. See the section, “To Create a DDE Link to the Hierarchy Spreadsheet,” in this chapter.

Select All Selects all spreadsheet cells.

View

Hierarchy Data Puts Hierarchy model into spreadsheet format where you can also edit the information.

Hierarchy Priorities Same as Data View but also includes the priority values for each connection. Very useful for understanding how the model calculates decision scores.

Hierarchy Graph Puts Hierarchy model in graphical form. This is the default view.

Note: The following menu items are available when the Hierarchy is in Graph view only (default view).

Hide Connections to Alternatives If you check this item, CDP displays the hierarchy model without the lines connecting the lowest level to the alternatives. Uncheck to reverse.

Show Missing Connections In general, all alternatives should be connected to all lowest criteria. If you check this item, CDP displays the hierarchy model with only missing connections from lowest criteria to the alternatives in a lurid color. Uncheck to reverse.

Connect All Alternatives A useful item that will fully connect all criteria in the lowest level to all alternatives.

Show Accumulated Weights Displays the accumulated weight of each block (criterion and alternative) in the block, preceding the name. Level widths are automatically adjusted to allow for these accumulated weight values. The accumulated weights are dynamically maintained as the Hierarchy is edited. See the subsection, “Enhanced Decision Hierarchy Views,” in this chapter. The default state is off.

Show Unrated Blocks Highlights, in Green, any block where *all* of its children have not been rated. The default state is off.

Show Disconnected Blocks Highlights, in Red, any criterion not connected (however remotely) to the Goal and at least one alternative. The default state is off.

Arrange Blocks Arranges blocks so that the main display shows the first level parents centered in front of its family. This means some parents are then spaced so far apart that they are out of view in your window. (See Glossary, Family Centered Views, for illustration.)

Resize Level Widths Adjusts the widths of all the levels to accommodate the longest block name in each level.

Navigator Displays the Navigator window on the left side. Shows a small version of your entire Hierarchy model. (See the “Use Navigator to View Large Models” section in this Chapter)

Note: The following two menu items are available in each of the three views.

Show Toolbar Displays graphical toolbar of select menu commands.

Show Toolbar Detail Displays brief written description of menu commands in addition to graphical toolbar format.

Block

Edit Name/Notes Displays the Notes dialog box to change the name and notes of the highlighted block. (Or, highlight block and press CTRL+N)

Delete Notes Deletes notes associated with the highlighted block.

Insert Block Above Creates a new, disconnected block above the highlighted block. Moves all blocks down beginning with the highlighted block.

Insert Block Below Creates a new disconnected block below the highlighted block. Moves all blocks up beginning with the highlighted block.

Duplicate Block Makes a new block with the same connections (parents and descendants) above or below the highlighted block.

Delete Block Deletes the highlighted block, but maintains any connection between its parent and descendants.

Rate Subcriteria Displays the ratings window to rate the subcriteria or alternatives of the highlighted block. (See “Weight the Criteria” in the next chapter.)

Link Block Allows you to select and link other models to the new block you created. Various restrictions apply.

Duplicate Branch Allows you to copy a selected branch of the model.

Delete Branch Allows you to delete a selected branch of the model.

Level

Level Notes Displays the level Notes dialog box where you can change the name or notes of the highlighted level.

Insert Level Puts a new level heading and column to the left of the highlighted level.

Delete Level Deletes the highlighted level heading and all blocks in that column.

Model

Options

Environment (submenu): sets the display defaults for the program.

New Model (submenu): sets defaults for a new hierarchy model when it is first created. These settings can then be modified to suit the particular model, and are then saved with that model.

Model Notes Displays the model Notes dialog box where you can change the name or notes describing the model.

Information Displays the Information window, allowing you to view all notes in the model at a glance (and copy for export).

Profile Lists model statistics.

Unrate Allows you to reset to “unrated” the values of the *Weights* - If using Weights Hierarchy Technique, clicking this item reverts all weights of subcriteria to unrated. If using Direct Tradeoffs Hierarchy Technique, sets all tradeoffs’ values as unrated. USE WITH CARE!

Scores - The ratings of all Alternatives against all lowest criteria. USE WITH CARE!

Equalize all Weights (Tradeoffs) If using Weights Hierarchy Technique, sets all weights of subcriteria to the scale average. If using Direct Tradeoffs Hierarchy Technique, sets all tradeoffs’ values to 1.

Technique - Alternatives Selects one of the following decision methodologies.

AHP Selects the Analytical Hierarchy Process.

SMART Selects the Simple Multiattribute Rating Technique. This is now the default option.

Technique – Hierarchy Selects one of the following methodologies.

Weights Selects weights. This is the default option.

Tradeoff Selects tradeoff .

Note: Choosing an option in the following two menus opens a Results or Analysis window. If the model is not fully connected (see Glossary), results can not be calculated and a dialog will appear inviting you to move directly to connect the offending block(s).

Results

Decision Scores Shows how the weights are distributed in your decision model. This option is discussed in the “Review Results,” chapter.

Uncertainty in Decision Scores Shows the uncertainties in the decision scores of the alternatives due to the uncertainties in their ratings.

Analysis

Sensitivity by Weights Shows how sensitive the decision is to changes in the criteria weights. This window is discussed in the chapter, “Check Reasonableness and Analyze.”

Contributions by Criteria Shows how the breakdown of the decision scores in terms of contributions from criteria. This window is discussed in the chapter “Check Reasonableness and Analyze.”

Alternatives Scatter Opens the Alternatives’ Scatter Plot analysis window. This window is discussed in the chapter “Check Reasonableness and Analyze.”

Tradeoffs of Lowest Criteria Shows how the various lowest criteria are being traded off against each other. This window is discussed in the chapter, “Check Reasonableness and Analyze.”

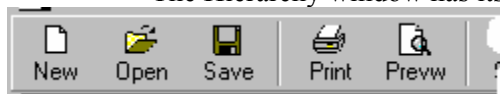
Contributions to Uncertainty Shows how the uncertainties in the individual rating of an alternative contribute to the uncertainty in that alternative’s decision score. This window is discussed in the chapter “Select Uncertainty.”

Group Tag Level This area allows you to select a level (or none), the names of whose criteria will prefix the names of all criteria in levels below that tag level. The First Letter Only checkbox allows you to choose to use only the first letter of the criteria names in the tag level as prefixes for lower criteria names.

Tag by First Letter Only The First Letter Only checkbox allows you to specify that only the first letter of the criteria names in the tag level are used as prefixes for lower level criteria names.

The Hierarchy Windows Toolbar

The Hierarchy window has its own specialized toolbar.



The basic icons, left to right, are:

12. New Hierarchy icon. Asks if you wish to save current hierarchy, then creates (empty) new one.
13. Open Hierarchy icon. Asks if you wish to save current hierarchy, then opens the file browse dialog.
14. Save Hierarchy icon. Saves the current hierarchy model. If the model is new and has not been saved, opens Save As file dialog.
15. Print Icon. Brings up the Print Dialog window.
16. The Print Preview icon. Brings up the Print Preview of whatever window you are in.
17. Snap Picture Icon. Builds a graphic of entire Hierarchy, then opens Save As file dialog so you can name and save as Windows Metafile (*.wmf).
18. Undo icon. Active when user has undertaken major editing action in Hierarchy. If clicked, will restore decision model to state before edit.

19. Navigator icon. Opens it.
20. Options icon. Opens the default Options dialog.
21. Rate Criterion icon. If valid criterion is selected, opens Rating window.
22. Decision Scores window. Opens it.
23. Help icon. Brings up context sensitive online Help.

Hiding Toolbar icons and/or text

As usual, checking the menu item Show Toolbar on the View menu determines whether the toolbar is visible or not. If the toolbar is visible, checking the Show Toolbar Detail determines whether the text label appears under each toolbar icon.

What's Next?

When you're comfortable with your model, and you feel you have included all or at least most of the elements you need in your model, you can begin rating your criteria and alternatives. The next chapter, Chapter 10, *Weight the Criteria*, describes how to rate each criterion using several rating methods. Chapter 14, *Document the Results*, describes how to print individual items and full customized reports from your decision model.

Chapter 10

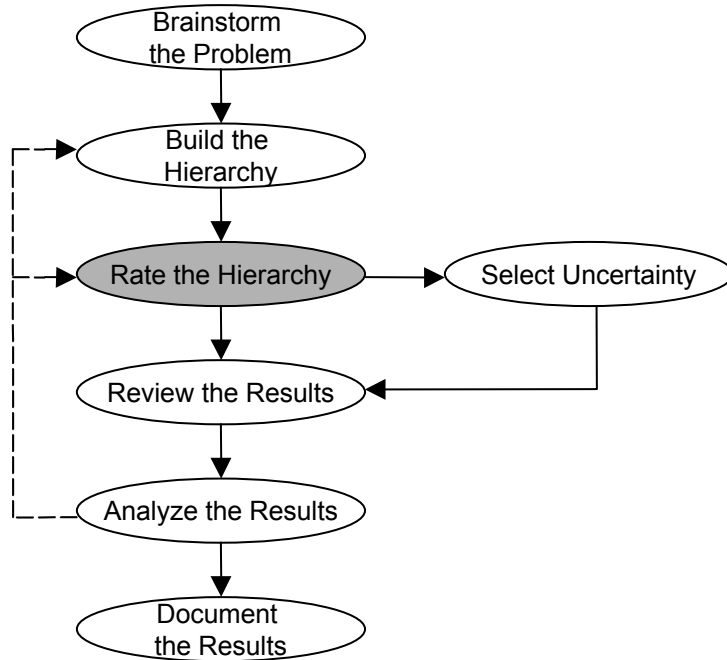
Rate the Model

In This Chapter

- Rate the Model as Part of the Decision Process
- Overview of Rating Techniques
- Hierarchy Rating Technique: Weights and Direct Tradeoffs
- Choosing the Hierarchy Rating Technique: Weights or Direct Tradeoffs?
- Alternatives Rating Technique: SMART and AHP
- Choosing the Alternatives Rating Technique: SMART or AHP?
- Choosing a Rating Set
- Choosing a Rating Method for Weights Technique
- Choosing the Rating Views
- Assigning Scales in Direct Comparison
- Entering Ratings in Direct Comparison
- Entering Ratings in Full and Abbreviated Pairwise Comparison
- Assigning a Pairwise Scale in Pairwise Comparison
- Selecting the Next Rating Set
- Accept or Cancel Your Ratings
- Choosing a Rating Method for Direct Tradeoffs Technique
- Choosing A Minimal Set for Direct Tradeoffs Technique
- Rating Alternatives against Lowest Criteria
- Assigning Value Functions under SMART
- Synchronizing Value Function Slopes to Scale Orientation
- Using the Alternatives Ratings Window
- Assigning Rules
- Rules Only Criteria
- Criterion Rating Menu Commands
- What's Next?

Rate the Model as Part of the Decision Process

Where are you? You are in the shaded part of the Process Diagram below:



Process Diagram

Now that you've built your Hierarchy, you need to assign relative weights to the criteria and score the alternatives. In DecisionPlus, this is called *rating the model*. You perform this rating in sets, by selecting a parent block and rating all its subcriteria or alternatives with respect to each other. These sets are called *rating sets*.

The steps involved in rating a rating set are as follows:

1. Choose a Rating Set
2. Decide on a Rating Method
3. Establish a Rating Scale
4. Enter the Ratings

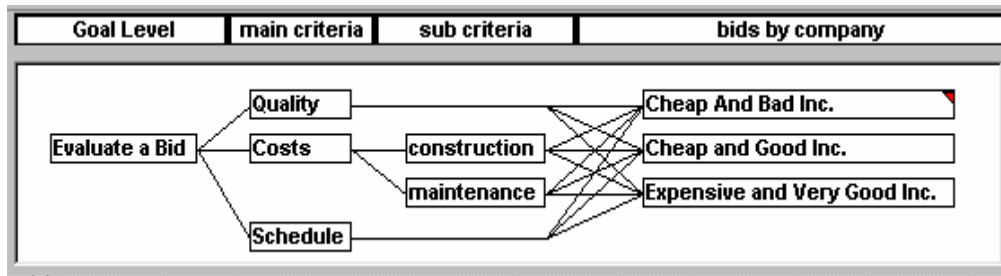
The following sections will walk you through each step. First, you need to decide which rating techniques to use for your decision hierarchy and alternatives.

Overview of Rating Techniques

The criteria against which the alternatives are rated are called lowest criteria. No matter how complex the hierarchy, the basic algorithm in multicriteria decision analysis is to multiply how each alternative scores against each lowest criterion by the relative importance of that lowest criterion. If those products are then summed over all lowest criteria to provide an overall decision score, the score serves as a measure of how well that alternative fits your decision model.

CDP provides you with two decision analysis techniques each to establish the relative importance of the lowest criteria and to rate alternatives against those lowest criteria.

Alternatives Rating Technique: AHP or SMART



Hierarchy Rating Technique: Weights or Direct Tradeoffs

Hierarchy Technique - Establish the relative importance of criteria.

You have two techniques at your disposal to establish the relative importance of criteria: weights and direct tradeoffs.

Hierarchy Rating Technique - Weights

Using the Weights technique you assign the relative importance of each subcriterion with respect to the other subcriteria of a given Goal or parent criterion. You might start at the Goal, relatively weight each of the criteria directly beneath the Goal, then repeat this for every criterion with subcriterion in the model. Once this is done, CDP takes care of multiplying these preferences down the structure of the hierarchy, so that all the criteria against which the alternatives will be rated, the lowest criteria, will have acquired a relative importance respect to all other lowest criteria.

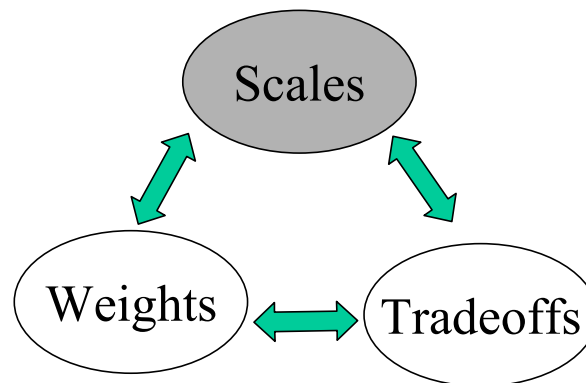
Hierarchy Rating Technique – Direct Tradeoffs

We've just seen how you can establish the relative importance of the lowest criteria by establishing preference weights at all nodes in your decision hierarchy of criteria. Another way to establish the relative importance of the lowest criteria is by directly setting their relative tradeoffs.

In any difficult decision, many of the decision objectives conflict – consider the common desire to have the highest quality at the lowest price. The essence of the multicriteria decision is the tradeoff between those objectives, and this is most easily measured by the numerical tradeoffs between the lowest criteria, which provide metrics for those objectives. For instance you may feel that a reasonable tradeoff between cost and schedule for a construction proposal might be \$100,000 for one month. Here you may be expressing your preference by saying that you would be willing to pay \$100,000 to avoid a 1 month delay in a particular project. If you proceed to make such tradeoff judgements pair by pair until all lowest criteria have been traded against each other, you will have succeeded in establishing the relative importance of all lowest criteria in your model.

Interchangeability between Hierarchy Techniques

Mathematically, if you know both the scales and the relative importance of the lowest criteria, you can calculate the tradeoffs. Conversely, if you know the scales and the tradeoffs, you can, with a few reasonable restrictions, calculate the relative importance of the lowest criteria (by uniquely determining the weights at every level of the hierarchy). CDP takes care of all the details, so providing the scales are unchanged, you can back and forward between weights and tradeoffs. You can calculate the tradeoffs as determined by the Weights technique, or, based on direct tradeoffs you assign, calculate the corresponding weights. *Changing from one method the other, providing some simple conditions are met, will not change the relative importance of the lowest criteria in your model.* (See the next section, Selecting the Hierarchy Ratings Technique for details of those conditions.)



Note: Those of you who have used the Analytical Hierarchy Process may never directly have developed scales. That is because the pairwise comparison approach creates relative scales based on the alternatives you are rating.

Choosing the Hierarchy Rating Technique: Weights or Direct Tradeoffs?

Comparison of the two Hierarchy techniques

So what is the difference between the two approaches? Numerical tradeoffs have the great advantage in that you can compare their values to company and industry norms, and they can be compared (with care) to published research. Saying that schedule is more important to you than costs leaves many questions unanswered and provides little opportunity for quantification or validation.

On the other hand, asking stakeholders to provide a direct tradeoff value can be intimidating. They may not understand what you mean by a tradeoff, or they may not be familiar enough with the decision space to hazard a good estimate, or both. The first you can tackle through training, the second through research. Both require time and resources. Furthermore, if many of your lowest criteria are qualitative in nature, a tradeoff such as 1 unit of Reputation for 3 units of Quality may be meaningless and hard to assess.

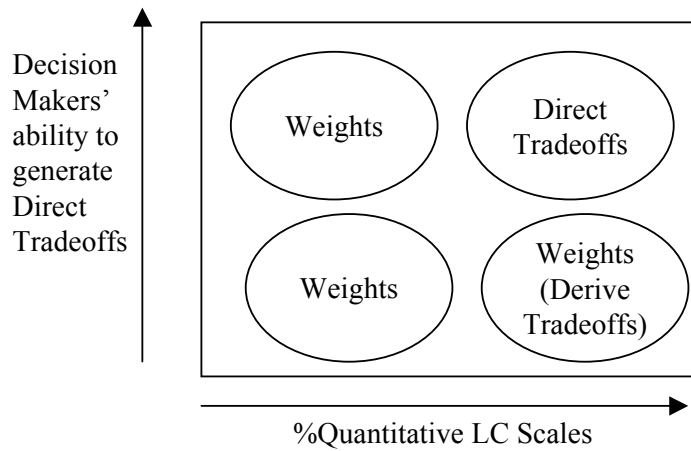
But for hundreds of years, people have made decisions that involve directly weighing the importance of one criterion against another, and deciding on that alternative that does best against the most important criteria. The Hierarchy Weight technique may thus provide a more intuitive approach when many of the lowest criteria are qualitative in nature, or your decision-makers are uncomfortable providing tradeoff judgements.

Making the Choice of Hierarchy Rating Technique

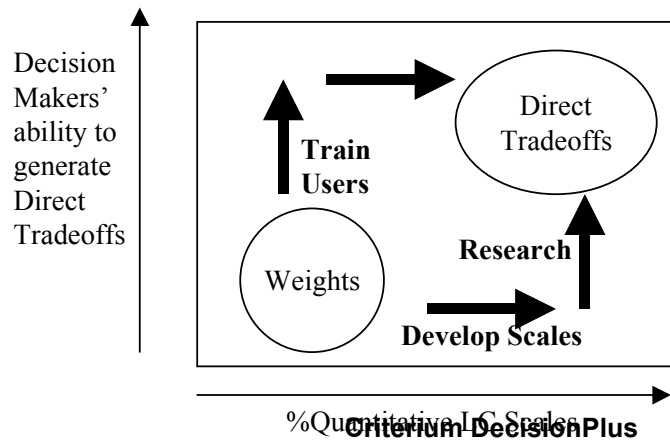
To summarize, our view is that if meaningful, quantitative scales are available for the lowest criteria and your decision makers are able to provide tradeoffs, then using a direct tradeoffs approach will likely provide a more accurate and persuasive decision analysis.

Starting with Weights, moving to Direct Tradeoffs

If you or your fellow decision makers are unfamiliar with tradeoffs or are starting on a totally new decision opportunity whose criteria are only being developed, you may want to start using the Weights technique, then use the Tradeoffs Analysis window to familiarize all with tradeoffs.



Once you have got to the point of developing a reasonable percentage of scales as quantitative, and you decision-making group is ready, convert your model to the Direct Tradeoff Rating technique.

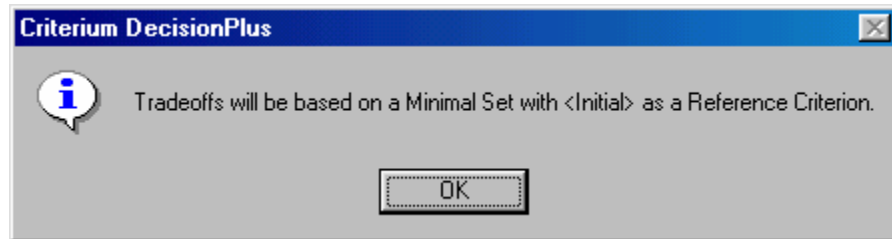


Selecting the Direct Tradeoffs Technique

The following steps describe how to select your underlying Hierarchy Rating Technique (Weights or Direct Tradeoffs).

1. In the Hierarchy window, from the Model menu, select Technique - Hierarchy. Two submenu items appear, one labeled Weights, the other Tradeoff. There is a check mark to the left of the menu item corresponding to the technique that is currently in effect. The default Technique in Version 3.0 is set to Weights.
2. Select Weights or Tradeoffs menu item.

When changing from Weights to Tradeoffs, the system uses the first available reference lowest criterion (unless you had been using tradeoffs earlier, in which case CDP will use whatever tradeoffs set you last employed, provided that tradeoff set is still valid). CDP will message you as to which reference criterion it is using.



Note: CDP will not let you convert from Weights to Direct Tradeoffs if your model contains any criteria that:

- Are subcriteria of more than one other criterion.
- Are rated with respect to their parent block at the minimum scale value (e.g., 0 on the Default numerical scale). See the section in this chapter entitled Rules Only Criteria for how to preserve criteria you only included in the model to support a rule.

When changing from Tradeoffs to Weights, there will be no visible changes in the Hierarchy window, but the Technique tray in the status bar will (within a few seconds) now show the word “Weights.”

Choosing Alternatives Rating Technique: SMART or AHP?

Before you begin rating your Alternatives, you should select the Analytical Hierarchy Process (AHP) or the Simple Multiattribute Utility Technique (SMART) to use as the alternative's rating technique in your decision model. The default technique in Criterion DecisionPlus is SMART. DecisionPlus uses SMART unless you select AHP or unless you load a file previously saved using AHP. For instructions on selecting and using SMART or AHP, see "Selecting the Alternatives Rating Technique: AHP or SMART," below.

Normalization

Before you can synthesize the contributions of criteria with differing scales, the decision model must provide a method that allows you to handle your differing model scales on an equal footing. For example, if a decision in the health care field were measuring in dollars and human lives in the same model, you would need to know at what dollar value a human life is being evaluated. In both AHP and SMART, the alternatives rating technique itself handles this problem for you. This is achieved by a process called normalization (see Glossary), where all scales are converted to a common internal scale that takes a value between 0 and 1.

Normalization in AHP

In AHP, using a Direct Rating method, to get the effective importance, or priority, of a subcriterion, you take its user-given score divided by the sum of the scores of all the other subcriteria of the common criterion. This guarantees that no matter what the original score, all weights will fall between 0 and 1.

This is a very simple and effective method that allows you to synthesize units that are completely different. However, it's clearly a relative judgment method. How a particular alternative scores in the model depends on what other alternatives are being considered. For instance, in AHP, if you created a model for one set of alternatives,

adding a new alternative later will change the scores of the original alternatives, sometimes in surprising ways (see Rank Reversal Phenomena when Using the AHP in Chapter 10).

Normalization in SMART

SMART doesn't use a relative method for scaling your units to a standard scale (from 0 to 1). Instead, you can define your own method for doing this using a value function. A value function allows you to explicitly define how each value on your scale is transformed to the common model scale. DecisionPlus provides three value functions in determining the ratings for the attributes: a linear function, an exponential function, and a piecewise linear function (see Using SMART in Chapter 10). A great amount of research has been done in determining the most appropriate value functions for a given decision problem (see References). The value functions in DecisionPlus provide sufficiently broad choices for you to make a quality decision.

Suggested Guidelines for use

We hope that the ability to apply both techniques within the same package will promote much research on the relative merits of the two approaches. (Most real-world models we have tested give the same ranking of Alternatives whether SMART or AHP is used.) In the interim, our tentative guide as to which technique to use is as follows:

AHP: The simplicity of model building in AHP suggests its use where possible. If it is unlikely that no new alternatives will need to be introduced beyond the set under consideration then rank reversal will not be such a problem. However, even in that case, if the majority of data available is quantitative, and particularly if there is known uncertainty in that data, SMART may provide an easier to understand and more powerful decision model.

SMART: If new alternatives are likely to be added to the model later, and most of the lowest criteria are amenable to a direct rating approach (not so qualitative as to require pairwise comparison), then SMART is a good choice.

Models rated using the AHP technique can exhibit a controversial anomaly called *Rank Reversal*, which you should be aware of. As a description of this effect requires some knowledge of how decision scores are calculated, please refer to the section “How Decision Scores are Calculated” in Chapter 12.

Some Differences Between SMART in CDP and AHP

The terminology used in SMART is different than that used in AHP. DecisionPlus adheres to this tradition. In SMART, the lowest criteria are called attributes. The numerical values assigned to these attributes are derived from value functions and are called ratings.

The structure used to model the decision problem in SMART is called a value tree, or objective hierarchy. The difference between a SMART value tree and an AHP hierarchy is that the value tree is a true tree structure, allowing one subcriterion to be connected to only one higher level criterion. In AHP, you can connect a subcriterion to more than one higher level criterion. If you select SMART, DecisionPlus does not force you to adhere to a true tree structure and calculates the model based on the criteria and weights you assign. DecisionPlus also requires you to define the alternatives and to connect them to the attributes.

DecisionPlus treats most of the SMART model the same way it treats the AHP model. Weighting the criteria is the same as we described earlier in this section. The difference occurs at the attribute level where you normalize, or tradeoff, the scoring of alternatives against different attributes. The value functions used in this process result in the creation of numerical values, or priorities.

Selecting the SMART Technique

The following steps describe how to select your underlying alternatives rating technique (AHP or SMART).

1. In the Hierarchy window, from the Model menu, select Technique. Two submenu items appear, one labeled AHP, the other SMART. There is a check mark to the left of the menu item corresponding to the

technique that is currently in effect. The default Technique in Version 3.0 is set to SMART.

2. Select AHP or SMART.

No visible changes occur in the Hierarchy window, but if there are Results or Analysis windows open, you may see some change in the results data, and you will see that the titles of those Windows will display AHP or SMART as appropriate.

Choosing A Rating Set

The actual rating in DecisionPlus is performed through the Criterion Rating window.

Displaying the Criterion Rating Window

1. On your Hierarchy window, click once on the goal block of your decision model.

Note: You can select any block: you do not have to begin with the Goal. However, because the most important criteria of your decision are those connected directly to the Goal, it is often a good idea to begin your ratings with those.

2. From the Block menu, select Rate Subcriteria.

Tip: A quick way to select the Rating window is to double-click on the block whose children you want to rate, or Right Click the block and select Rate Subcriteria.

AHP Rating - Direct Method

Method View Rules Options Uncertainty Help

Criterion: Buy a Car Next Notes

Scale Information

Units: Default Assign Scale

Worst: 0.00 Best: 100.00

Subcriterion	Weight
Style	<input type="text"/> <input type="text"/> UNRATED
Performance	<input type="text"/> <input type="text"/> UNRATED
Cost	<input type="text"/> <input type="text"/> UNRATED
Resale Value	<input type="text"/> <input type="text"/> UNRATED

Restore Current Ratings

OK Cancel Information Help Rate
 Hierarchy Alternative

Criterion Rating Window Description

Your goal name appears in the Criterion box near the top of the window. About one third the way down the window, the children of the goal are listed. This area displays the *rating set* you selected. A new menu bar appears at the top of your window with the menus Method, View, Rules, Options, Uncertainty (Uncertainty is light gray and unavailable until your model is rated or until you select a lowest

criterion whose subcriteria are alternatives). When you first display the Rating window, the Direct Comparison method is active. By clicking on the Method menu or View menu, you are able to see which Options are currently in effect. Selected options are preceded by a check mark.

- **SMART** If you are using the SMART technique, the Rating window displays the title “SMART Criterion Rating - Direct Method” (see “Using SMART and AHP” later in this chapter).
- **AHP** If you are using the AHP technique, the Rating window displays the title “AHP Criterion Rating - Direct Method.” (Direct is the default rating method.)

If you want to use AHP and have not selected AHP, turn to the section on “Choosing the Alternatives Rating Technique: AHP or SMART?” in Chapter 9, for steps to change the Alternatives Rating Technique to AHP.

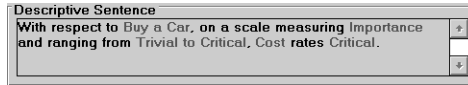
Criterion List displays the name of the parent block you highlighted. You are rating the subcriteria or alternatives of this block. The List may be ordered in a number of ways, but the default is by the importance of each criterion to the overall model. See the section, *Selecting the Next Rating Set*, later in this chapter.

Next Button You can click this Next button to choose the “next” criterion listed in the Criterion List. The exact behavior under Next is determined by the Next Button Action submenu setting under the Options menu. The default Action is “First Unrated Criterion,” namely clicking the Next button will cause DecisionPlus to jump in the Criterion List from the present position to the first unrated criterion in the list. See the section, *Selecting the Next Rating Set*, later in this chapter.

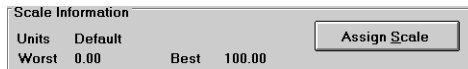
Note: If you prefer, you can select the next rating set by closing the Criterion Rating window, selecting a criterion in the hierarchy and returning to the rating window.

Notes Button Accesses the Notes box where you can enter notes about the criterion whose rating set you are considering.

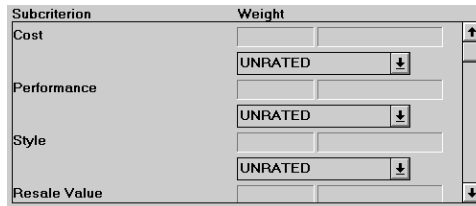
Descriptive Sentence This box describes the rating logic as it relates to your goal. It uses the wording of the verbal scale you select to describe how one subcriterion rates against another subcriterion. When you select a different verbal scale, or change ratings, the wording in your descriptive sentence also changes. This is a verbal display, so if you turn off the Verbal scale view, the descriptive sentence automatically turns off.



Scale Information The units of measurement and the range of those measurements you select are displayed in this box. In our illustration, we are using the units in the Default scale, which has a range of 0.00/Worst to 100.00/Best. Individual criterion ratings must be between those numbers. You can choose a different scale from a list of existing sales or design and assign a customized scale of your own.



Subcriterion/Weight Box The children of the parent block you highlighted are listed here. When you first display the Rating window, all the viewing options appear on the window, but they are either blank or “UNRATED” until you rate the children.



When you reach any lowest criteria to rate, the headings in this box, Subcriterion/Weight, change to **Alternative/Score** as illustrated below.

Alternative	Score
BMW	UNRATED
Ford	UNRATED
Toyota	UNRATED

Restore Ratings When you edit ratings, you can use this button to restore your rating set back to its original ratings. It only restores the ratings of the particular rating set you are editing.

Value Function If you are using SMART and are weighting a lowest criterion, a button will be visible to the left of the Restore Ratings button. This button allows you to define a Value Function for the parent criterion - see the section Assigning a Value Function in this chapter.

OK When you are finished entering new ratings, or updating old ratings, entering or updating rules, or assigning new or creating new scales, select this button to accept your current rating entries.

Cancel Select this button to cancel rating entries, scale changes, rules entries, or uncertainty distributions assigned since you opened the Criterion Ratings window.

Information You can access an alphabetical list of your criteria, and any attached notes. You can edit notes from this widow by double-clicking on the notes or click the Edit button (see description in Chapter 10).

Help Select this button to display information and instructions for the Rating window.

Choosing a Rating Method in Weights Technique

We provide three methods you can use in rating your model. They are Direct Comparison, Full Pairwise Comparison, and Abbreviated Pairwise Comparison.

Direct Comparison

This is a good method to use if you feel confident that you can rate each element of the rating set directly against an objective scale. Your information may come from a detailed understanding or experience with factors in your decision problem. Or, your information may come from an analysis that provides data you can assign in a direct rating.

Full Pairwise Comparison

Pairwise comparison means comparing in pairs. You may find this method useful if you have an intuitive feel for how the elements rate with respect to each other, but lack any objective yardstick against which you could directly measure them.

This method rates each element in turn against all the elements within its rating set. Your subjective judgment or intuition is all you need to determine how one subcriterion compares to another. In our example, we would rate the subcriteria of Performance (Acceleration and Braking) against each other.

Note: Pairwise Comparisons become impractical as the number of elements being compared increases. If there are more than 20 elements to be rated, neither the Full nor Abbreviated (see below) Pairwise Methods will be available to you.

Abbreviated Pairwise Comparison

This method is an approximation to Full Pairwise Comparison that skips some comparisons. This method is based on the assumption that if A is x times better than B, and B is y times better than C, then A is

$x*y$ times better than C. The comparison of A to C is then not necessary.

Choosing the Rating Views

We provide three views in which you can enter your ratings: Numerical, Verbal, and Graphical. You can enter a number in the Numerical view that is within the range of the scale you assign. You can select a word or a phrase in a Verbal view to describe how a criterion is rated. Or, you can adjust a horizontal bar on the Graphical view to show graphically how a criterion rates.

When you adjust a rating in one view, such as Numerical, the other two views immediately adjust to reflect the same value within its own scale. You can display one or all three of these views in your Criterion Rating window at the same time.

Cost	95.81	<input type="text"/>	Critical
Performance	64.8	<input type="text"/>	Very Important
Style	17.6	<input type="text"/>	Unimportant
Resale Value	39.2	<input type="text"/>	Important

Numerical View: In the Direct Comparison method, you can assign one of five different numerical measurements, each with its own numeric range. Or, you can create a customized numerical scale of your own. In the Pairwise Comparisons, there is only one numerical fixed range that shows how one criterion rates against another on a scale of eight above or eight below a midpoint

Verbal View: In the Direct Comparison method, you can assign one of six different verbal scales, each with its own verbal range. Or, you can create a customized verbal scale of your own. In the Pairwise

Comparisons, there is only one verbal fixed range that describes how much better or how much worse one criterion is than another.

Graphical View: You'll find this view is useful when you are conducting a "what if" analysis to see how a different value affects the results. Because this view visually illustrates the rating, there are no additional measurements from which to select.

Assigning Scales in Direct Comparison

If you already have rating values to assign, you can use the Direct Comparison rating method. The Numerical, Verbal, and Graphical scales are available with the Direct Comparison. Once you select the verbal or numerical views you want, you can enter the values directly in the Subcriterion/Weight box.

- In the Criterion Rating window, select Direct from the Method menu. (Direct is usually the default, indicated by a preceding check mark, when you display the Rating window for the first time.)

Assigning a Numerical Scale in Direct Comparison

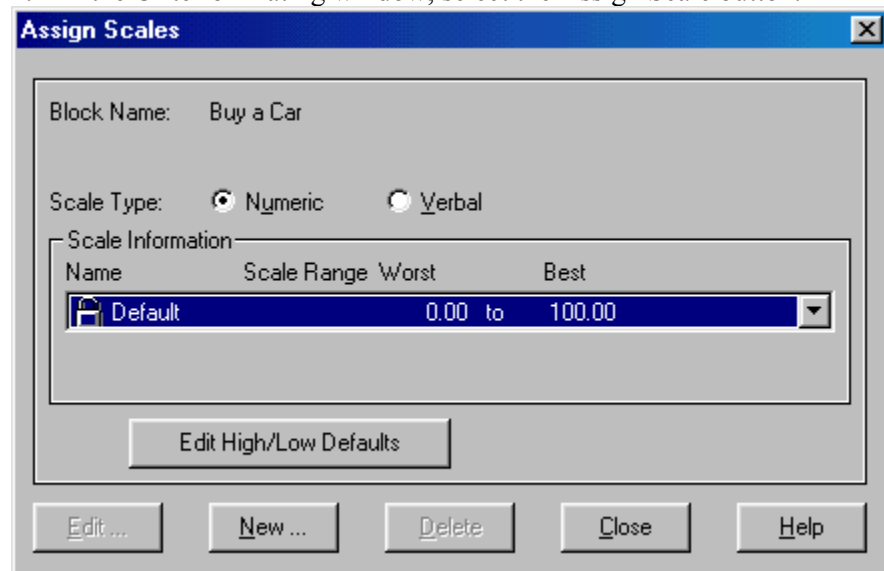
The Default scale is a measurement that may be used frequently. However, you can select a scale that represents your decision criteria more closely. We provide five scales, each with different units of measurement, from which you can choose. The scales described below are displayed in the list box with a padlock graphic to indicate that they cannot be modified or erased.

Scale	Measurement
Default	0.00 - 100.00
Rank	Last to First
Percent	0.00 - 100.00
0-10	0 - 10
Probability	0.00 - 1.00

Display the Assign Scales Window

To assign a numerical scale other than the default scale, access the Assign Scales dialog. The Assign Scales Dialog allows you to assign, create and maintain your scales.

1. In the Criterion Rating window, select the Assign Scale button.



Choose and assign a numerical scale

1. In the Assign Scale window, for Scale Type, select Numeric.
2. In the Scale Information box, click the drop-down menu arrow to display a list of scales.
3. Select the scale you want from the list of scales.
4. Select the Close button to assign the scale to the current rating set.

If the current rating set is already rated, you will get a message asking if you want to change your current values to correspond to the scale you just selected.

Create a Customized Numerical Scale in Direct Comparison

You can create a numerical scale of your own that uses a unit of measurement better suited to your decision problem. This is again accomplished through the Assign Scale window.

1. In the Criterion Rating window, select the Assign Scale button.
2. In the Assign Scale window, for Scale Type, select Numeric.
3. Select the New button at the bottom of the Assign Scales window to display the Add Scale box.
4. In the Units Name block, type the name you want to give this scale. (It is usually related to the units of measurement you create.)
5. For Best Value, type a number representing the best of your scale.
6. For Worst Value, type a number representing the worst of your scale.
7. Select the OK button. Your new scale is now recorded. You return to the Assign Scale dialog.
8. In the Assign Scale dialog, choose Close to assign the scale to the current rating set.

If the current rating set is already rated, and you select your new scale, you will get a message asking if you want to change your current values to the scale you just selected.

Assigning a Verbal Scale in Direct Comparison

The default scale is called Importance. It allows you to determine a weight by selecting from a group of words ranging from Trivial to Critical. However, you can select a scale that represents your judgments more closely. We provide six scales, each with different units of measurement, from which you can choose. The scales listed below are displayed in your window with a padlock graphic to indicate that they cannot be modified or erased.

Scale	Measurement
Importance	Critical to Trivial
Frequency	Always to Never
Yes/No	Yes to No
Quality	Finest to Unsatisfactory
Degree	Maximum to Minimum
Grades	A to F

Choose and Assign a Verbal Scale Window

To assign a Verbal scale other than the default scale, access the Assign Scales window.

1. In the Criterion Rating window, select the Assign Scale button.
2. For Scale Type, select Verbal.
3. In the Scale Information box, click the drop-down menu arrow to display a list of scales.
4. Select on the scale you want.
5. Select the Close button to assign the scale to the current rating set.

Create a Customized Verbal Scale in Direct Comparison

You can create a verbal scale of your own that uses verbal graduations better suited to your environment or decision problem. This again is accomplished through the Assign Scale window.

1. In the Criterion Rating window, select the Assign Scale button.
2. In the Assign Scales window, for Scale Type, select Verbal.
3. Select the New button at the bottom of the Assign Scales window to display the Add Scale box.
4. In the Scale Name block, type the name you want to give this scale.
5. In the Most Desirable list box, begin typing names representing the best of your scale to the worst of your scale.

Tip: To create a n effective scale, enter an odd number of graduations so one will act as a midpoint, and try to make sure that items in your weighting set will take values across the full scale.

6. To edit a measurement name, select a name from the list, select the Edit button (or double-click the name), and make your changes.
7. To move a measurement name to another position in the list, drag and drop the name into the position you want.
8. To delete any measurement names, highlight the name and select the Delete button.
9. Select the OK button when you are finished creating your new scale.

Assigning a Graphical Scale in Direct Comparison

DecisionPlus has only one graphical scale. There are no options for selecting or creating a different one. The scale's implicit range is from 0 to 100.

Entering Ratings in Direct Comparison

Once you assign the rating scales you want, you can begin rating the elements (subcriteria or alternatives) in your rating set. You can change rating scales at any time. For instructions on changing rating scales, see the instructions for assigning various scales in the preceding pages for the rating method you are using.

Enter Ratings in the Subcriterion/Weight Box

As we illustrated earlier in this chapter, the actual rating takes place in the Criterion Rating window. When you close the Assign Scales window, the Criterion Weighting window is updated with your assigned scales. You can display all three viewing methods, or only one or two.

Rating in the Numerical Scale

1. In the Criterion Rating window, from the View menu, select Numerical if it is not already selected.
2. Click once in the blank rectangle next to the first criterion to insert a blinking cursor. (In our example, this is Performance.)
3. Type in your rating, including decimals if needed. (In our example, we type in 80.00 for Performance.)

When you enter a rating in any one of the three scales for that criterion, the other two scales adjust their displays to reflect the equivalent value within their own scale. (In our case, 80.00 represents Critical in the Verbal scale, and a red bar just about the full length of the bar graph.)

4. Press ENTER to move to the blank rectangle next to the second criterion.
5. Type in your rating, including decimals if needed. (In our case, we type in 60.00 for Cost.)

6. Repeat steps 4 and 5 and enter the ratings for the remaining unrated criteria. (In our case, we type in 50.00 for Style, 30.00 for Resale Value.)

You'll notice that ratings of 50.00 and 60.00 are both represented by the same verbal measurement.

To Turn Off the Numerical Scale Display

- From the View menu, select Numerical.

Rating in the Verbal Scale

Another way to enter your ratings is to select from the Verbal drop-down menus.

1. In the Criterion Rating window, from the View menu, select Verbal if it is not already selected.
2. Click once on the drop-down menu for your first criterion to display a list of verbal measurements.
3. Select the word that best represents how you would rate this criterion.
4. Repeat steps 1 and 2 for the remaining criteria.

To Turn Off the Verbal Scale Display

- From the View menu, select Verbal.

Rating in the Graphical Scale

Of course, if you prefer you can simply adjust the bar on the Graphical scale.

1. In the Criterion Rating window, from the View menu, select Graphical if it is not already selected.
2. Hold your cursor down on the bar next to your first criterion and drag to the point you want the red bar to end.
3. Or, you can just click at the point you want the red bar to end.

Tip: As a guide, you can watch the values change on the other two scales as you adjust the bar.

To Turn Off the Graphical Scale Display

- In the Criterion Rating window, from the View menu, select Graphical.

Entering Ratings in Full and Abbreviated Pairwise Comparison

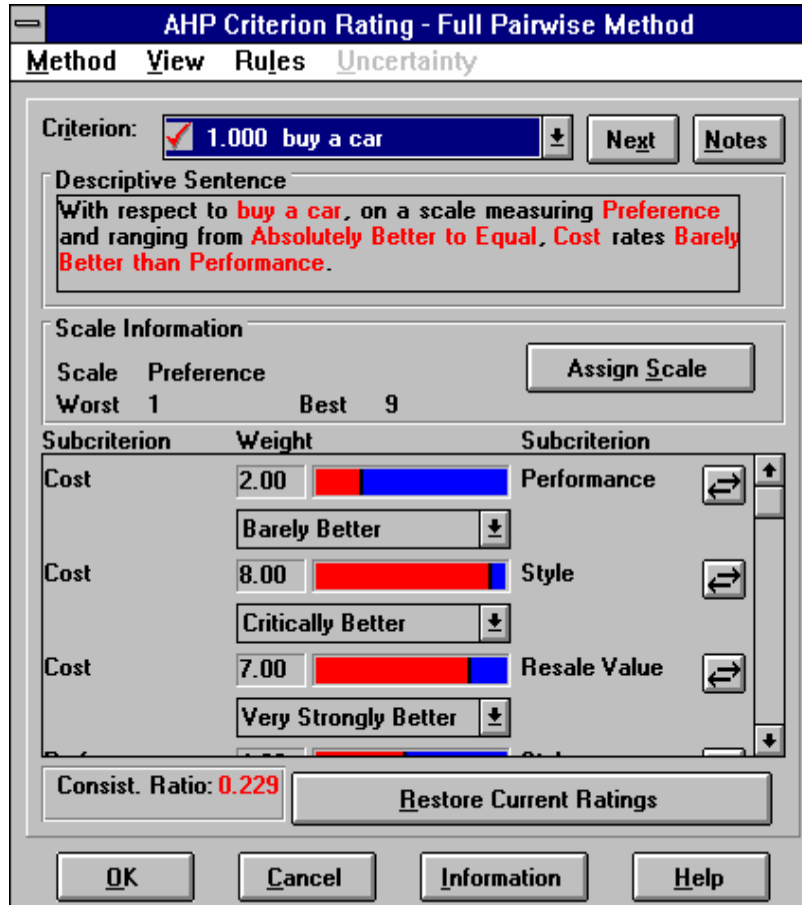
We mentioned earlier in this chapter that pairwise comparison means comparing items one against another. Even when no objective scale independent of your subcriteria or alternatives exists, your well-developed intuition allows you to make effective one-to-one comparisons. The Pairwise Comparison method facilitates such judgments by providing a range of 9 verbal increments and 9 numerical intervals that you can use to estimate how much better, important, etc., one criterion or alternative is over another.


Both the Full Pairwise Comparison and the Abbreviated Pairwise Comparison rating methods use the following numerical and verbal measurements:

<u>Standard AHP</u>	<u>DecisionPlus</u>	<u>DOS Criterion</u>
9	9 Absolutely Better	+9
8	8 Critically Better	+8
7	7 Very Strongly Better	+7
6	6 Strongly Better	+6
5	5 Definitely Better	+5
4	4 Moderately Better	+4
3	3 Weakly Better	+3
2	2 Barely Better	+2
1	1 Equal	±1
1/2	<>Barely Worse	-2
1/3	<>Weakly Worse	-3
1/4	<>Moderately Worse	-4
1/5	<>Definitely Worse	-5
1/6	<>Strongly Worse	-6
1/7	<>Very Strongly Worse	-7
1/8	<>Critically Worse	-8
1/9	<>Absolutely Worse	-9

The "<>" symbol indicates that you reverse the order for these comparisons: B is better than A rather than A is worse than B.

The Subcriterion/Weight box changes slightly to accommodate the comparisons. In the Full Pairwise Comparison, each criterion is compared with another criterion in the same rating set.



The "switch" button  reverses the order of comparison.

Consistency Ratio

One of the strengths of Pairwise Comparison ratings as developed by Professor Saaty (see References), is that it helps you remain consistent in determining the comparison between criteria. You might decide that apples are tastier than pears, while pears are tastier than oranges, but that oranges are tastier than apples. Clearly this is an internally inconsistent set of pairwise comparisons. The consistency ratio,

appearing in the lower left hand corner of the Criterion Ratings window, was invented by Professor Saaty as a measure of consistency and is calculated directly from your individual pairwise comparisons over the entire rating set. When the Consistency Ratio is larger than 0.10, the general wisdom is that your comparisons may be inconsistent.

Assigning a Pairwise Scale in Pairwise Comparison

There are six pairwise scales from which to choose. They are all measured in the range from 1 to 9 and their verbal equivalents. The scales listed below are displayed in the list box with padlock graphics to indicate they cannot be modified or erased.

Scale	Measurement
Preference	1 to 9 and verbal equivalents
Likelihood	
Size	
Importance	
Contribution	
Magnitude	

Display the Assign Scales Window

To assign a pairwise scale other than the default scale, access the Assign Scales window.

1. In the Criterion Rating window, select the Assign Scale button.

2. In the Assign Scale window, in the Scale Information box, click the drop-down menu arrow to display a list of scales.
3. Select the scale you want.
4. Select the Close button.

Create a New Pairwise Scale

1. In the Criterion Rating window, select the Assign Scale button.
2. Select the New button to display the Add Scale window.
3. In the Scale Name block, type the name of measurement you want.
4. Select OK.
5. Select the Close button.

Selecting the Next Rating Set

When you have finished rating a rating set, you can let DecisionPlus select the next rating set from the Criterion Rating window, or you can select it yourself from the Hierarchy window.

Selecting Another Rating Set from the Hierarchy Window

1. Close the Criterion Rating window.
2. Save your ratings by selecting Save from the File menu.
3. Double-click the next parent block whose children you want to rate.
4. Repeat the steps for assigning scales and rating each rating set until all your criteria are rated.

Selecting Another Rating Set from within the Criterion Rating Window

There are two ways you can select another rating set in the Criterion Rating window: by using the Criterion List Box, or by using the Next button.

Setting the Ordering Option for the Criterion List box

The Criterion List displays the name of the parent block you selected in the Hierarchy. You are rating the subcriteria or alternatives of this block. A check before the name indicates that the rating set of that criterion has already been fully rated. The list is ordered according to the options chosen through the Sort Next Criteria List By menu item under the Options menu:

Priority The default list sorting is by the priority (importance) of each criterion to the over all model as calculated by the Accumulated Weight of that criterion. The value of each criterion's accumulated weight is shown numerically before its name in the list. For information on exactly how the accumulated weights are calculated, see Chapter 12.

Name Choosing the Name option simply sorts the criteria alphabetically by name.

Hierarchy Order Choosing this option orders the criteria by the structure of the hierarchy - level by level, starting at the Goal, and from top to bottom in each level.

Rating the Next Criteria From the Criterion List Box

1. Click on the down arrow at the end of the Criterion box to display a list of criteria blocks. The blocks will be listed in the order of importance. Criteria already rated are indicated by a check mark preceding the block. You can select the next item listed or any item you are ready to rate.
2. Click the parent block you want. You will be rating the children of this parent block.

0.022 Model	↓
✓ 1.000 Buy a Car	↑
0.512 Cost	
0.322 Performance	
0.256 Maintenance	
0.256 Initial	
0.122 Resale Value	
0.107 Braking	
0.107 Miles Per Gallon	↓

Setting the Action Option for the Next button

You can select the NEXT button to choose the “next” criterion listed in the Criterion List. The exact behavior under Next is determined by the Next Button Action submenu setting under the Options menu

First Unrated Criterion Under the default Action, “First Unrated Criterion”, clicking the Next button will cause DecisionPlus to jump in the Criterion List from the present position to the first (according to the ordering of the list - see above) unrated criterion in the list. If you are already in the rating set of the highest unrated criterion in the model, but have not finished rating it, clicking Next will have no effect.

Next Unrated Criterion Under this Action, clicking the Next button will cause DecisionPlus to move *down* the Criterion List from the present position until it encounters an unrated criterion in the list.

Next Criterion in List Simply moves to next item in the List.

Rating the Next Criteria From the Next Button

1. On the Criterion Rating window, select the Next button. The Criterion Rating window will update itself with the rating set of the “next” criterion in the list box.

Accept or Cancel Your Ratings

When you finish rating all or part of the criteria, you can close the Criterion Rating window and either store your entries or cancel them. You can cancel all the ratings you entered since the last time you

saved your Hierarchy file. Your file will return to the state it was in when you last saved.

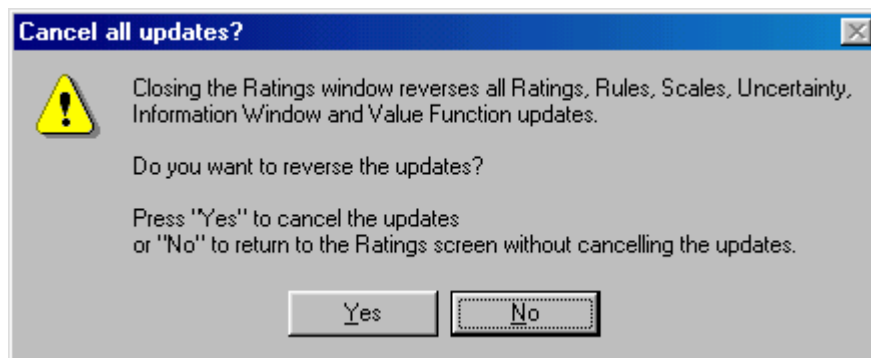
To Accept and Save Your Ratings

1. On the Criterion Rating window, select the OK button. The Criterion Ratings window closes, returning you to the Hierarchy.
2. To save your ratings in your decision model, use the Save option on the File menu on the Hierarchy window.

To Cancel Your Ratings

1. On the Criterion Rating window, select the Cancel button. Or, select the Close option from the Control-Menu Box.

The following dialog box displays asking if you want to cancel your recent entries, some of which may be updates to existing ratings, some may be first time ratings.



The message includes activity for several other windows to which you can make entries: Rules, Scales, Uncertainty, and Value Function. Some of these functions are discussed earlier or later in this manual. For now, you are only concerned with Ratings and Scales.

- To cancel, select Yes. DecisionPlus cancels all entries since you entered the Criterion Rating window and then exits from the window.
- To return to the Criterion Rating window without canceling, select No. DecisionPlus retains your entries and redisplay the Criterion Rating window.

If you opened the Criterion Rating window and made no changes, you will not get this message.

Choosing a Rating Method for Direct Tradeoffs Technique

Now that you have seen how to use the Weights Hierarchy Method, let's look at the details of how to establish the relative importance of the lowest criterion under the Direct Tradeoffs technique.

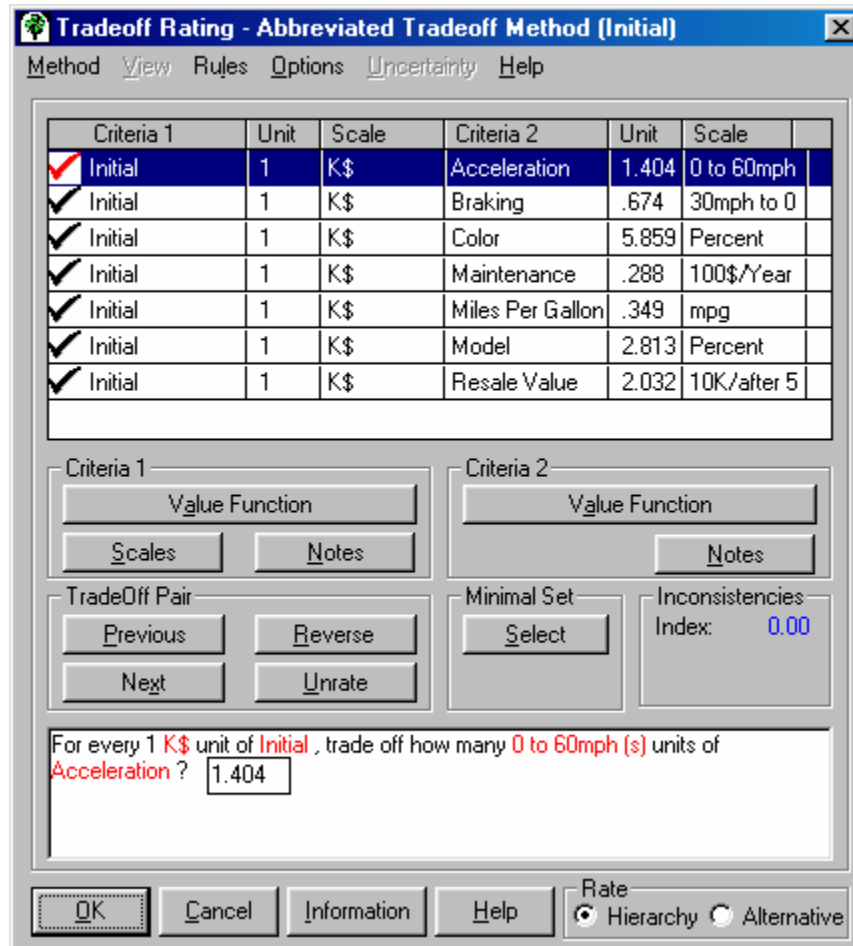
With the model Hierarchy Ratings Technique set to Direct Tradeoffs, proceed as follows.

Displaying the Criterion Rating Window

1. On your Hierarchy window, click once on the Goal or any non-lowest criterion to bring up the Tradeoffs Rating window.
2. From the Block menu, select Rate Subcriteria.

Tip: A quick way to select the Tradeoffs Rating window is to double-click on the Goal, or Right Click the Goal and select Rate Subcriteria.

Criterion Rating Window Description



The title of the Window says “Tradeoff Rating” and then the name of the Rating Method being used. If this is the first time you have opened the Tradeoffs Rating screen it will be the “Abbreviated Tradeoff Method (initial).” More about the Tradeoff Rating Methods below.

Tradeoffs Grid A grid displays the Tradeoff Set. A tradeoff set is a collection of lowest criteria pairs that are to be assigned tradeoff values. Each row in the grid lists one tradeoff pair. The first column gives the name of the tradeoff, then next the number of its scale units being traded for how many (column 6) units (column 5) of criterion 2's (column 4) scale. In the graph shown, the criterion "initial" was a reference criterion, and by default, the tradeoffs are expressed as how many units of the other criteria would be traded of for one unit of it's scale (\$1000). The check marks in the first column indicate that all tradeoff pairs have been assigned tradeoff values.

Below the Tradeoffs Grid, are areas that allow you to access and edit the Name, Notes and Value Function (if Alternatives Rating Technique is SMART).

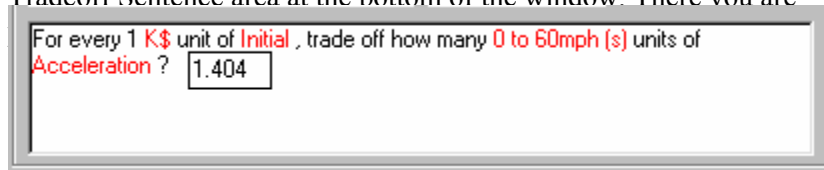
Tradeoff Pair Below that on the left is a tradeoff pair utility area. This provides buttons for moving up (**Previous**) and down (**Next**) the Tradeoffs Grid, as well as a button (**Reverse**), that changes the sense of the tradeoff from 1 unit of A is equivalent to X units of B, to that of 1 unit of B is equivalent to 1/X units of A. This reversing of the tradeoff sense can often make the tradeoff evaluation much easier. Finally, the **Unrate** button sets the tradeoff value back to unrated, which is represented in the grid by the value 0.

Minimal Set Select The minimal set **Select** button is used to launch the Select Minimal Tradeoff Set window (see below).

Inconsistencies – Index The Inconsistency Index gives an indication of how inconsistent the tradeoff set's values are (see below for an explanation of tradeoff set inconsistencies). A value of 0 means that the set is consistent.

Descriptive Tradeoff Sentence

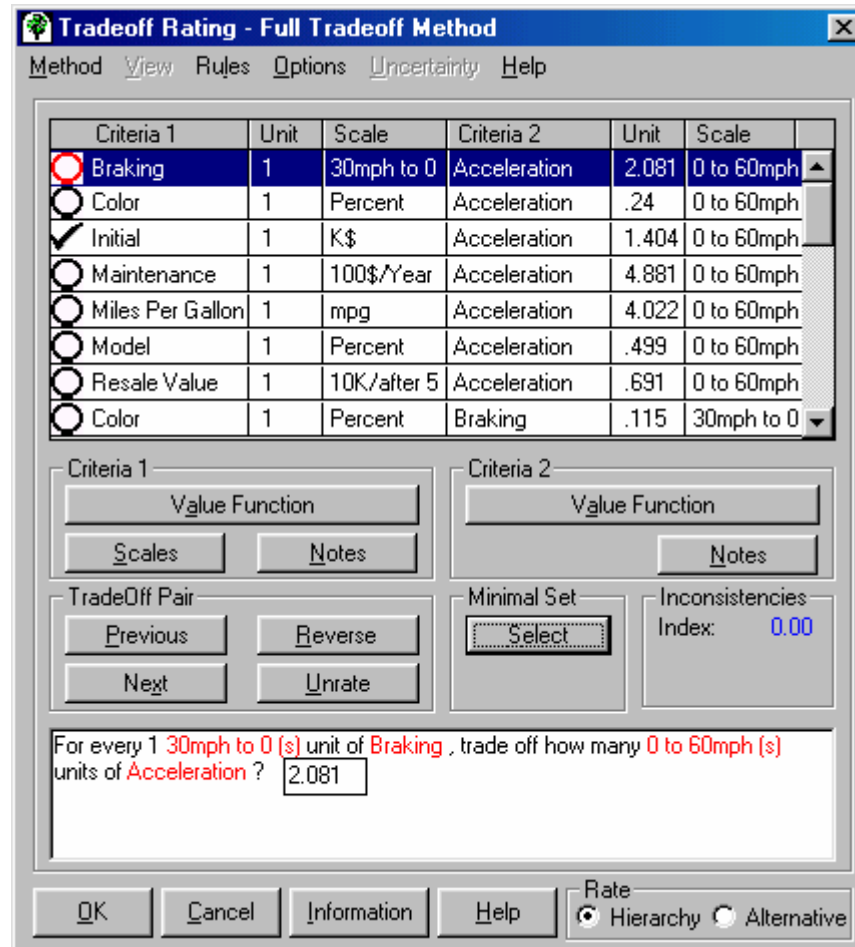
The heart of the direct tradeoffs Rating window is the descriptive Tradeoff Sentence area at the bottom of the window. There you are



Full Tradeoff Rating Method

Click the **Full Tradeoff** menu item under the **Method** menu. In the Buy A Car example, you would see 28 pairs listed. CDP indicates those tradeoff pairs you have directly rated by a check mark in the first column, and those values that it calculated indirectly from the values you have input, (assuming a consistent tradeoff set), with circles. Unrated pairs have nothing in that column.

You could proceed to consider each question, enter each value, press the Return Key, and move on to the next tradeoff pair (row) in the list.



Inconsistent Tradeoff Sets

Just as in the AHP pairwise comparison, tradeoff values should satisfy an inconsistency condition. As an example, if A is traded off at 5 units of its scale to 1 unit of B's scale, and B is traded off at 3 units of its scale to 1 unit of C's, then A should be traded off at $3 * 5 = 15$ units to 1 unit of C's scale. If you directly assign values to the A-B, B-C and A-C tradeoff pairs, your given values may or may not satisfy that

condition. If they don't, they are *inconsistent*, and the whole tradeoff set is considered to be inconsistent.

Minimal Tradeoffs Set

If there are 10 lowest criterion, and you *assume* all tradeoffs will be consistent, then it only takes 9 = 10-1 tradeoff pairs to uniquely determine values for all possible $(10 * 9)/2 = 45$ tradeoff pairs. This is because, if you assume the tradeoffs are consistent, and knew the A-B and B-C tradeoff pairs' value you could just calculate the value of the A-C tradeoff as $15 = 5 \times 3$.

The group of 9 tradeoff pairs has to have the special property that no pair could be directly calculated from products of the other 8. If that is true, the group of 9 constitutes a minimal set of tradeoffs pairs, and the values of all tradeoff pairs not in the minimal set can be calculated from products of the 9's values. There are many possible minimal sets for any tradeoffs problem, and CDP will help you construct them.

Abbreviated Tradeoff Rating Method

By choosing to use the Abbreviated Tradeoffs Rating Method, you can ensure that you are only assigning tradeoff values pairs belonging to a minimal set, and remove the possibility of inconsistencies.

To choose the Abbreviated Tradeoff Rating Method.

1. In the Tradeoffs Ratings window, click the Method menu item and select the Abbreviated Tradeoff item.
2. The **Select a Minimal Set of Tradeoff Pairs** window will open. Use it, as described in the next section, to choose your minimal set.

Choosing A Minimal Set for Direct Tradeoffs Technique

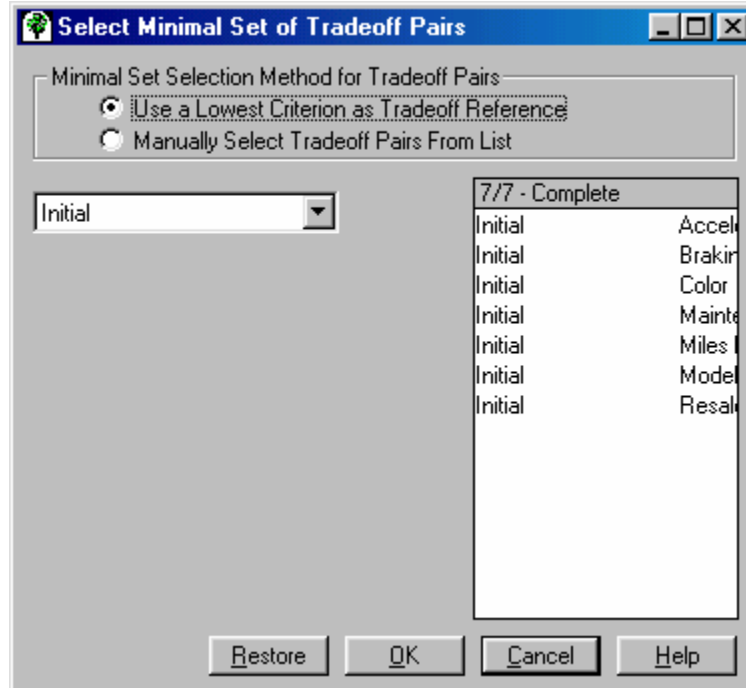
Selecting a minimal set of tradeoff pairs, rather than trying to tradeoff all lowest criteria pairs in your model, will both drastically reduce the

number of tradeoffs you need before you have a fully rated model and avoid inconsistent tradeoffs (see section above).

To select a Minimal Tradeoff Set

In the Tradeoffs Rating window, either

1. Click the **Select** button in the Minimal Set area, OR,
1. Click the **Abbreviated Tradeoffs** item under the Method menu.
2. **The Select Minimal Set of Tradeoff Pairs** window opens.



CDP provides two ways to select a minimal set.

Select a Reference Criterion

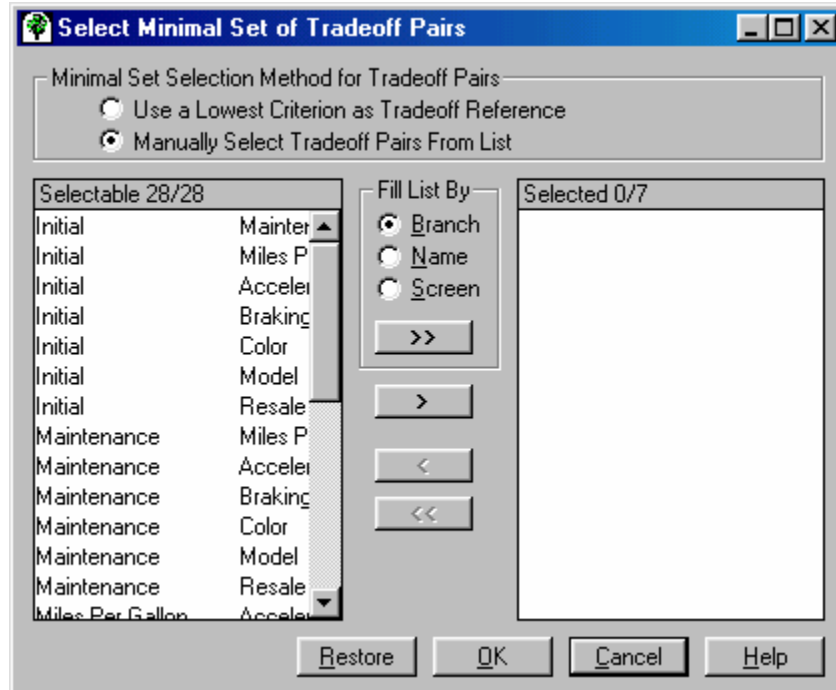
Click the Option (if not already clicked) **Use A Lowest Criterion as a Tradeoff Reference**. The area below the options area shows a dropdown listbox showing all candidate reference criteria. To the right is a list of the resultant minimal tradeoff set. In the screen capture above, “Initial“ (price) is the reference criterion, and all other lowest criteria are traded off with respect to “initial”.

Note: A lowest criterion must be a) connected to all alternatives b) have a non-zero accumulated weight before it is considered a viable tradeoff reference criteria.

If there is a criterion against whose scale all other scales can be traded off, that leads to very understandable and verifiable models. The initial price in \$'s for the Buy A Car Model is a reasonable choice. The problem is that many decisions have a large number of very different criteria, and there is no single criterion against which all others can be directly traded off. You could say that this problem is at the core of multicriteria decision making. For example, in a large environmental model, you may have whole branches of the model, e.g., Health and Human Safety and Project costs where subcriteria within each branch can be easily traded against each other, but tradeoffs between two lowest criteria, one from each branch, are difficult to establish and verify.

Manually Select Tradeoff Pairs from List

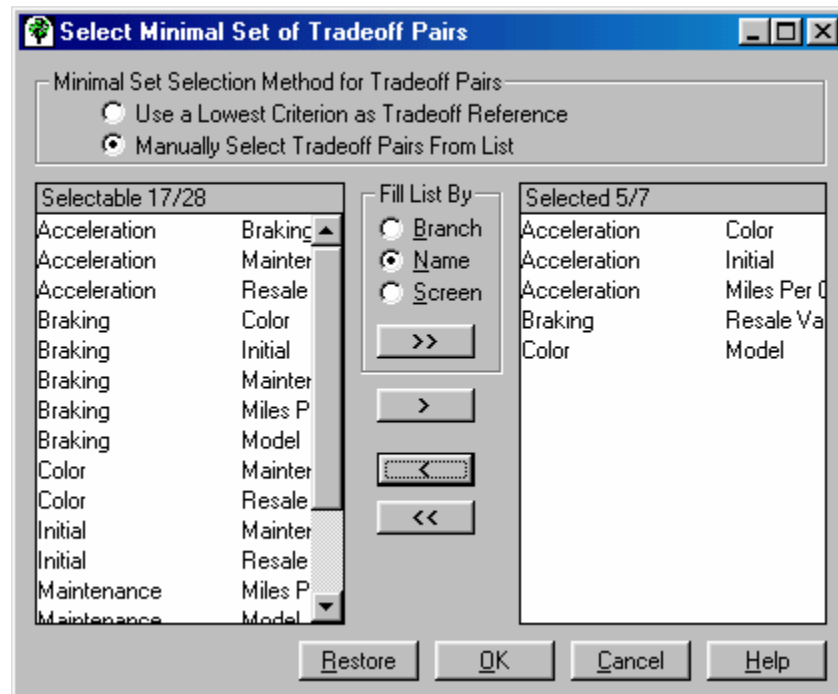
Instead of using a reference criterion, you can manually create a minimal set. Click the Option (if not already clicked) **Manually Select Tradeoff Pairs from List**.



On the left is a list of all Selectable tradeoff pairs. On the right, a list of pairs you have selected as members of your minimal set. (If you have some or all tradeoff pairs in the right hand list, click the “<<” button to move them all to the left hand (selectable) list).

Browsing the Selectable (left hand) list, you can select a pair you feel comfortable trading off. Then Click the “>” button to move that pair to the right hand, Selected list. As you continue to do this, you’ll notice that the number in the Selectable will start decreasing rapidly. Selecting and moving a single pair may make the number in the Selectable List decrease by 10 or more. That is because when a new

pair is selected, we remove all pairs in the Selectable list that can be



calculated, based on consistent ratios, from any combination of Selected Pairs. As mentioned before, there are $N*(N-1)/2$ tradeoff pairs, but only $N-1$ independent tradeoffs are required for a complete minimal set.

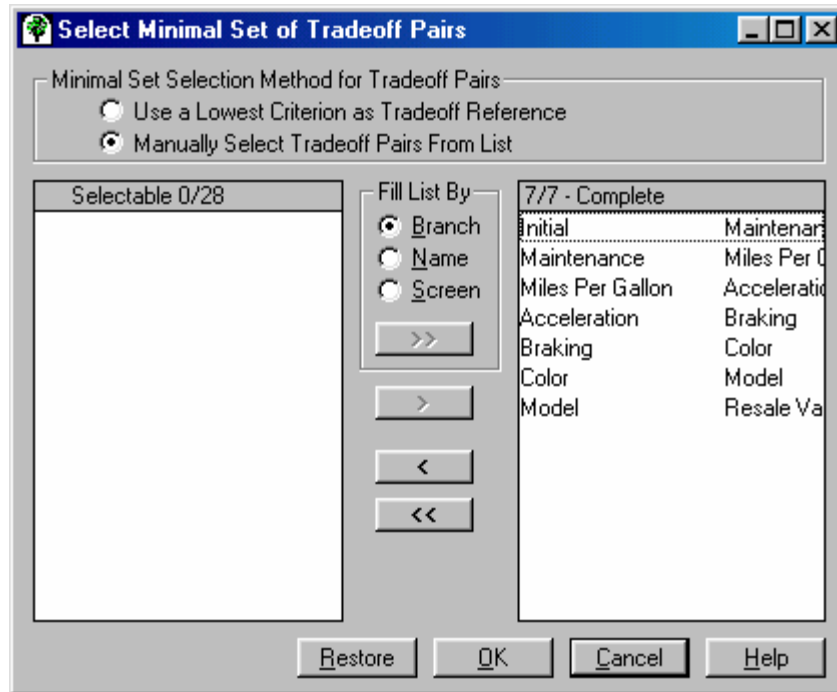
Auto Completing a Minimal Set

CDP offers three ways to complete your minimal tradeoff set in an ordered fashion by using the **Fill List By** option. By Branch, by Name and by Screen order. In each of these, CDP chooses pairs systematically until it has completed a minimal set.

To complete a minimal set by Branch.

1. In the Select Minimal Set of Tradeoffs Pairs, click the **Branch** option button.

2. Click the “>>” button to create a minimal set based on pairs of tradeoffs ordered by branch.



This Branch ordering can be critical in helping tradeoff large decision hierarchies. It allows you to tradeoff all the criteria of a large sub-branch amongst themselves, which is generally manageable because those criteria should be closely related. The tradeoff pairs that span two large branches then are seen to be critical – their tradeoff value sets all tradeoffs between the two branches. A single tradeoff could be responsible for all the tradeoffs between H & HS criteria and those of Project costs.

To Accept Your Minimal Set

1. Click OK to accept your Minimal Set and close the Select Minimal Set of Tradeoffs Pairs window
2. CDP will ask you do you wish to define all existing tradeoff values as directly assigned, even if they had been indirectly calculated. Any tradeoff pair whose value had been directly assigned, but does not belong to your new Minimal Set, will then have its value recalculated indirectly.

To Restore the Minimal Set

1. Click the Restore button to restore the minimal set to that which was in effect when you opened the window.

To Cancel

1. Click the Cancel button. The Minimal Set you choose will be discarded and you are returned to the Ratings Window.

Equalizing all Weights or Tradeoffs in a model

It can sometimes be very useful when starting to rate a new hierarchy, to start with equal weights or tradeoffs. In the Hierarchy Window, you can in a single menu selection unrate or equalize the Hierarchy weightings (tradeoffs) depending on whether you are using the Weights (Tradeoffs) Hierarchy Rating Technique.

To equalize all weights (using Weights Hierarchy Technique, only)

1. Make sure you are in the Hierarchy window
2. Select the item Equalize all Weights from the Model menu.

All weights of subcriteria in each rating set are set to the scale midpoint. Note that this does not mean that all lowest criteria will have equal accumulated weights – far from it.

To equalize all tradeoffs (using Direct Tradeoffs Hierarchy Technique, only)

1. Make sure you are in the Hierarchy window

2. Select the item Equalize all Tradeoffs from the Model menu.

All tradeoffs are set to 1. Note that this does not mean that all lowest criteria will have equal accumulated weights. Different scale ranges will lead to different accumulated weights.

Unrate All Weights and Direct Tradeoffs

Weights or Direct Tradeoffs may be universally reset to their default unrated values.

1. In the Model menu on Hierarchy window, click Unrate,
2. Then choose All Weights or All Tradeoffs.

Note: Exercise this universal Unrate action with extreme care!

Rating Alternatives Against Lowest Criteria

Having assigned the relative importance of the lowest criteria, now let's rate the alternatives against them. As discussed at the beginning of this Chapter, this is achieved using either the Analytical Hierarchy Process or Simple Multiattribute Rating techniques.

Using the AHP to rate Alternatives

Rating the Alternatives against the lowest criteria using the AHP is exactly as described in the earlier sections of this chapter covering weighing criteria under the Hierarchy Weights Technique.

Using SMART to rate Alternatives

If you have selected SMART, there are some differences from AHP. No pairwise comparison rating method is available when rating alternatives. And there are Value Functions. The use and purpose of value functions is explained in the next sections.

Assigning Value Functions under SMART

If you selected the SMART technique in the Hierarchy window the word SMART appears in the title bar of the window instead of AHP. To select SMART, turn to section in this chapter “Choosing the Alternatives Rating Technique: AHP or SMART.”

Other than the window caption, choosing SMART or AHP makes no difference as to how higher level criteria are weighted.

Rating Lowest Criteria

When you reach a lowest criterion (one whose rating set consists of Alternatives), the Rating window in SMART changes in several places: the Criterion name box changes to **Attribute**, Subcriterion/Weight changes to **Alternative/Rating**, and the **Value Function** button appears in the lower left corner of the window. These changes are to adhere to the terminology commonly used in the SMART technique. For both techniques, the Uncertainty menu item becomes available when you rate any lowest criteria. See following illustration.

SMART Rating - Direct Method

Method View Rules Options Uncertainty Help

Attribute: Maintenance Next Notes

Descriptive Sentence
 With respect to Maintenance, on a scale measuring Importance and ranging from Trivial to Critical, BMW rates UNRATED.

Scale Information
 Units: Default Assign Scale
 Worst: 0.00 Best: 100.00

Alternative	Rating
BMW	UNRATED
Ford...	UNRATED
Toyota	UNRATED

Val Functn Lin (+) Restore Current Ratings

OK Cancel Information Help Rate: Hierarchy Alternative

To Rate Attributes with Value Functions

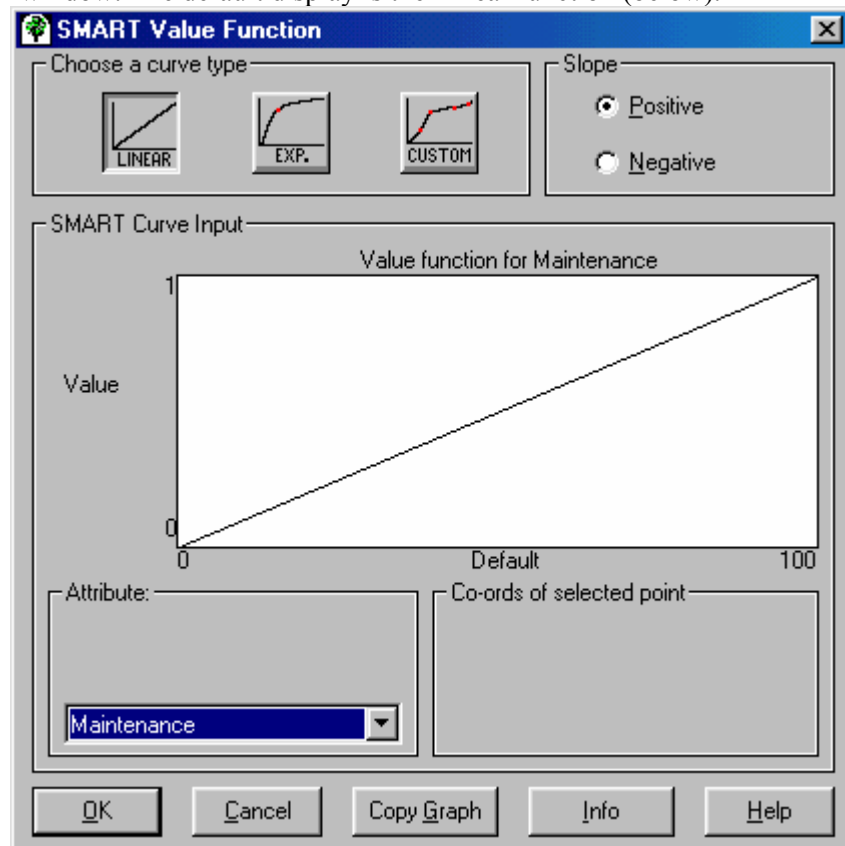
The default value function for determining a rating for an attribute is a linear function. If you assign a rating using the numerical, graphical, or verbal views, the value is determined using a linear value function. To select the scale you want,

1. In the Criterion Rating window, select the Assign Scale button.

Select any of the scales provided in the list box, or create a customized scale by selecting New. Follow the steps for “Display the Assign Scales Window” in the sections on Assigning Ratings earlier in this chapter.

DecisionPlus uses this scale and advises you if you previously assigned values beyond the upper and lower bounds of the scale.

2. Click the Value Function button to open the Value Function window. The default display is the Linear function (below).



3. Select the value function you want to work with: Linear (already displayed upon first entering the window), Exponential, or

Custom. Detailed instructions on how to work with each type are supplied in later sections of this User's Guide.

4. Close the Value Function window. You are again in the Criterion Rating window. The Value Function you have chosen is shown on the Value Function button, e.g., Lin (-) indicates a linear value function with a negative slope.
5. Rate your rating set exactly as before. The impact of your choice of value functions will become apparent only when you are calculating the results (see Chapter 12).

Normalization in SMART and AHP

Anticipating the comprehensive discussion on how decision scores for alternatives are calculated, which appears in Chapter 12, the basic difference between AHP and SMART techniques is how they implement the *normalization* of user scales. Normalization is how the model takes disparate user scales, such as costs in billions of dollars and human life days saved, and puts them on a common, internal *priority* scale. The priority scale always has values between 0 and 1.

In AHP, the direct method uses a simple relative normalization technique, that divides the score of an item under a criterion, by the sum of the scores of all the alternatives under the same criterion, to produce the priority of that alternative under that criterion.

In the SMART technique, the scores for the alternatives are normalized to priorities differently than when using the AHP technique. In SMART, the normalization process uses simple mathematical functions, the value functions, to map one end of the user scale to 0, and the other to 1 (look at the curve in the Value Function window above). All other values are mapped to values within this range (0 to 1) according to the value function you choose.

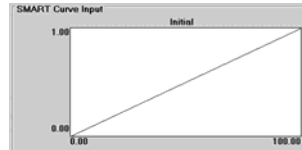
Using the Linear Value Function

1. To select the value, click on the appropriate point on the curve.
2. To change the scale, select Cancel to return to the Criterion Rating window, then select Assign Scale and continue as before.

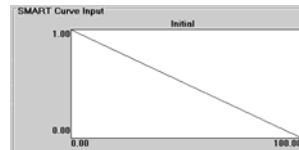
Setting the Slope

In SMART, the user chooses which end of the user scale is mapped to 0 and which to 1, by selecting a positive or negative *slope*. By default, DecisionPlus assumes that higher numbers correspond to a better priority. In some cases, such as when working with costs, the higher numerical value corresponds to the less desirable case. In a value function, this is expressed by choosing a negatively sloped function.

To set the slope, select either Positive or Negative in the Slope group box.



Positive

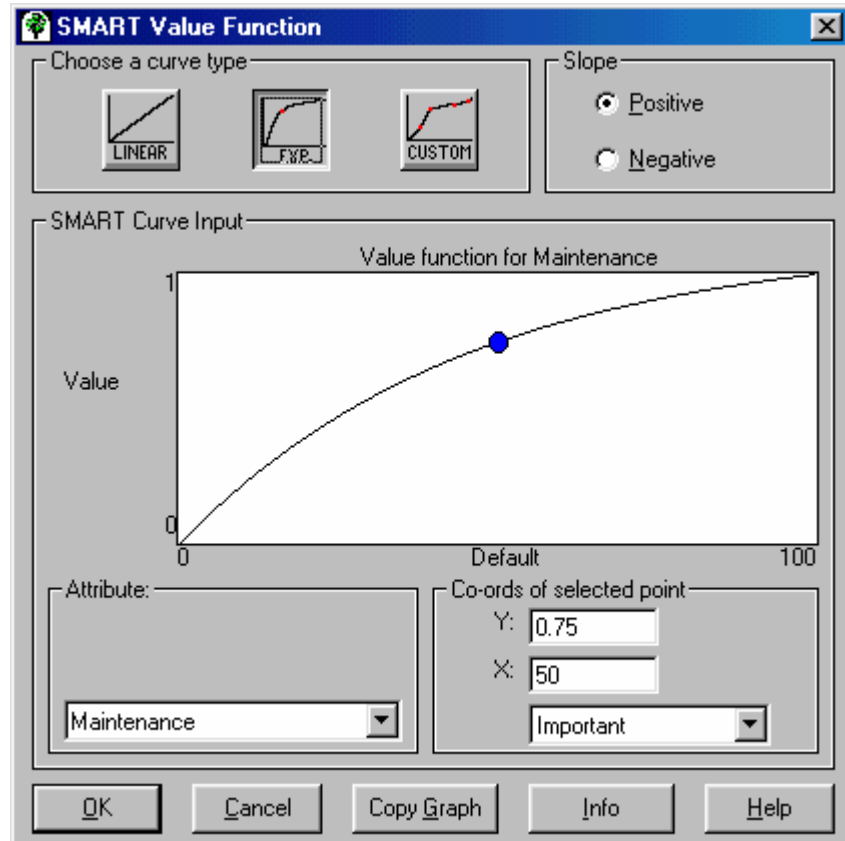


Negative

The interplay between your choice of Best and Worst when you defined your numerical scale (its *orientation*) and your choice of slope for your value function is important to understand. Please see the section Synchronizing Value Function Slope to Scale Orientation below.

Using the Exponential Value Function

1. Select on the Exponential (EXP.) button.



2. To change the curve, click and drag the blue point on the curve. The exponential curve changes so it passes through the blue point. The coordinates of the current value are given below the curve area in the Values box.

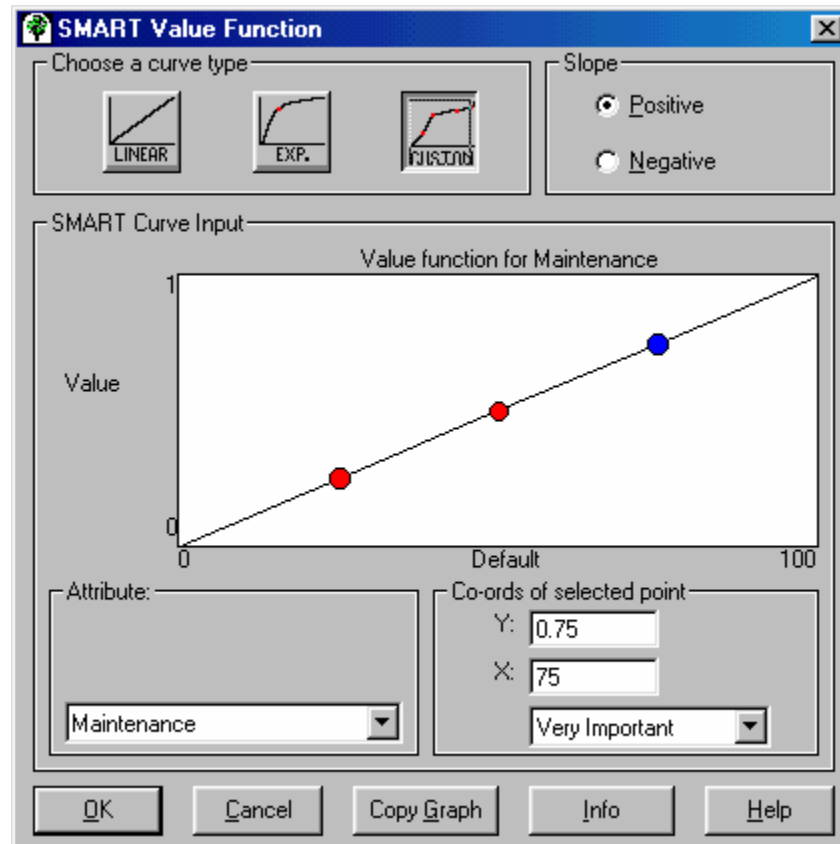
Coordinate values may also be entered directly into the value box. Note that extremely angular curves are not permitted. If the blue reference point is dragged into an off-diagonal corner, the point relaxes slightly toward the center. The range of curves permissible is adequate for most decision problems. If you need a more

angular curve, use the custom value function to create a set of points that meet your needs.

Using the Custom Value Function

The custom value function allows you to define up to ten points of a piecewise linear function.

1. Select the Custom button.



2. To move one of the three points displayed, click and drag one at a time. The point you drag turns blue when selected.

The value of the selected point shows in the Values box below and conversely, the value field may be used to position the point.

3. To add additional points, double-click the background canvas above the curve. A point appears along the curve for each double-click you make.

Note: Value functions in DecisionPlus are always either monotonically increasing or decreasing.

4. To delete a point, use the right mouse button to click on a point.

When you finish rating your model in SMART, you can continue below with Assigning Rules, or save the entries to your model and proceed to the next appropriate chapter.

Synchronizing Value Function Slopes to Scale Orientation

When you create or edit a numerical scale you establish an Orientation for that scale by deciding whether high numerical values of the scale correspond to Best or Worst values. When using SMART, each lowest criterion has its own unique value function, with a user defined Slope. These two properties both indicate which end of the scale corresponds to a higher decision score. Since they are set independently (as one scale may be assigned to several criteria), they may conflict when:

- 1) A numerical scale is assigned to a Lowest Criterion (Attribute) under SMART
- 2) An existing scale, which has been assigned to a Lowest Criterion (Attribute) under SMART, is radically edited so that its orientation is reversed.

While DecisionPlus will always use the information from the value function slope over the scale orientation, this conflict can cause confusion for the decision-maker.

The default approach in DecisionPlus is to automatically synchronize the value function slopes to the orientation of the scale. For scales with positive orientation, the source of the conflict may be:

- 1) A numerical scale is assigned to a Lowest Criterion (Attribute) under SMART, then the lowest criterion with that scale has the slope of its value function made positive.
- 2) An existing scale, which has already been assigned to a Lowest Criterion (Attribute) under SMART, is radically edited so that its orientation is negative, then all lowest criteria using that scale have the slopes of their value functions set to negative.

Sometimes you may have a good reason to let such a conflict exist. This is often the case with \$ scales. For example, Costs might use the scale with a negative slope, while Revenues might use the same scale with a positive slope. In that case, you need to change DecisionPlus's way of handling such conflicts from automatically synchronizing to one of querying you for your preference. This is done as follows:

1. In the Assign Scales window, uncheck the [Synch Value Function Slope](#) checkbox.

Subsequently when a conflict opportunity arises, DecisionPlus will query you as to how you wish to proceed. This can result in a lot of messages. To revert to the default behavior, check the [Synch Value Function Slope checkbox](#) again.

Using the Alternatives' Rating Window

The Alternatives Rating Window allows you to edit all the attributes of a single alternative in one dialog.

Criteria	Units	Minimum	Maximum	Value
Initial	K\$	10	50	45
Maintenance	00\$/Year	5	15	11.3
Miles Per Gallon	mpg	25	55	26
Braking	0mph to 0 (s)	8	20	9.2
Color	Desired Color	Other	Red	Red
Model	Desired Model	Unavailable	Available	Unavailable
Resale Value	K/after 5 years	3	35	32
Acceleration	to 60mph (s)	15	40	17.2

Only the primary view is represented for each lowest criterion. You can change views, scales or methods from this window.

You can enter all score values directly, except for those lowest criterion using pairwise rating methods.

Alternative Listbox

You can use the Alternatives drop-down listbox to choose any other alternative, and proceed to rate its attributes.

To open the Alternatives' Rating Window

1. In the Hierarchy window, select an Alternative.
2. Choose the Rate Subcriteria (!) item from the block menu.

OR

1. In the Hierarchy window, Double Click an alternative.

OR

1. In the Hierarchy window, Right Click an alternative,
2. Choose the Rate Subcriteria menu item.

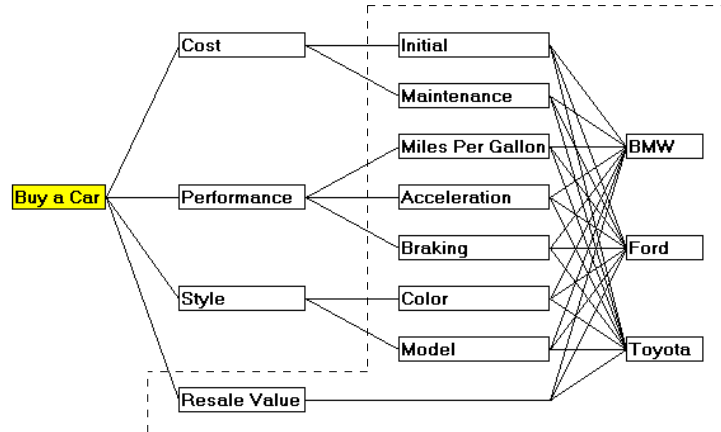
To Unrate all Alternatives' scores

All scores may be reset to default values.

1. In the Model menu on Hierarchy window, click Unrate, then
2. Choose Scores

Assigning Rules

If you have used AHP before, you have probably assigned rules to help identify when conditions are not met. Rules are conditional statements that apply to the lowest criteria, criteria blocks whose children (subcriteria) are Alternatives. (See illustration below.) Rules do not affect the decision scores of your model, but any lowest criterion that fails a rule is highlighted in the Results window so you can easily identify it.

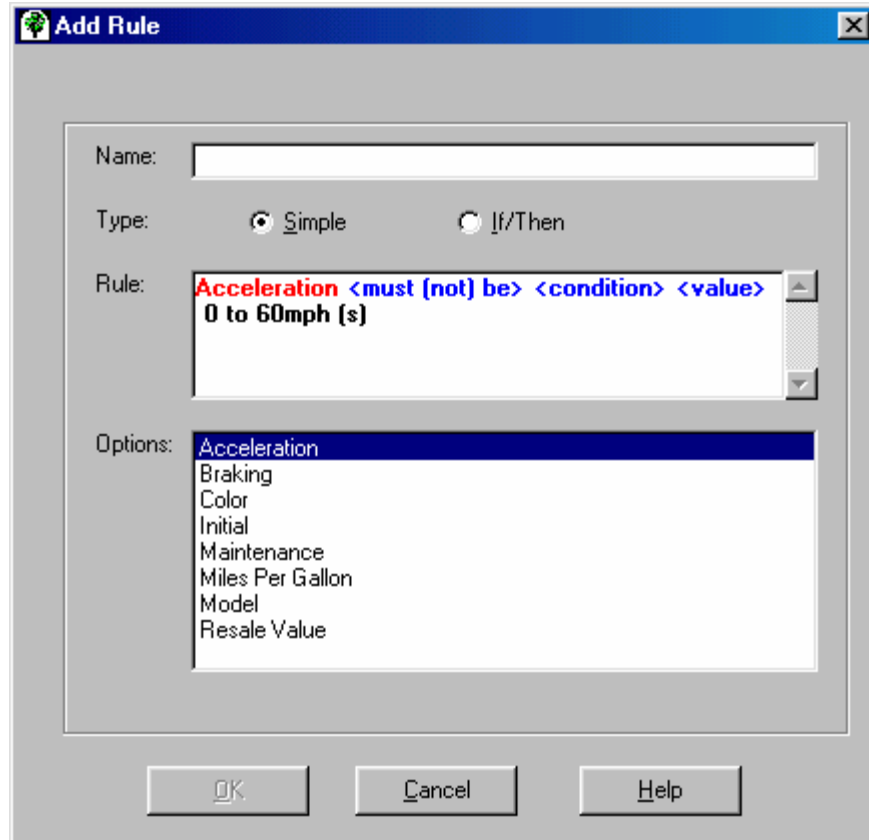


DecisionPlus has two types of Rules: Simple rules and If/Then rules. An example of a Simple rule using our Car model above is: *Initial must not be better than 50.00*. If you were using DecisionPlus to hire a new employee, you might write a rule that says their experience in customer support must be greater than 1 year.

An example of an If/Then rule using our Car model above is: *If Initial is better than 50.00, then Maintenance must be no better than 50.00*. If you were using DecisionPlus to hire a new employee, you might write a rule that says IF their degree is no better than a Bachelor's, THEN their grade point average must be better than B to be considered.

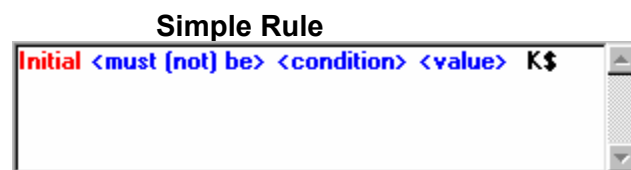
Display the Add a Rule Window

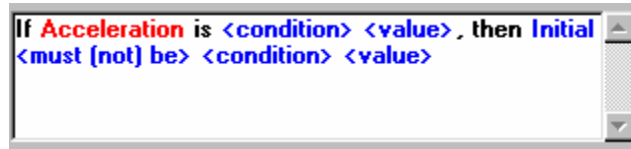
1. In the Hierarchy window, from the Block menu, select Rate Subcriteria to display the Criterion Rating window. Or, double-click on the first criterion of the lowest criteria.
2. In the Criterion Rating window, select Rules from the menu. The message, “There are no rules on file. Press ‘New’ to add a rule”, displays. This message alerts you that your first task, once you are inside the Rules window, is to add rules.
3. Select OK to display the Maintain Rules window.
4. Select the New button to display the Add Rules window.
5. In the Name block, type in a name for the rule you want to add. If you do not type in a name, the message “Rule name must be entered” displays.



6. Select the type of rule you want, Simple or If/Then. The Rule box below displays a template of the selected rule statement and bracketed terms you must fill in. The first item to define (the first on the list of your lowest criteria) is already filled in and is highlighted red.

Below are illustrations of templates for both types of rules.



If/Then Rule**To Specify Your Rule**

First, select the lowest criterion for which you want to add a rule. The first one in the list of lowest criteria is already inserted for you.

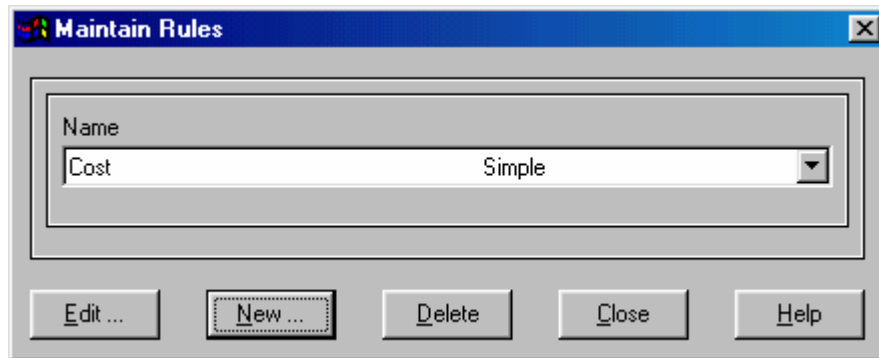
- If the red highlighted criterion listed in the Rule box is the one you want, go to the steps below to define the conditions.
- If the criterion you want is in the list of criteria below, click once on the one you want. The red highlighted criterion is replaced with the one you selected.

Now define the conditions between the brackets < >.

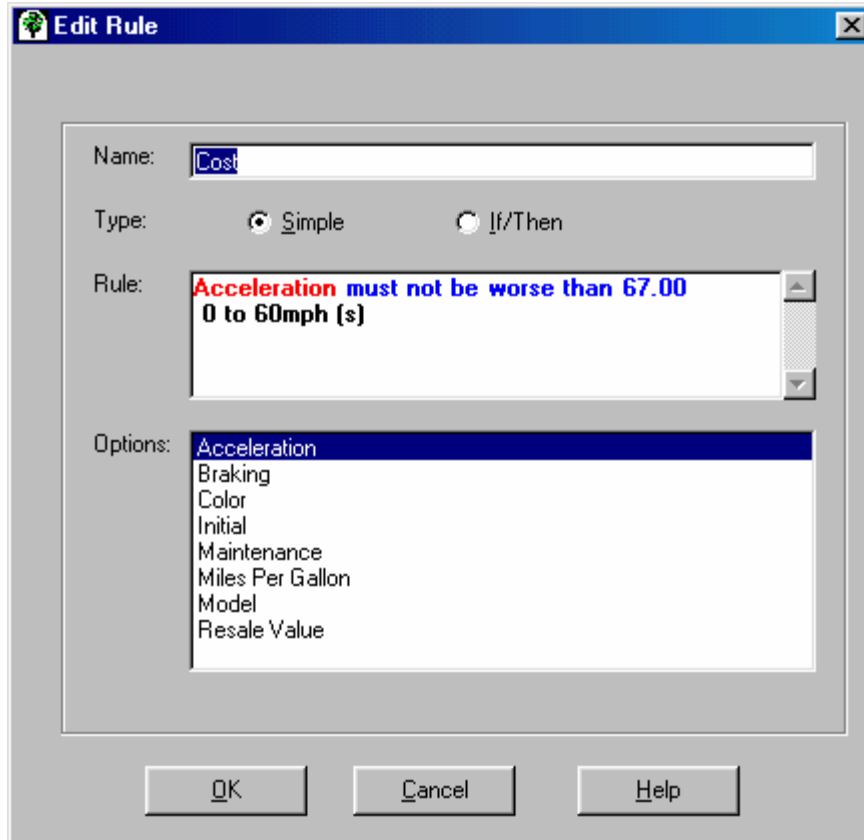
1. In the Rule box, click on the word <condition> to display a list of conditions in the Options box. The bracketed word is replaced with the first option in the list and is highlighted red. If this is the option you want, move on to the next condition.
2. To select a different condition, in the Options box, select the condition you want. The option then replaces the condition highlighted red in your Rule box.
3. Repeat steps 1 and 2 for each word in < > until you have completed your statement.
4. When your statement is complete, select OK. The Add Rule window closes and the Maintain Rules window redisplay.
5. To add more rules, begin again at Add a Rule.
6. To cancel your entries, select Cancel.

To Edit Rules

1. Display the Criterion Rating window.
2. Select Rules from the menu.



3. On the Maintain Rules window, click the Name drop box down arrow to display a list of rules.
4. Select the rule you want to edit.
5. Select the Edit button. The Edit Rule window displays the current name and version of that rule.
6. The Rule Name is highlighted. Type a new name if needed, or edit the highlighted name.



7. Click the part of the rule you want to change. A list of options displays below.
8. Select the option you want.
9. Repeat steps 6 and 7 until you have completed your changes to this rule.
10. When you have completed the changes to this rule, select OK.
11. To cancel the changes, select Cancel.

Rules Only Criteria

Sometimes you may want to add a rule, but no relevant criterion exists. It might be a legal requirement, such as foreign ownership has to be less than 70%. So you would add a criterion called “Foreign Ownership”, connect it to all alternatives and to the Goal (say). Then set your Rule as described above. But you don’t wish this criterion to be part off the tradeoffs in the model. This can be done as follows.

When using Weights Hierarchy Technique

Double click the block with respect to which your “Foreign Ownership” block is a subcriterion. Set the Weight of “Foreign Ownership” to the scale minimum. (This is usually is the scale end marked “Worst.” But if you are using SMART, make sure it is the value that maps to 0 in the Value Function

When using Direct Tradeoffs Hierarchy Technique

Setting the weight of a criterion to the scale minimum would correspond to a tradeoff with a value of 0– an infinite amount of change would be required to equal a unit change in any other criterion. CDP does not allow tradeoffs of value 0. Instead CDP allows you to remove lowest criteria from being traded-off at all. To do this, select the “Foreign Ownership” in the Hierarchy view, and select the “Exclude Lowest Criterion from Tradeoffs” item in the “**Block**” menu item. If you then double click any non-lowest criterion to see the Ratings screen, you’ll see that “Foreign Ownership” is not included in the Tradeoffs Set.

To include a hitherto excluded lowest criterion.

1. In the Hierarchy window, select the excluded lowest criterion.
2. From the **Block** Menu, select **Add Lowest Criterion to tradeoffs**

Criterion Rating Menu Commands

Many of the Criterion Rating window functions described earlier using the mouse can also be performed using the menu options. Below is a list of all these menus and options.

Hierarchy Weights, Alternatives AHP or SMART Rating Techniques

Method

Direct Selects the Direct Comparison rating method, making available the selection of Numerical and Verbal rating scales.

Full Pairwise Selects the Full Pairwise Comparison rating method, making available the selection of Pairwise rating scales.

Abbreviated Pairwise Selects the Abbreviated Pairwise Comparison rating method, making available the selection of Pairwise rating scales.

View

Numerical Displays or turns off the numerical view on the Criterion Rating window.

Verbal Displays or turns off the verbal view on the Criterion Rating window.

Graphical Displays or turns off the graphical view on the Criterion Rating window.

Descriptive Sentence Displays or turns off the Descriptive Sentence on the Criterion Rating window. Because this is a verbal display, it is only active when the verbal view is active.

Decimal Places Lets you choose how many decimal places you wish to numerical scales to exhibit (from none to 6). The default is Auto, which usually produces 2 decimal places. Your choice applies to all numerical scales.

Options

Note: These options, if changed from their defaults, are only active while the application is open. If you close DecisionPlus, all options will have returned to their defaults when you next open it. You can change the defaults using the Options dialog on the Hierarchy Window.

Sort Next Criteria List By

Name Sorts the Criteria in the Next Criteria listbox alphabetically.

Hierarchy Order Sorts the Criteria in the Criterion listbox by Hierarchy Order.

Priority Sorts the Criteria in the Next Criteria listbox by their Accumulated Weights. This is the default setting.

Next Button Action

First Unrated Criterion Clicking the Next button takes you to the first Unrated block in the list. However the list is sorted (see above), and regardless of your starting point, this is the default setting.

Next Criterion in List Clicking the Next button simply takes you to the next block in the list, however the list is sorted (see above).

Next Unrated Criterion Clicking the Next button takes you to the next Unrated block in the list, however the list is sorted (see above).

Group Tag Level

Sets the Group Tag level. For an explanation, see Setting the Tag Level Options in Chapter 13. The options are the list of levels within the hierarchy model. The default is "(None)".

Tag By First Letter Sets the Group Tag Level. This is a checked menu item. It is disabled if the Group Tag Level is set to "(None)".

Real Time Update When this option is checked, all visible results and analysis windows are updated as soon as you make any change to the ratings. If you are using a Numerical view, and editing the

numerical text box directly, these updates occur every time a digit is entered. For large models this can slow your work. Clicking the option off ensures that the general model results are only updated when the Criterion Ratings dialog is closed. The default is real time updating on.

Rules Accesses the Maintain Rules window where you can add and edit rules for your lowest criteria.

Uncertainty Available for lowest criteria once you rate them. Accesses the Uncertainty function which is described in Chapter 11, “Select Uncertainty.”

Direct Tradeoff Hierarchy Rating Technique

Method

Full Tradeoff Display and assign values to all tradeoffs pairs.

Abbreviated Tradeoffs Only display and assign values to members of the minimal set you have selected. When you click this menu item, the **Select a Minimal Set of Tradeoff Pairs** window appears. Use that to select a minimal tradeoff set.

Options

Note: These options, if changed from their defaults, are only remembered while the application is open. If you close DecisionPlus, all options will have returned to their defaults when you next open it. You can change the defaults using the Options dialog on the Hierarchy Window.

Order By

Name Sorts the tradeoffs pairs lists alphabetically, first by the name of the first criterion, then by the name of the second in each tradeoff pair.

Screen (Hierarchy) Order Sorts the Criteria in the Criterion listbox by Hierarchy Order, first by the name of the first criterion, then by the name of the second in each tradeoff pair. This is the default setting.

Next/Previous Button Action

First Unrated Tradeoff Clicking the Next/Previous button takes you to the first Unrated tradeoff in the list, however the list is sorted (see above), and regardless of your starting point.

Next/Previous Tradeoff in List Clicking the Next/Previous button simply takes you to the next/previous tradeoff pair (row) in the list, however the list is sorted (see above).

Next/Previous Unrated Tradeoff Clicking the Next button takes you to the next/previous Unrated tradeoff pair (row) in the list, however the list is sorted (see above). This is the default.

Return Invokes Next Action

If this option is checked, hitting return after entering a tradeoff value or digit, will cause not only the model to be updated to the new value, but also the action of the Next button will be invoked (see above). This is useful for the fast, systematic entry of tradeoffs, but can be confusing. The default is off.

Hide Indirectly Rated Tradeoffs Available only when Full tradeoff method is chosen. Hides all tradeoff pairs who have acquired values through consistency assumptions. These are the pairs which are preceded in the tradeoffs pairs list by circles

Group Tag Level Sets the Group Tag level. For an explanation, see Setting the Tag Level Options in Chapter 13. The options are the list of levels within the hierarchy model. The default is "(None)".

Tag By First Letter Sets the Group Tag Level. This is a checked menu item. It is disabled if the Group Tag Level is set to "(None)".

Real Time Update When this option is checked, all visible results and analysis windows are updated as soon as you make any change to the ratings *and press the Return key*. Clicking the option off ensures that the general model results are only updated when the Criterion Ratings dialog is closed. The default is real time updating off.

Rules Accesses the Maintain Rules window where you can add and edit rules for your lowest criteria.

Setting Default Options for Ratings

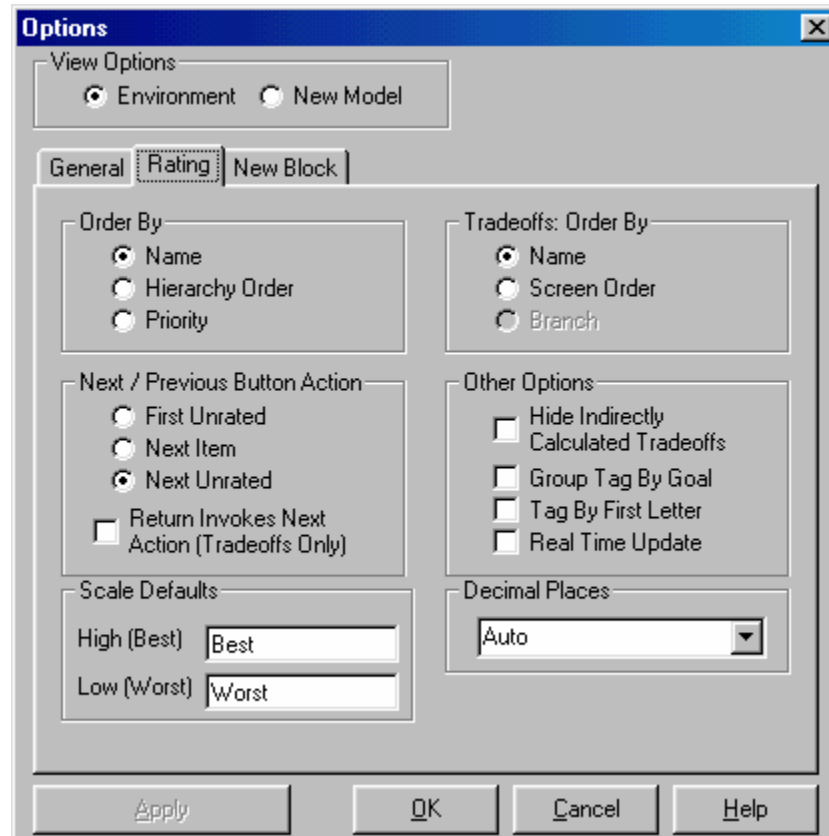
Many of the Options in the Ratings Windows may have their default values set through the Options Dialog, as indeed may the default techniques, hierarchy and alternatives. These defaults are stored on your computer, and will be applied any time you use CDP.

Setting Ratings Options: the Ratings Tab

In the Hierarchy window select **Options, Environmental** from the **Model** menu. Click the **Ratings** tab. Here we briefly describe the individual options.

Order By and Tradeoffs: Order By Simply lets you specify separately the default orderings under the two Weights and Tradeoffs Hierarchy Rating techniques.

Next/Previous Button Action Determines the default Action the Next button takes when pressed, both for Weights and Direct Tradeoffs. The check box that determines whether the Return key invokes the next action is only available under the Direct Tradeoffs technique.



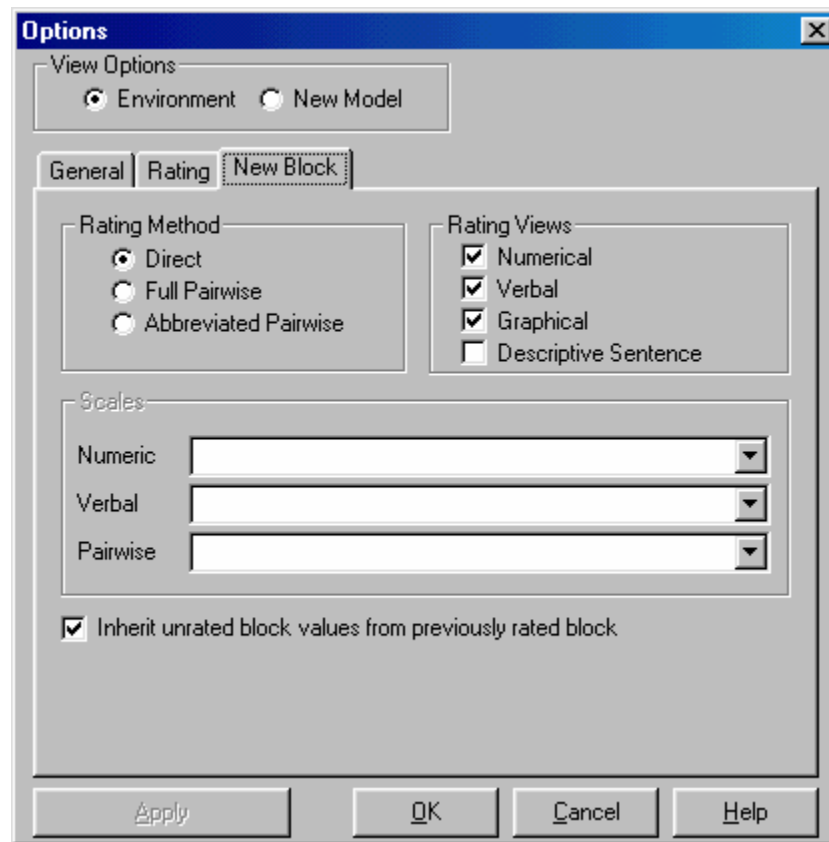
Scale Defaults CDP uses Best and Worst to indicate which end of a numerical scale correlates with higher and lower decision scores, respectively. Those words appear on the Ratings window, on the Value Function graph and other graphs' axes. In some decision models, this terminology can be inappropriate. Here you can set your own default terminology. (You can edit those values for a particular model by using the Edit High/Low Defaults button on the Assign Scales dialog (see the section "Create a Customized Numerical Scale in Direct Comparison," earlier in this chapter).

Hide Indirectly Calculated Tradeoffs Turning this on helps control large models when performing Direct Tradeoffs using the Full Tradeoffs method. But it can be confusing when on.

Decimal Places Default number of decimal places to show for values entered against numerical scales.

Setting Ratings Options: the New Block Tab

The defaults you can set in the New Block tab can significantly speed up the creation of new models, particularly in terms of ratings. These all apply only to models using the Weights Hierarchy Rating Technique. You can choose which Method, View and Scales you wish to use for new Blocks. (Default Scales are limited to permanent default scales that CDP provides.)



Inherit unrated block values from previously rated block This is a very useful option to check. It means that your rating methods and views carry over from your previous ratings set.

Note: When you click either the **Apply** or **OK** button, all the default settings will be applied to your current model (where applicable), not just the option you have changed. The **Apply** button does not close the **Options** Dialog.

What's Next?

You now have ratings in your decision model, you know how to edit them using the steps in this chapter. You can go on to Chapter 12, *Review the Results*, to look at your decision scores, or go to Chapter 11, *Select Uncertainty*, to apply uncertainty to the scores of your alternatives. Chapter 14, *Document the Results*, describes how to print both specific items and general reports from your decision model.

Chapter 11

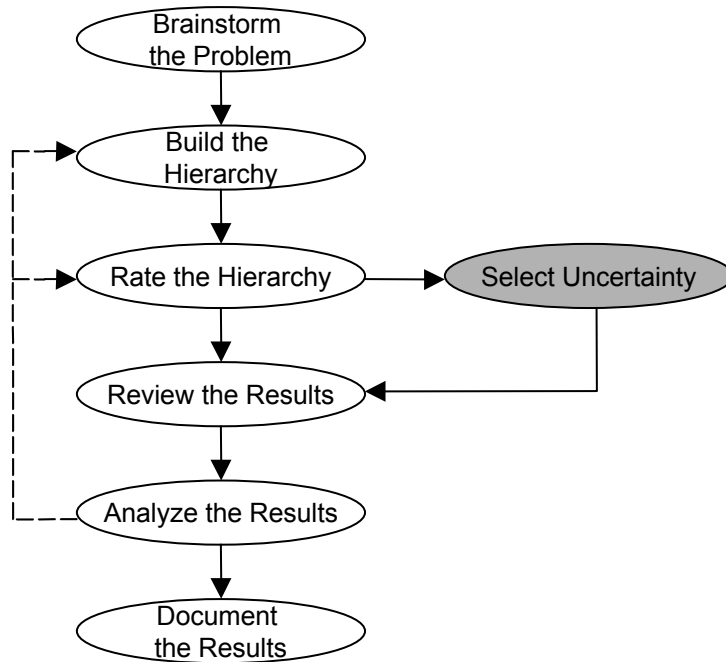
Select Uncertainty

In This Chapter

- Selecting Uncertainty as Part of the Decision Process
- Modeling Uncertainty
- Displaying the Uncertainty Input Window
- Assigning a Distribution Type
- Specifying Inputs for Distributions
- What's Next?

Selecting Uncertainty as Part of the Decision Process

Where are you? You are in the shaded part of the Process Diagram below:



Process Diagram

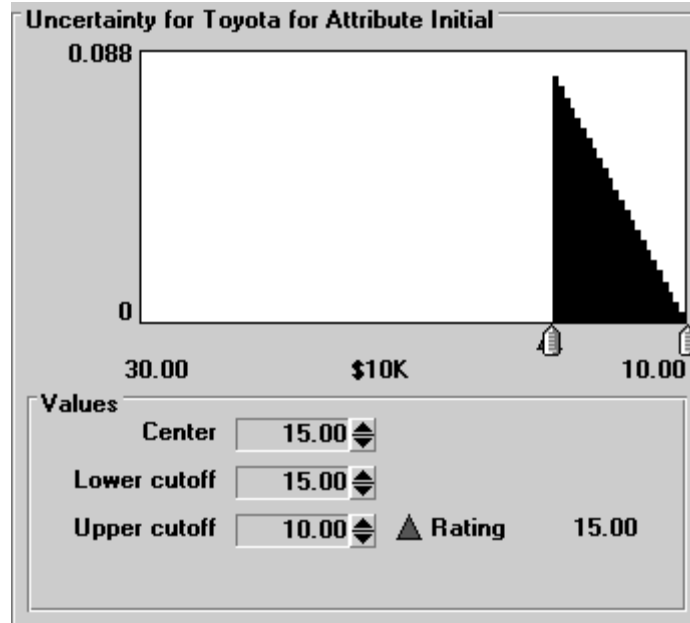
Modeling Uncertainty

Often, the values you assign to the ratings of your criteria and alternatives are not precise but have an uncertainty associated with them. This uncertainty itself is often quantifiable for lowest criteria (those attached to alternatives) where you have more data on the criteria and alternatives you are considering. Uncertainty in the data you use in your decision introduces the element of risk to choosing the preferred alternative.

For example, if the values you feed into the model are incorrect, there is a possibility that had you used the correct values, a different alternative might be preferred. While the initial price of the Toyota is \$15,000 today, maybe that will be reduced at the year-end inventory clearance to \$12,000, in which case the Toyota might be the best buy (its decision score would be the highest, making it the preferred alternative).

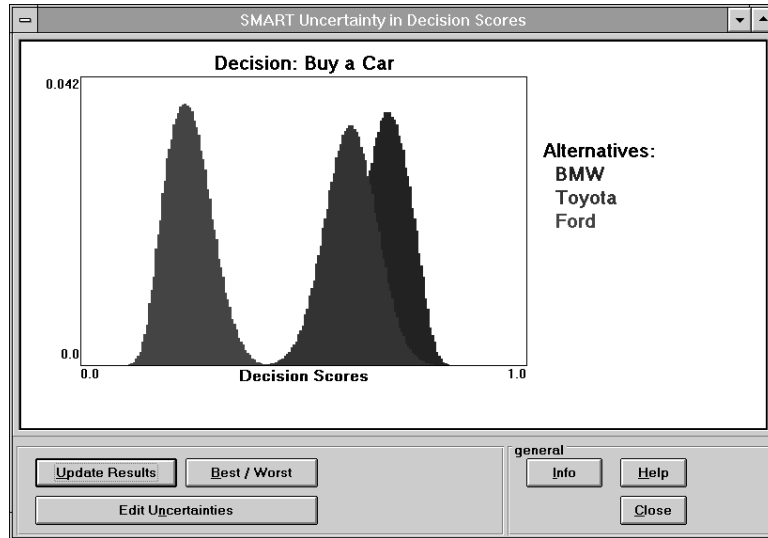
Using Probability Distributions

DecisionPlus allows you to characterize this uncertainty or risk by entering probability distributions for the weights (ratings) of



alternatives with respect to lowest criteria. That is, it takes the “What if?” speculation about the price of the Toyota a step further: it asks you to assign a rough probability that the price at year’s end would be \$12,000 or less. The decision score of each alternative is then characterized as a distribution representing the uncertainty in the decision process. Because of the uncertainty in price, the decision score of the Honda might range from 0.4 to 0.6, enough to overtake the score of the preferred alternative based on discrete values. Through this decision score distribution, you can review how uncertainty influences the decision.

It is likely that if you are using fixed discrete values, and you then choose to include uncertainty in your model, you’ll see that the preferred alternative is no longer a clearly preferred choice. If there is some possibility that the true values of the weights, or ratings, of the preferred alternatives fall short of what you thought, then some of the possible decision scores would be less than that calculated using discrete values.



Conversely there might be a significant probability of competing alternatives scoring higher than expected. By comparing the decision score distributions of the alternatives, DecisionPlus determines what is probabilistically the preferred alternative and by what percentage it is so. As an example, the alternative preferred in the discrete calculation might be the preferred choice only 55% of the time, which could be anticipated by noticing the overlap of its decision score distribution with those of other alternatives.

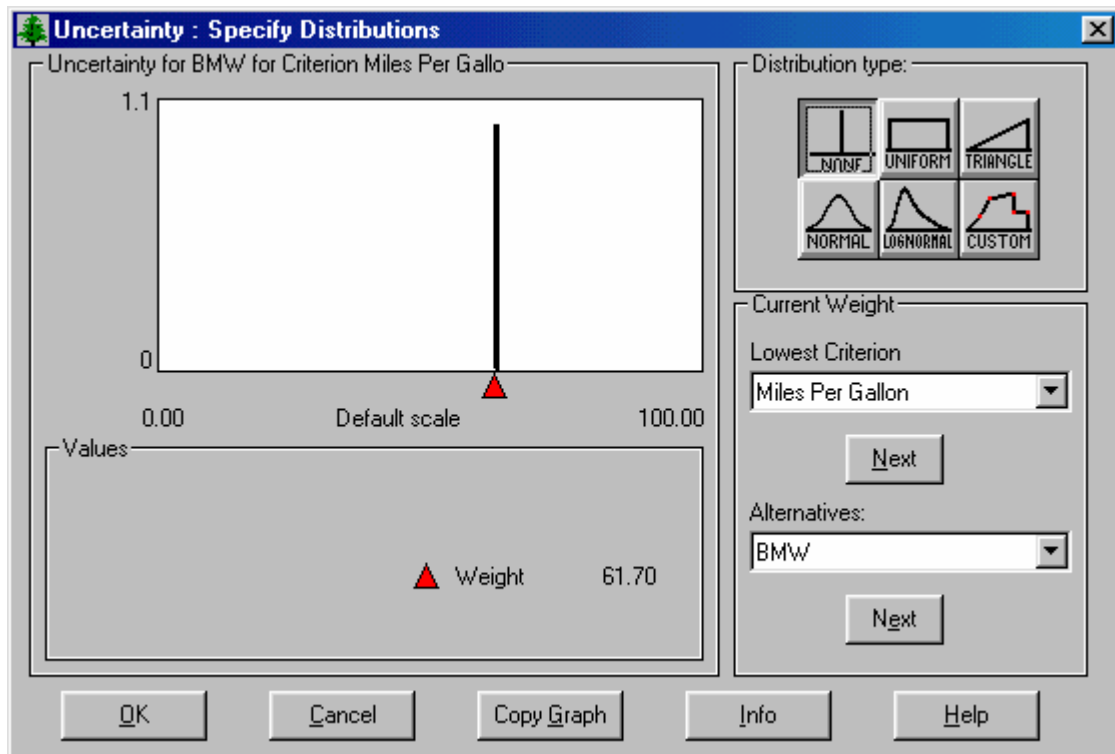
If this occurs, we recommend that you reconsider the decision and study the problem more closely with the objective of reducing the uncertainty or introducing new criteria to better discriminate between alternatives.

Throughout this chapter, we will use SMART terminology of attributes (instead of lowest criteria) and ratings (instead of alternatives' scores).

DecisionPlus allows you to assign uncertainty only to the ratings of alternatives with respect to relevant attributes.

Displaying the Uncertainty Input Window

1. In the Hierarchy window, highlight the lowest criterion (one attached to an alternative) on which you want to work.
2. From the Block menu, select Rate Subcriteria to display the Criterion Rating window.
3. Select Uncertainty from the menu bar to display the Uncertainty Specify Distributions (or input) window.



Uncertainty Specify Distributions Window Description

The Uncertainty input window has three primary areas: The graphical display, the Distribution Type, and the Current Value (Rating).

The **graphical display** box shows the distribution for the alternative and the lowest criterion listed in the Current Value part of the window. The default distribution is None and displays your criterion in a discrete value.

Distribution Type box provides selections of the following distributions to characterize your uncertainty: None, Uniform, Triangle, Normal, Log-normal, and Custom.

The **Current Value** box allows you to select the criterion and alternative you want for the distribution.

Editing the Distribution

You can edit the distribution by specifying the parameters (such as mean, lower bound, upper bound) in the graphical display portion of the window. The x-axis represents the scale of the rating being used and the y-axis represents the probability density function for that value of the rating. The area under this function, between two values of the weight/rating, is equal to the probability of that rating taking a value between those two.

You should choose the end values of the scales (see Assign Scales in Chapter 10, Weight the Criteria) so they are less than and greater than the lowest possible and highest possible values that the rating could take. As the probability of the rating taking a value between its highest and lowest possible values has to equal one, so the area under the curve in the graph must always equal one, and the range of values on the y-axis adjusts accordingly.

The **red triangle** in the area under the curve displays the current discrete value that you entered in the Criterion Rating window for the attribute. This is the default for the mean value for those distributions which includes the value of the mean in their descriptive parameters (for example, to describe a Normal curve, you must specify a mean, a standard deviation, and the upper and lower cutoffs). As you select

different values for the mean, using the bullet-shaped sliders next to the red triangle, the red triangle remains fixed on the x-axis (changing the uncertainty distributions has no effect on the discrete value at which you rated it) and the numerical value associated with the slider reflects the new value of the mean.

You can select the rating you want to work with in the Current Values portion of the window. Select both an alternative and the attribute with respect to which the rating is defined.

Assigning a Distribution Type

1. On the Uncertainty Specify Distributions window, in the Distribution Type box, select the distribution you want.
2. The Values box contains the values of the parameters describing the distribution you selected. You can edit these values by typing directly into the edit boxes, or by using the up/down arrows next to each box.
3. To delete a distribution and return to a discrete value, select None in the Distribution Type box.

A Rough Guide to Choosing a Distribution Type

Choose the simplest distribution that fits the knowledge you have of the uncertainty in the value of the rating you are considering. The more parameters required to specify a distribution, the more time and energy you need to expend in estimating their values.

The following chart suggests guidelines for choosing a distribution type.

Choose	When
Uniform Distribution	all you know is that the value must fall between a lowest and a highest value.
Triangular Distribution	in addition to an upper and lower bound, you know what is the likeliest (mode) value (such as a value that would show up most often). It is especially useful for modeling distributions where the likeliest value is closer to one of the bounds than it is to the other.
Normal Distribution	the values are likely to fall close to an average value and are as likely to be above that average value as they are to be below it.
Log Normal Distribution	it is important that the distribution starts at a particular value at one extreme, but is open at the other (human age is a good case).
Custom Distribution	you know the probabilities for some key values (as is often the case if you are using the results of a specialized forecasting tool).

Specifying Inputs for Distributions

You can edit the descriptive parameters for each distribution you select to better describe the uncertainty in the value of the rating you are considering.

Specify Inputs for Uniform Distribution

1. In the Uncertainty : Specify Distributions window, select the Uniform (rectangular) distribution by following the instructions in

“Select a Distribution Type” above. The Uniform distribution displays in the graphical display box.

2. To set the lower cutoff, click and drag the bullet-shaped sliders to the value you want on the x-axis.
3. To set the upper cutoff, click and drag the slider to the value you want on the x-axis.

Note: You can also select the values by clicking on the up and down arrows next to the corresponding numeric text box for the upper or lower cutoff, or entering values directly in those text boxes.

Specify Inputs for Triangle Distribution

1. In the Uncertainty : Specify Distributions window, select the Triangle distribution by following the instructions in “Select a Distribution Type” above. The Triangle distribution displays in the graphical display box.
2. To set the upper and lower cutoffs, click and drag the bullet-shaped sliders to the values you want on the x-axis.
3. To set the mode (peak of triangle), click and drag the center slider to the value you want on the x-axis. The red triangle is fixed at the rating you entered in the Criterion Rating screen.

Note: You can also select the values by clicking on the up and down arrows next to the numeric box for the upper or lower cutoff.

Specify Inputs for Normal and Log-Normal Distributions

1. In the Uncertainty : Specify Distributions window, select the Normal (Gaussian) or Log-normal distribution by following the instructions in “Select a Distribution Type” above. The distribution displays in the graphical display box.
2. To set the upper and lower cutoffs, click and drag the bullet-shaped sliders to the values you want on the x-axis.

3. To set the mean (second slider from the left), click and drag the slider to the value you want on the x-axis.
4. To set the standard deviation (third slider from the left), click and drag the slider to the value you want on the x-axis.

Note: You can also select the values by clicking on the up and down arrows next to the numeric box for each parameter.

Specify Inputs for Custom Distribution

By selecting the Custom distribution, you can define your own distribution. Initially, this distribution displays with four line segments that you can customize by adding new points up to a total of ten.

1. In the Uncertainty : Specify Distributions window, select the Custom distribution by following the instructions in “Select a Distribution Type” above. The Custom distribution displays in the graphical display box.
2. To change either of the two points that appear on the graph, click and drag the points to any value on the graph. Note that the selected point turns blue and the x (weight value) and y (probability) value for each point displays in the Value box.
3. To add up to a maximum of 10 points, double-click on the graph in the spot or the value you want.

Note: Although you can move these points by clicking and dragging them, you cannot move a point horizontally beyond its two adjacent points. You can select the values by clicking on the up and down arrows next to the numeric box for each parameter.

Selecting Another Rating

You can repeat the steps above for any rating of an alternative with respect to an attribute. First, select the weight in the Uncertainty window.

1. To select the next attribute in the Uncertainty Specify Distributions window, in the Current Value box of the Uncertainty window, Click the Next button alongside the Attribute list box.
2. To select the next alternative, Click the Next button in the Alternatives list box.

What's Next?

Now you're ready to review your results. Turn to Chapter 12, Review the Results, for instructions.

Chapter 12

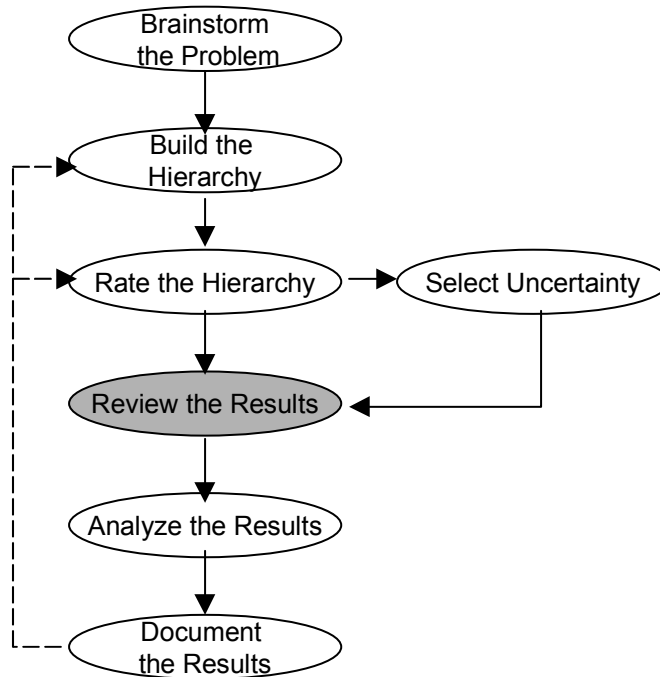
Review the Results

In This Chapter

- Reviewing the Results as Part of the Decision Process
- Reviewing Your Decision Scores
- Displaying the Decision Scores Window
- How Decision Scores are Calculated
- Enhanced Views of Decision Scores Results
- Sorting Decision Score Results
- Resource Tracking
- Viewing Uncertainty Results
- Displaying the Uncertainty Results Window
- To Compare Uncertainty Results to Standard Decision Scores
- To View the Decision Scores in Spreadsheet Format
- Exporting Results from Decision Scores Window
- Decision Scores Menu Commands
- Uncertainty in Decision Scores Menu Commands
- Results Windows Toolbar
- What's Next?

Reviewing the Results as Part of the Decision Process

Where are you? You are in the shaded part of the Process Diagram below:



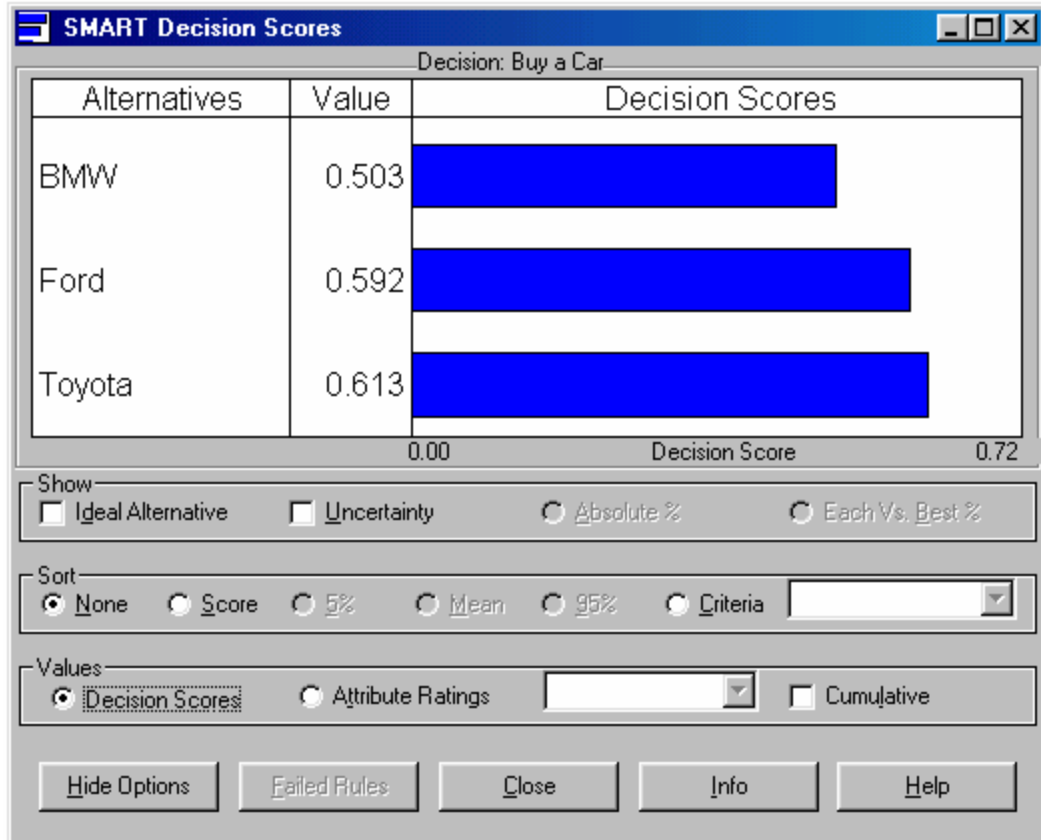
Process Diagram

Reviewing Your Decision Scores

The basic results of your model are the decision scores. The decision score for an alternative is the sum of the score (rating) of that alternative with respect to each of the lowest criteria (attribute) weighted by how important each such criterion is in the model. The higher the decision score of the alternative, the closer that alternative comes to meeting all the criteria in the decision.

Displaying the Decision Scores Window

- From the Hierarchy window menu, select Decision Scores from the Results menu.



Decision Score Window Description

The Decision Score window has five primary areas: the Graphical Display, Show Options, Sort Options, Value Options, and the general control areas.

Graphical Display Box This box shows the decision score for each alternative of your decision model in a horizontal bar chart. Each line shows the name of the alternative, the value of the decision score, and the horizontal bar reflecting the value of the decision score. At a

glance, the alternative with the longest bar best meets your criteria. Sometimes, not all alternatives will fit on the window, and you need to scroll the Graphical Display vertically to other alternatives.

Show Options The controls in this area allow you to show the Ideal Alternative. (The Show Uncertainty options are discussed in the next section, “Viewing Uncertainty Results.”)

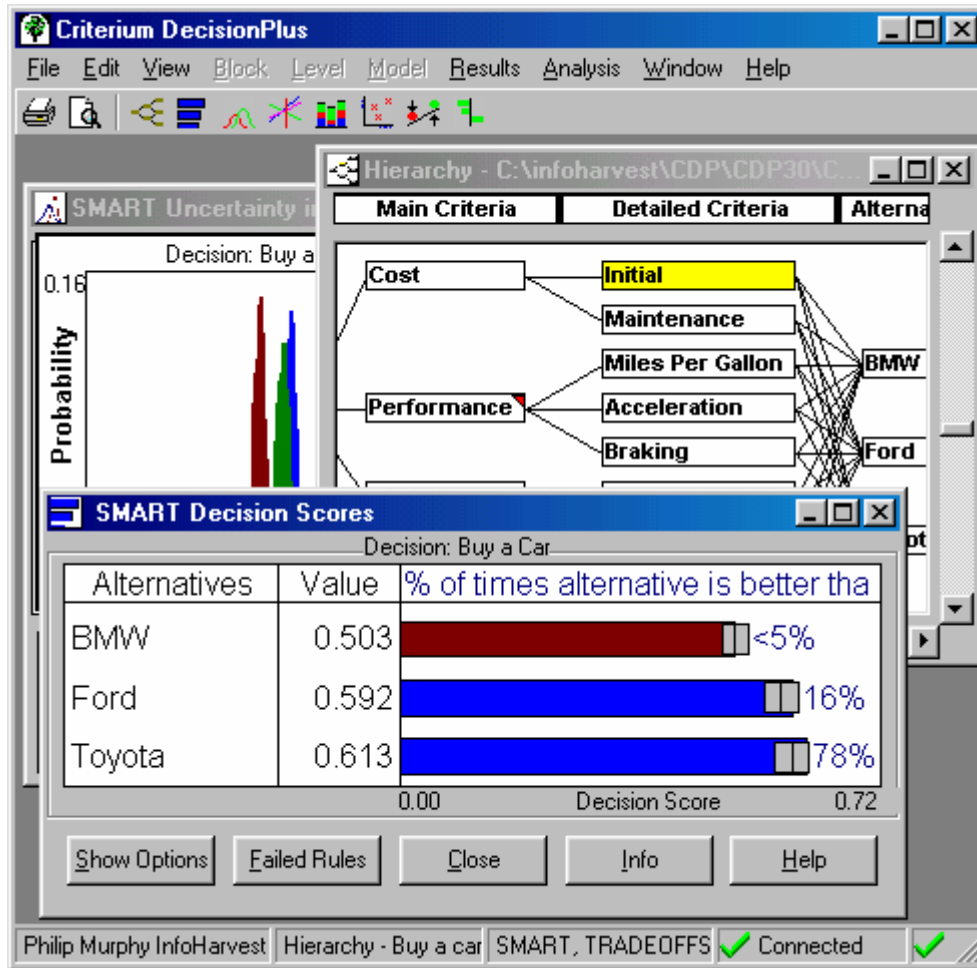
Sort Options The option buttons here allow you to sort the Alternatives vertically by decision score or by the ratings of the alternatives against any single lowest criterion or unsort them (the default). (The Sort by Uncertainty options are discussed in the next section, “Viewing Uncertainty Results.”)

Value Options The option buttons here allow you to display numerical values other than decision scores (the default) in the Graphical Display area. You can choose to show the value of the ratings of the alternatives under any lowest criterion (attribute), and you can choose to have the values shown cumulatively.

Show Failed Rule If an alternative has violated a rule you defined in the Criterion Rating window (Chapter 10, Weight the Criteria), you can review that rule in the general control box.

Arranging Windows

Throughout CDP, you have the option of displaying more than one result window at a time. As you open each new window, it overlays previously opened windows. You can arrange several windows by using the Cascade or Tile command from the Window menu, and resize each window so you can see most of all windows. When you resize, the displays become smaller for better viewing, though features may degrade. You can minimize windows and you can close all windows except for the Hierarchy window. Closing the Hierarchy window closes the model.



How Decision Scores are Calculated

Here we provide a number of algorithms that describe the basic calculations in DecisionPlus, and provide some details regarding the

updating of windows after information is edited. You may want to skip this section for now and return to it later, after having read the rest of Chapters 12 and Chapter 13.

Decision Score of an Alternative

As discussed in previous sections, the user rates each alternative against each lowest criterion (or attribute) as a score with respect to a user-defined scale associated with that lowest criterion. That score is then normalized (converted to a priority) and multiplied by the normalized weight of the criterion. Finally all such terms are aggregated (summed) over all lowest criteria to give the Decision (or aggregate) score for that Alternative.

Normalization of scales to priorities - weights

How the user's judgments are normalized to a standard internal scale depends on the type of Comparison (Direct or Pairwise) and, for the rating of Alternatives, the model methodology (AHP or SMART) chosen.

1) Direct Comparison: Converting user's weighting scale to internal priority scale:

Let S be a subcriteria to criteria C. Let r_S^C be the user's rating of subcriteria S under criteria C. Then the priority of S under C, W_S^C , is given by:

$$W_S^C = (r_S^C - r_0^C) / \sum_{S'=1}^{NC} (r_{S'}^C - r_0^C)$$

where r_0^C is the user defined scale minimum.

2) Direct Comparison: Converting user's score (for alternatives) scale to internal priority scale:

Let A be an alternative to be measured against criteria C.

Let r_A^C be the user's rating of alternative A under criteria

C. Then the priority of A under C, P_A^C , is given by:

$$P_A^C = (r_A^C - r_0^C) / \sum_{A'=1}^{N^C} (r_{A'}^C - r_0^C)$$

where r_0^A is the user-defined scale minimum.

3) Pairwise Comparison (Always available for weighting Criteria, available for rating Alternatives only when AHP methodology is chosen)

Here the user compares a subcriterion C1 against another C2 in terms of a set scale that ranges from 1 to 9, where a score of 3, indicates that C1 is 3 times "more important" than C2 in terms of the parent criterion.

For a parent criterion with N subcriteria, the relative weighing of the subcriteria will then result in an NxN comparison matrix whose elements A_{ij} have the interpretation that C_i is A_{ij} more important than C_j .

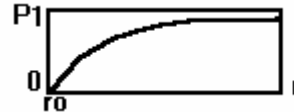
Converting this matrix of comparisons to a normalized set of weights for the subcriteria is achieved (in standard AHP) by the use of a most interesting formula using principal eigen-values. The proof that this conversion is valid is essentially the success that the AHP has had in capturing qualitative judgments. See the reference *Multicriteria Decision Making - The Analytical Hierarchy Process - Applications and Studies* for a complete discussion.

Normalization of scales to priorities - ratings

AHP The Analytic Hierarchy Process, for Direct Comparisons, reduces to the *relative* normalization in (iii). Essentially this has the form:

$$P = (r - r_0) / (r - r_0 + \text{residue})$$

where r is a given rating, r_0 the minimum value of the scale, and residue is the sum over the terms from all other alternatives in the rating set. The equation maps the users scale non-linearly to $[0,1]$, as sketched opposite.



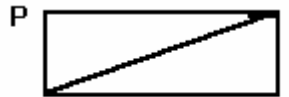
SMART The user defines a mathematical function called a *value function*. The Value Function maps directly from the user's scale range to $[0,1]$.

The curve shown opposite would indicate a risk averse scale,



and could have an exponential format.

The curve shown opposite is linear.



The curve shown opposite indicates a risk affinitive scale and again could be

represented by an exponential curve.

Since the value function is defined on the scale itself, the priority of an alternative is now *independent* of the other alternatives:

$$P_A^C = F^C(r_0^C, r_M^C; r_A^C)$$

Aggregation of terms into the decision score

For a model with a single layer of criteria, the decision score of an alternative is the weighted sum of scores on each alternative:

$$D_A = \sum_{C=1}^{N^G} W_C^G P_A^C$$

where G is the Goal or decision and N^G is the number of subcriteria of the Goal, W_C^G is the priority of the Criterion C, and P_A^C the priority of the score of alternative A with respect to criterion C.

For hierarchies of M levels of criteria (including the Goal), the formula reads as:

$$D_A = \sum_{C_1=1}^{N^G} W_{C_1}^G \sum_{C_2=1}^{N^{C_1}} W_{C_2}^{C_1} \dots \sum_{C_M=1}^{N^{C_{M-1}}} W_{C_M}^{C_{M-1}} P_A^{C_M}$$

$$= \sum_{C_M=1}^{N^{C_M}} A_{C_M}^G P_A^{C_M}$$

Essentially the decision score for alternative A is given by the priority P_A^{C_M}, of the alternative against each lowest criterion (attribute), times A^G_{C_M}, the *accumulated weight* of that criteria, summed over all lowest criteria.

Accumulated weights

The *accumulated weight* of any criterion is the product of normalized weights along each path from the Goal block to that Criterion, summed over all such paths. (In Criterium DecisionPlus, the accumulated weights for all criteria in a model may be seen in the Hierarchy window by using the *Show Accum. Weights* menu item in the *Model* menu.)

The *accumulated weight* of a lowest criterion is also called the *Model Weight* of that criterion, as it represents the normalized weight of the lowest criterion in the decision model. The values of the *Model Weights* and normalized ratings of the alternatives may be seen directly in the Data View of the Decision Results window. The Decision Score of each alternative (the number at the bottom of each column) is the sum, over all lowest criteria (attribute) of each normalized rating times the model weight.

Updating Results (Updating)

In DecisionPlus, actual calculation of your model's decision score results occurs automatically when you open any results or analysis window. If any results or analysis windows are open, and you change ratings in the model using the Criterion Ratings window, all such screens will be updated automatically (unless you have chosen otherwise - see Chapter 10 and Options).

Calculating the decision scores of the alternatives does not take much time. However, when you want to view sensitivity or uncertainty in your model, calculations of these results can take a long time depending on the size of your model. We let you choose when you want to start that update process by letting you select an update button. A message appears on each results or analysis window to remind you, if an update is necessary, allowing you the opportunity to make any last minute changes to include in the update.

Fully Connected Models

If a criterion in your model is not at least indirectly connected both to the Goal and to at least one alternative, the decision scores of the alternatives would be difficult to interpret. DecisionPlus only calculates results for “fully connected” models, such as models in which every criterion is both connected to the Goal *and* to at least one alternative. If you attempt to open a Result or Analysis screen when the model is not fully connected, DecisionPlus will identify the unconnected blocks in the hierarchy so that you can proceed to connect them.

How Unrated Criteria are Prioritized

If you have not fully rated your criteria (i.e., all the items in the rating set), DecisionPlus assigns all items an equal priority score according to the number of items in the rating set.

For example, with a criterion with four unrated subcriteria, each subcriterion would receive a priority of $1/4 = 0.25$. Subcriteria of a criterion with six unrated children would have a ranking of $1/6$ each, etc. These priorities are then used in calculating the overall decision scores for each alternative.

Rank Reversal Phenomenon when Using AHP

An important consequence of the relative normalization of the scores of alternatives used in AHP normalization, whether direct or pairwise rating methods is used, is that relative order in rank of the alternative preferences can change when adding new alternatives. This is called *rank reversal* and is caused by the normalization of the scores on the lowest criteria. If an alternative is added to the model whose overall decision score is low, but scores well on criteria where the highest ranked preferred alternative has had the highest scores, then this new alternative receives a large share of those priorities. This can sometimes affect the weight of the preferred alternative in a way that results in the preferred alternative losing its position, causing a reversal of rank.

For example, imagine you were choosing which car to buy, you created and rated a decision model, and a BMW was leading slightly over a Porsche. At that point your spouse insists you consider a Neon. Though the Neon scores poorly overall, you might discover that after its addition, the Porsche now has edged the BMW as your best choice.

Rank Reversal emphasizes that in AHP, the outcome of the decision model depends on the specific set of alternatives you are considering. Since the value functions in SMART are defined on the scales of the criteria, they are independent of the alternatives, and the decision score provides an independent metric of how well alternatives fit your criteria.

Enhanced Views of Decision Score Results

Display the Ideal Alternative

The ideal solution to your decision problem is the “perfect alternative” that rates the highest possible value for each criterion in your model. In the Decision Scores window, you can compare the alternatives under consideration to the perfect solution. In the light of this comparison, you might find that none of those alternatives comes close to the ideal, and you might decide to search for new alternatives.

1. In the Decision Scores window, select Show Ideal. The ideal alternative displays.
2. To remove the ideal alternative, select Show Ideal again.

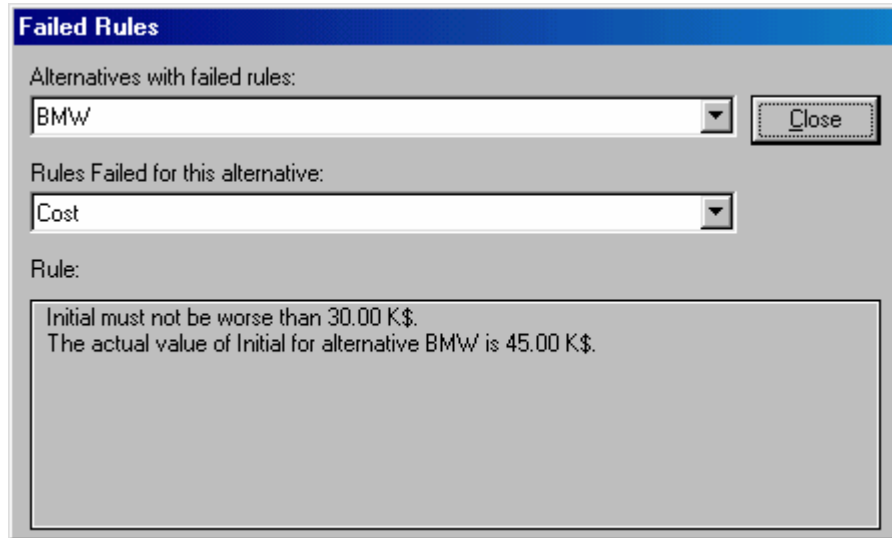
Note: Under SMART, the ideal alternative always scores 1.0, so there is no mystery. Under AHP, the ideal alternative may have a score considerably less than 1.0.

Show Uncertainties

The options for showing uncertainties will be described in the section “Uncertainty Results in the Decision Scores window” later in this chapter.

Review a Failed Rule

If you entered rules for your lowest criteria, and any of those rules are violated by an alternative, you can view them in this window. When an alternative violates at least one rule, its decision score bar appears in red, and the Show Failed Rule button is enabled. The following steps allow you to view the failed rules:



1. In the Decision Scores window, select Show Failed Rule in the General box. Violated rules and alternatives violating them display in the Failed Rules dialog box.

Any alternative that failed a rule is listed in the upper list box, and the rule(s) they failed are listed in the lower list box. The text of the chosen rule for the chosen alternative is displayed in the text area at the bottom of the window, followed by the actual situation.

2. To close the dialog box, select the close button.

Sorting Decision Scores Results

Sort the Decision Score Graph by Preference

You can order the results so they appear in the window from best (highest decision score) to least. This feature allows you to view the best rated alternatives first.

1. In the Decision Scores window, in the Sort area, select Decision Scores. The graphical box displays the results rearranged in order of decreasing decision score.

Sort Decision Scores by Uncertainty

The definition of the 5% mean and 95% uncertainty intervals will be given in the following section. To sort the alternatives according to decreasing values of any one of those parameters:

1. In the Decision Scores window, in the Sort area, click the option button corresponding to your desired parameter. The graphical box displays the results rearranged in order.

Sort Decision Scores by any Criterion

1. In the Decision Scores window, in the Sort area, Click the option button labeled criteria, then choose the criterion of interest from the drop-down list box. The graphical box displays the results rearranged in order.

Close the Failed Rules window.

2. To remove the sort, select Sort Results again. The results return to the original order.

Hide Options button

The various option setting devices above allow you to quickly set the result options the way you want them. However the buttons, option boxes and list boxes take up a lot of screen space.

Clicking the Hide Options button will hide the various controls that set options for the Decision Scores window. This will significantly increase the available space for graphics, which is particularly useful when you have large numbers of Alternatives.

Resource Tracking

When the decision task is to select more than a single alternative, you may wish to choose as many of the highest scoring alternatives as your resources allow. For instance, if each alternative has a cost, and you have a budget, you may only be able to afford the first 5 items in your prioritized list.

The Decision Scores window in DecisionPlus is a powerful tool for determining which are the best alternatives your limited resource can afford. By sorting the results by their desirability, then showing the cumulative amount of your resource required to afford all alternatives, starting with the most desirable, you can clearly determine where your budget would be exhausted.

1. In the Decision Scores window, select the Score option in the Sort options. Each alternative's decision score provides the overall measure of its worth having taken all criteria into account. Sorting the alternatives by decreasing decision scores therefore places the most desirable alternatives at the top of the decision scores graph, the least desirable at the bottom.

Note: If you are using uncertainty distributions, you should sort by the Mean decision score, not by decision scores (see To Sort Decision Scores By Uncertainty Results later in this chapter).

2. In the Values area click the Attribute Ratings option. The adjoining listbox will be enabled.
3. From the listbox, select the Lowest Criterion corresponding to your limiting resource. The rating of each alternative appears

to the left of the corresponding graphical bar, replacing the decision score value.

4. If the Cumulative checkbox is clear, click it to check it. The rating of each alternative for the selected criterion is added to a cumulative total running from the top (most desirable) alternative to the least.
5. By checking the cumulative value against your resource limit, it should be clear which is the last alternative that, together with its higher scoring companions, you can afford.

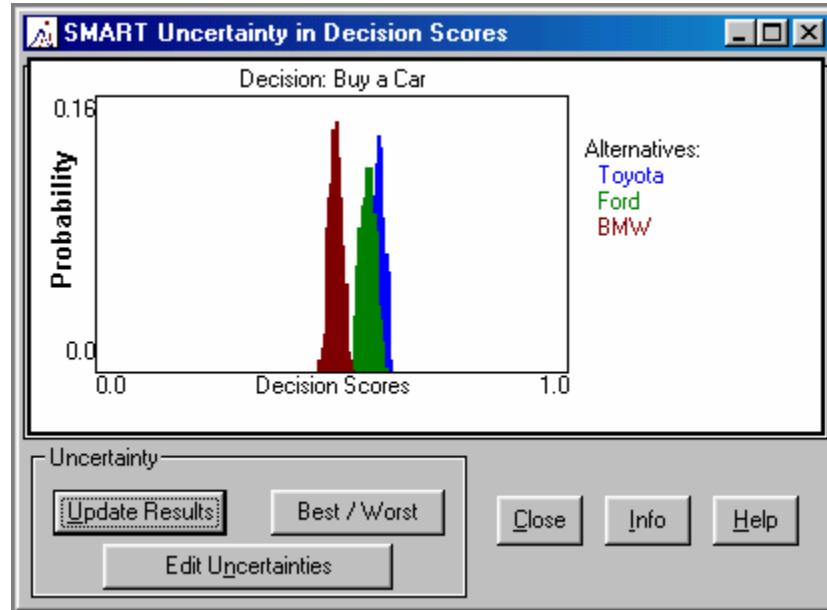
Viewing Uncertainty Results

This section shows you how to access results of assigned uncertainty distributions in your decision models. Without uncertainty, each alternative has as its result a single decision score. Once uncertainties are assigned to any of the weights/ratings of an alternative with respect to the lowest criterion, that alternative could have a number of different decision scores in the model. For each alternative, DecisionPlus considers each possible decision score in turn and calculates, given the uncertainties in the information about that alternative, the probability that the alternative could have that score. The probability for all the decision scores are compiled into a histogram, or uncertainty distribution.

Displaying the Uncertainty Results Window

In the Hierarchy window, select Uncertainty in Decision Scores from the Results menu.

When you first enter the window, it will not display any of your model's information until you update results.



To Update the Uncertainty Results

1. In the Uncertainty window, select Update Results. The program calculates the results, which may take a few minutes depending on the size of your decision model, and displays them as overlapping distributions for each of the five top alternatives.

Uncertainty in Decision Scores Window Description

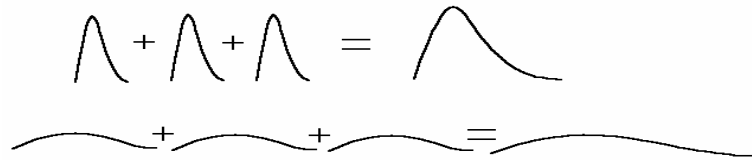
There are two primary areas in the Uncertainty in Decision Scores window: the Graphical Display box below and the General Control box.

Graphical Display You can use this box to update the results in your decision model through the Update Results button below. This box displays your results as (usually) overlapping distributions for the five top scoring alternatives in your model. You can compare the

alternatives' uncertainty distributions with a best and worst case analysis using the Best/Worst button, or return to the Decision Score window and view the alternatives in a bar graph.

General Control This part of the window provides the window Close, Information and Help buttons standard to the results and analysis windows. The Information button displays a list of your model's goal, criteria, and alternatives, and any attached notes.

Your model's distributions may not look like the ones you assigned because the results reflect the total aggregation of uncertainties in the model. Distributions with small variances generally result in more spiked, localized distributions, whereas distributions with large variances produce more spread-out results. Below is a very symbolic representation of uncertainty aggregation.



Representation of Uncertainty Aggregation

To Edit the Uncertainty Inputs

1. In the Uncertainty Results window, select Edit Uncertainties to open the Uncertainty Input window.
2. Edit the uncertainty inputs as described in Chapter 11.
3. Close the Uncertainty Input window.

To View the Uncertainty Results in Spreadsheet Format

The data underlying the Uncertainty in Decision Scores window distributions may be seen directly by changing to the data sheet format. Data can also be copied from this view to any other Windows application, which might facilitate custom graphing and analysis.

1. In the Uncertainty in Decision Scores window, select Results Data from the View menu.

The names of the 5 (or fewer) Alternatives with the highest mean decision scores are listed across the top of the spreadsheet.

In the first twelve lines, relevant statistical parameters for the distribution curves are recorded: Mean, Lower Bound, Upper Bound, Std. Deviation, Mode, Median, Skewness, Kurtosis, Min. Y (Probability), Max.Y.

The actual distributions' data points are listed below that. The Right hand column lists the decision scores from 0 to 1 in increments of 0.005, successive columns providing the likelihood that each alternative would achieve that decision score (in Uncertainty Densities view).

1. To return the graphical representation of the Uncertainties in Decision Scores window, choose Uncertainty Graph from View menu.

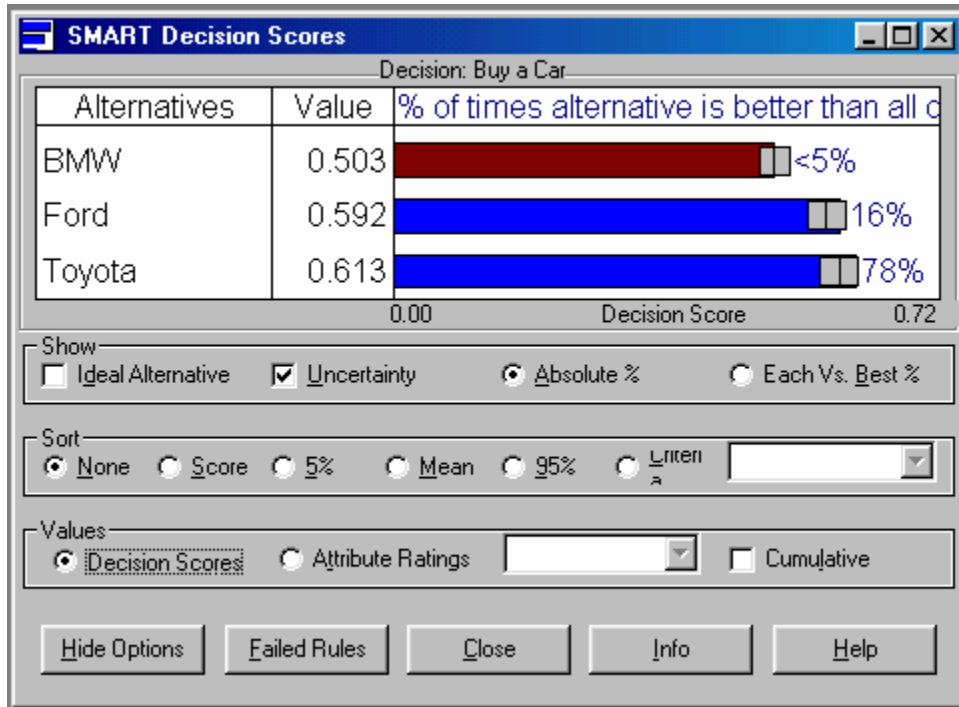
To Compare Uncertainty Results to Decision Scores

Naturally, you would expect the likeliest decision score according to the uncertainty distribution of an alternative to be close to the decision score of that alternative without uncertainty. Often they can differ by a wide margin, and understanding these differences can vastly improve your understanding of the uncertainties and risk inherent in the model.

1. To compare directly the uncertainty results to the decision score results without uncertainty, redisplay the Decision

Scores window (follow the instructions for “Displaying the Decision Score Window” at the beginning of this chapter).

- Click the Uncertainty check box in the Show area of the Decision Score window. Gray rectangles are superimposed on the decision score bars of each alternative. The lengths of the blue decision score bars themselves are still calculated based on the weights (and ratings) you entered, without regard to uncertainty, so they are unchanged.



The left edge of the gray rectangle shows that decision score value corresponding to the lower 5 percentile of the uncertainty distribution. That is, with 95% probability, that particular alternative has a decision score with higher value than that. The right hand side is given by the 95 percentile, and the vertical line within the gray rectangle shows the

mean (expected) decision score for the alternative when uncertainty is taken into account.

To Select Each vs. Best Alternative % or Absolute % Option

1. In the Decision Scores window, select the option you want.

Each vs. Best Alt% This option displays a percentage at the end of each bar. This shows what percent of the time each alternative in turn is better than the “best” alternative, that with the highest mean decision score. For example, another alternative might be better than this best alternative 30% of the time. (By default, the best alternative is better than itself 50% of the time.)

When a decision must be made from the available alternatives, these comparisons clarify, based on the known uncertainties in the model, which alternative is statistically the better choice.

Absolute % The Absolute % option also displays a percentage at the end of each bar. In this case the number represents what percent of the time the alternative would be a better choice than all of the other alternatives taken together.

If you have the option of adding alternatives to the decision, these numbers indicate whether any of the present alternatives truly stands out from the rest, in which case the decision process may be terminated. If not, you might search for additional, better alternatives.

2. To remove the uncertainty results, click the Uncertainty check box again to uncheck it.

To View the Decision Scores in Spreadsheet Format

The data underlying the Decision Scores window may be seen directly by changing to the data sheet format. Data can also be copied from this view to any other Windows application.

1. In the Decision Scores window, select Results Data from the View menu.

The names of the Alternatives are listed across the top of the spreadsheet, and those of the Lowest Criteria along the left-hand side. The priority value of each Alternative with respect to each lowest criterion is shown in the corresponding cell. The model weight of each lowest criterion is shown in the last column on the left. The Decision Score for each Alternative is shown at the bottom of each column, and is the sum of the priorities with respect to each lowest criterion multiplied by the model weight of that criterion.

If the Show Uncertainties box is clicked, relevant information pertaining to the uncertainty distributions is also listed.

Return to Graphical View

1. To return the graphical representation of the Decision Scores window, choose Results Graph from View menu.

Exporting Results from Decision Scores Window

One way to create custom reports is to use a wordprocessor and copy and paste graphics and data from DecisionPlus to that application. DecisionPlus allows you to copy Graphs, Tables and create DDE links to other applications.

"Hot" Link to other applications

DecisionPlus presently supports "hot" DDE link only of the Decision Scores data to another windows application. The Decision Scores data sheet may be linked in its entirety from CDP to another spreadsheet. Note that the decision scores spreadsheet contains both decision scores and uncertainty in decision scores data.

To create a DDE link of Decision Scores data to another application:

1. In the [Data](#) view of the Decision Scores window, choose [Select All](#) from the [Edit](#) menu,

2. Select **Copy** from the same menu.
3. In the target application (e.g. Excel), choose any appropriate range of cells and choose Paste Link or its equivalent (see that application's documentation).

Any change in the DecisionPlus model that changes the numerical values of the decision scores or uncertainty results, will then automatically cause the target application's data to be updated.

Note: Only one "live" link is supported at a time. Creating a new link will destroy the existing link. If a model is closed, the link must be recreated by hand when the model is next loaded. Data pertaining to the link is stored in the note of the Goal Block. The time and date when the link was established, and the file with which it was established is recorded.

Decision Scores Menu Commands

File

Close Closes the Decision Scores window.

Print Preview Allows you to view on screen the results of your document.

Print Prints the contents of the active file. Opens the print dialog box to set printing options for your item or report.

Export Decision Scores to Excel Exports the results of the active window's spreadsheet to Excel. This option is only available from Decision Scores, Uncertainty in Decision Scores, and Hierarchy spreadsheets.

Export to Text File Exports the results of the active file to a text file.

Exit Exits DecisionPlus.

Edit

The following Edit menu sub-item is only available when viewing the decision scores graph.

Copy Graph Copies Decision Scores graph to the Windows Clipboard for Pasting to other applications.

The following Edit menu sub-items are only available when viewing the data spreadsheet format.

Copy Click this menu item to copy data in the Decision Scores spreadsheet to the Windows Clipboard.

Select All Selects all data in the Decision Scores spreadsheet.

View

Results Data Click this menu item to display the active model results in data spreadsheet format.

Results Graph Click this menu item to display the active model results in bar graph format.

Show Toolbar Checking this menu item displays the command toolbar, un-checking it hides the toolbar.

Show Toolbar Detail If the toolbar is visible, determines whether the button icons have short text descriptions beneath them. Turning on the text descriptions of toolbar items significantly increases the screen size of the toolbar.

Analysis

Group Tag Level Selects the level to be used as to tag criteria.

Tag By First Letter Only Tags criteria only with the first letter of criteria from the tagged branch. Tagging is explained in full in Chapter 13.

Uncertainty in Decision Scores Menu Commands

This window has the same **File** menu options as the Decision Scores menu commands above.

Edit

The following Edit menu sub-item is only available when viewing the uncertainty in decision scores graph.

Copy Graph Copies Uncertainty in Decision Scores graph to the Windows Clipboard for Pasting to other applications.

The following Edit menu sub-items are only available when viewing the data spreadsheet format.

Copy Click this menu item to copy data in the Uncertainty in Decision Scores spreadsheet to the Windows Clipboard.

Select All Selects all data in the Uncertainty in Decision Scores spreadsheet.

View

Uncertainty Data/Graph Shows your scores in data or graph format.

Density Distribution Shows the probability of getting a score falling within a unit interval.

Cumulative Distribution Shows the probability of the alternatives being less than a given value on the decision score axis.

Reverse Distribution Shows the cumulative distribution in reverse, such as the probability of the alternatives' decision score being greater than the value on the decision score axis.

Curve Options Allows you to set the appearance of the distribution curves on the screen.

Line Curves Shows the outlines of your curves.

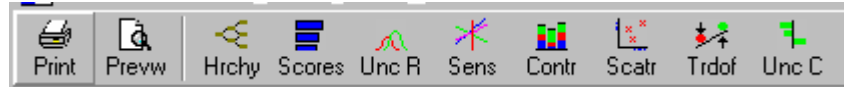
Solid Curves Fills in your curves in solid colors.

Show Toolbar Displays toolbar of select commands in layout at top of screen.

Show Toolbar Detail If the toolbar is visible, provides brief written descriptions of toolbar items.

The Analysis Windows Toolbar

When you are in any of the results or analysis windows, and the toolbar is visible, you will notice that it is different than when you were in the Hierarchy window.



The icons, left to right, are:

24. The Print Icon. Brings up the Print Dialog window.
25. The Print Preview icon. Brings up the Print Preview of whatever window you are in.
26. The Hierarchy Icon. Brings the Hierarchy Window to the fore.
27. The Results window. Opens the Decision Scores window
28. The Uncertainty Results window. Opens it.
29. The Sensitivity Analysis window. Opens it.
30. The Contributions window. Opens it.
31. The Alternatives Scatter window. Opens it.
32. The Tradeoffs of Lowest Criteria window. Opens it.
33. The Contributions to Uncertainty window. Opens it.

Hiding Toolbar icons and/or text

As usual, checking the menu item Show Toolbar on the View menu determines whether the toolbar is visible or not. If the toolbar is visible, checking the Show Toolbar Detail determines whether the text label appears under each toolbar icon.

What's Next?

You can turn to Chapter 13, Check Reasonableness and Analyze, to understand and validate your initial decision results, or you can turn to Chapter 13, Document the Results, to print specific results of your decision model.

Chapter 13

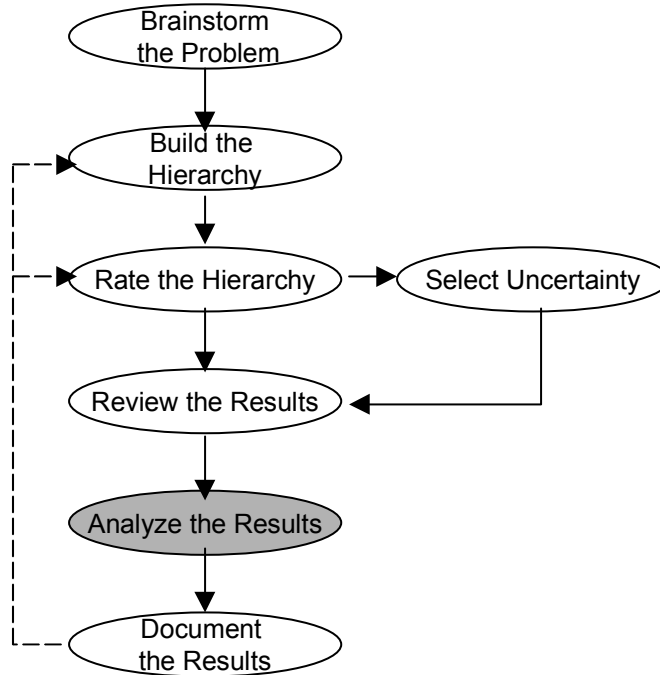
Analyze the Results

In This Chapter

- Analyze the Results as Part of the Decision Process
- Analyzing Your Results
- Viewing Contribution by Criteria Window
- Tagging Criteria by Tag Level Names
- Contribution by Criteria Radar Graph
- Contribution by Criteria Pie Graph
- Analyzing Sensitivity in Your Results
- Performing Sensitivity Analysis
- Viewing Tradeoffs of Lowest Criteria Window
- Viewing Contribution by Uncertainty Window
- The Analysis Windows Toolbar
- What's Next?

Analyze the Results as Part of the Decision Process

Where are you? You are in the shaded part of the Process Diagram below:



Process Diagram

Analyzing Your Results

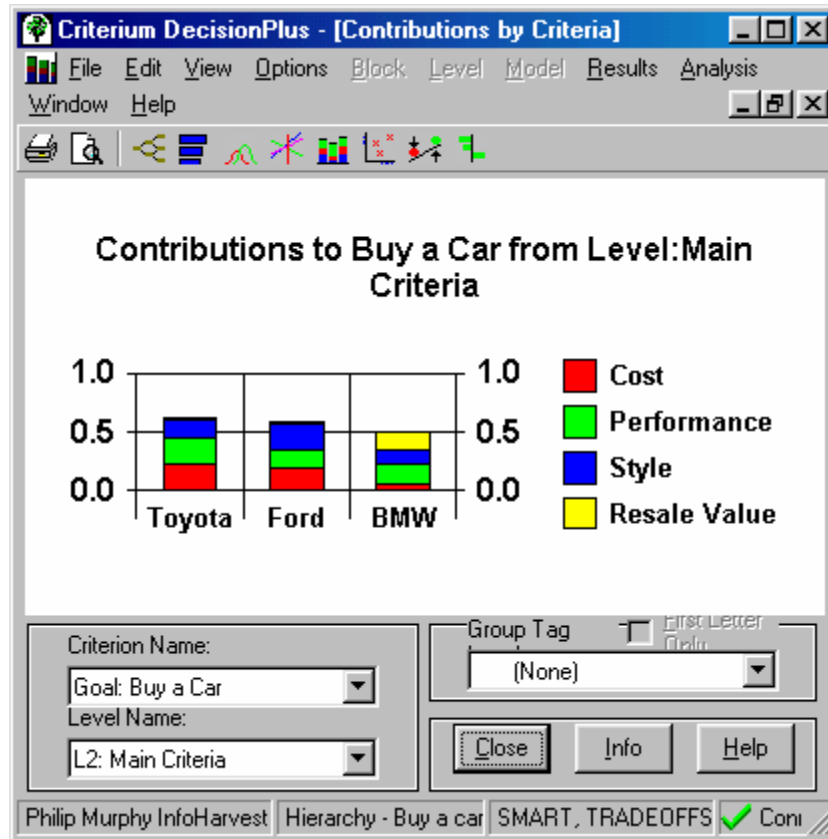
Once you review the results, if you're like most decision-makers, you probably ask yourself, "Is my decision a reasonable one?" "Does the model I created really capture my thinking?" or "How dependable is this outcome?" DecisionPlus helps you answer these concerns by providing four tools you can use to analyze your results: *Contribution by Criteria*, *Sensitivity by Weights*, *Tradeoff of Lowest Criteria* and *Contribution by Uncertainty*.

Viewing Contribution by Criteria Window

Having weighted the criteria, you expect those with the highest accumulated weight to contribute more toward the results than others. However, if all the alternatives score low on those criteria, those criteria's contribution to the total decision score of each alternative may be less than you imagined. Through DecisionPlus's contribution by criteria analysis, you can easily see which criteria actually made the largest contribution in your decision and which made the least. This discovery may indicate whether your decision is or is not a reasonable one: are your weights sensible? Do your scales have the proper orientation?

Display the Contribution by Criteria Window

1. In the Hierarchy window, select Analysis from the menu bar.
2. Select Contribution by Criteria to display the Contribution by Criteria window.



Contribution by Criteria Window Description

The Contribution by Criteria window has three primary areas: a graphical presentation area, an area allowing you to select both the target criterion and the contributing criterion level, and an area allowing you to select a tag level.

Graphical Area This portion of the window shows, in the Stacked Bar default graph style, stacked histograms of the Accumulated Values of the alternatives at a target criterion (usually the Goal), broken-down by the contribution (shown as a color coded strip) from each of the criterion in a selected level.

Accumulated Values are a generalization of decision scores. The decision score for an alternative in the model is the sum of all the ratings of that alternative against each lowest criterion, weighted by the importance of that criterion to the decision. If you imagine the hierarchy as a network of waterways flowing from the alternative to the Goal, the decision scores are the accumulation of the flows along all pathways from that alternative to the Goal. The Accumulated Value for *any* criterion (not just the Goal), and for a given alternative, is the accumulation of the flows along all pathways from that alternative to that criterion. Here in the graphical area, the height of each alternative's histogram bar is the Accumulated Value for that alternative at the target criterion.

Criterion Name In this box, you can select the target criterion at which you wish to analyze the decision scores of the alternatives.

Level Name In this box, you can select the level by whose criteria's contributions you wish to breakdown the Accumulated Values of the target criterion.

Tag Level This area allows you to select a level (if any), the names of whose criteria will prefix the names of all criteria in levels below that tag level. The First Letter Only checkbox allows you to choose to use only the first letter of the criteria names in the tag level as prefixes for lower criteria names.

View Menu

Graph Style Allows you to choose one of four graph styles – stacked bar, radar, pie and trend.

Legend Choose if you want a legend, and place it to the left, top, right or bottom of graph.

Alt Labels Lets you choose if you want the names of the alternatives as labels, and orient them horizontally or vertically, or let the program orient them automatically.

Options Menu

Dimensions – All Alternatives Information on all alternatives will be shown in the graphs.

Dimensions – All Criteria Information from all criteria in the target level will be shown in the graphs.

Dimensions - Defaults If there are more than seven criteria in a level, it shows the contributions from the first six, and lumps all the rest under “others.” If there are more than seven alternatives, it shows seven at a time, and you must scroll to see a different seven.

To Close the Contribution by Criteria Window

- Select the Close button. This closes the window and returns to the previous window.

Selecting the Target Criterion and Level

When you first open the Contributions by Criteria window, the default settings are the Goal for the target criterion and the level immediately below the Goal for the contributing level. You can select both the target criterion and the contributing level in the Contribution by Criteria window in the following manner:

- In the Contribution by Criteria window, select the target criterion you want to analyze from the Criterion Name list box in the lower left of the window.
- In the Contribution by Criteria window, select the level of detail you want in the analysis from the Level Name list box in the lower left of the window.

The histogram displays the contributions from each criterion in the contributing level to the Accumulated Weights of each alternative at the target criterion. The Contribution by Criteria plot shows the alternatives five at a time, starting with those with the highest decision score. Use the horizontal scroll bars to access additional alternatives.

Note: You can not choose a target criterion/contributing level combination where the target criterion would lie below the contributing level (i.e., further from the Goal).

To Copy the Contributions Graph and Data

To copy the actual contributions graph or its underlying data to the Windows Clipboard, for insertion in other applications, do the following.

1. From the Edit menu in the Contributions by Criteria window, choose Copy Graph. A bitmap copy of the graph area is copied to the Windows' clipboard.

or

From the Edit menu in the Contributions by Criteria window, choose Copy Data. A tab-delimited copy of the underlying data is copied to the Windows' clipboard.

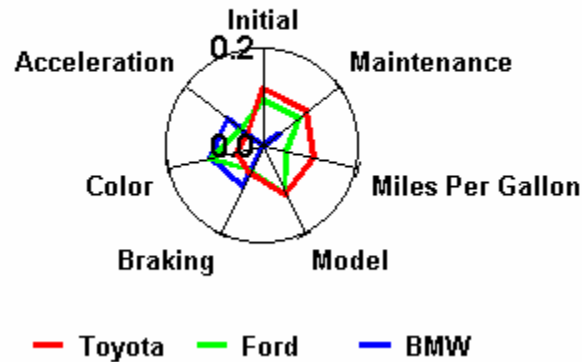
2. In your target application, paste (see that application's relevant documentation) the bitmap or data table.

Contribution by Criteria Radar Graph

To see the Contributions by Criteria window in radar style, click the item Graph Style under the View menu and click Radar.

The radar graph style is very useful for identifying unique alternatives. Very often the majority of alternatives are essentially slight variations of a few distinctive alternative primitives.

Contributions to Buy a Car from Level:Detailed Criteria



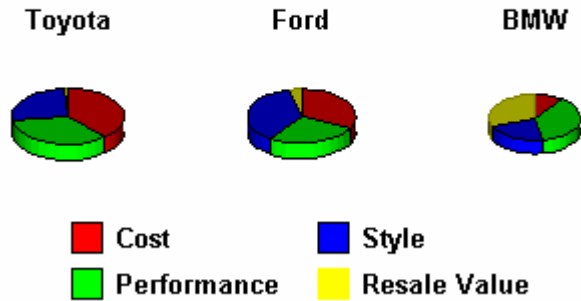
It is clear from the above radar graph, that the Toyota and BMW models are radically different primitives, taking their strengths from almost complimentary attributes. The Ford model is a hybrid solution scoring well across all attributes.

Knowing whether the top scoring alternatives are of a common primitive is very important in winner take all decisions. If they are so similar, there is no great risk in choosing one over the other. If the top two scoring alternatives are from radically different primitives, which just happen to have near equal aggregate decision scores, then the choice between them is a radical one, with high potential risk if any underlying assumptions prove erroneous.

Contribution by Criteria Pie Graph

To see the Contributions by Criteria window in pie graph style, click the item Graph Style under the View menu and click Pie.

Contributions to Buy a Car from Level:Main Criteria



Your eye is nature's most effective pattern matching device. The alternatives, in all of the Graph styles are ordered by decreasing Accumulated Values. In problems where there are many alternatives, the Pie Graph style allows your eye free rein to discern visual correlations between distinct primitives and high decision scores.

Tagging Criteria by Tag Level Names

As discussed in the chapter 10 section regarding Group Decision-Making, there is a need to be able tag the names of lower criteria by the names of higher criteria. This can be achieved using the Tag Level functionality.

Selecting the Tag Level

The criteria contributing to a score may now be tagged by related criteria at a higher level. This is very useful when various criteria have the same name, e.g., cost, but refer to costs of different types.

The tag level is chosen from a listbox of levels, and the name of a criterion at that level will appear before the names of criteria in that criterion's branch.

1. In the Contribution by Criteria window, select the level you want to analyze in the Group Tag Level list box in the lower right of the window.

2. If the Tag Level is between the Criteria Level and the Goal, the tagging will appear in the Legend.

Note: When a new model is loaded, the Tag Level is reset to a default of none.

First Letter Only checkbox

If the names of the tagging criteria are too long, this tagging becomes unwieldy, as the prefix:name combination becomes too long to fit in most analysis windows. By checking the First Letter Only option, only the first letters of the tagging criteria are used - naturally you have to choose tagging criteria with differing first letters for this to be useful.

Note: If no Tag Level is selected this checkbox is disabled.

Note: The Tag level and First Letter Only option may be set through menu items also. See Setting the Tag Level and First Letter Only options.

Setting the Tag Level and First Letter Only Options

Through Analysis menu items

The Tag level and First Letter only option may be set through menu items as well as through the Tag Level listbox and First Letter Only checkbox on the Contributions by Criteria Window.

Clicking the Group Tag Level item in the Analysis menu on any of the results or analysis windows creates a set of submenus corresponding to each of the model levels, or "(None)." If you choose a Tag Level, then the Tag By First Letter Only item is enabled in the Analysis menus. Choosing no Tag Level i.e., "(None) ," will disable the Tag By First Letter Only item.

Other ways to Set the Tag Level and First Letter Only Options

- the Criterion Rating window,

- the Contributions by Criteria window,
- the Print and Report Dialog options.

Analyzing Sensitivity in Your Results

When you weight a subcriterion with respect to a parent criterion, you are giving your decision model the power to discriminate between the alternatives under consideration. When you have finished rating the model, changing the value of the weight you assigned earlier may change the decision scores of the alternatives. This may result in the current preferred alternative being replaced by a different alternative. If the ordering of the leading alternatives changes at the smallest change in a particular weight, then your decision model is said to be “sensitive” to that weight. Since many of the weights you enter, especially in the more abstract levels of the model nearest the goal, are based on qualitative judgments on your part, it is important to understand if the model is overly sensitive to such weights.

Performing Sensitivity Analysis

Whether you are new to or familiar with decision analysis, it’s easy to test how sensitive your results are to changes in weights using DecisionPlus. In the Sensitivity Analysis function, you can determine the sensitivity of the preferred alternative to changes in the criterion weights, or ratings values. Critical changes in the weights or ratings are those that cause a change in the preferred alternative and are those with which you should be most concerned. The steps below detail how to perform sensitivity analysis on your results.

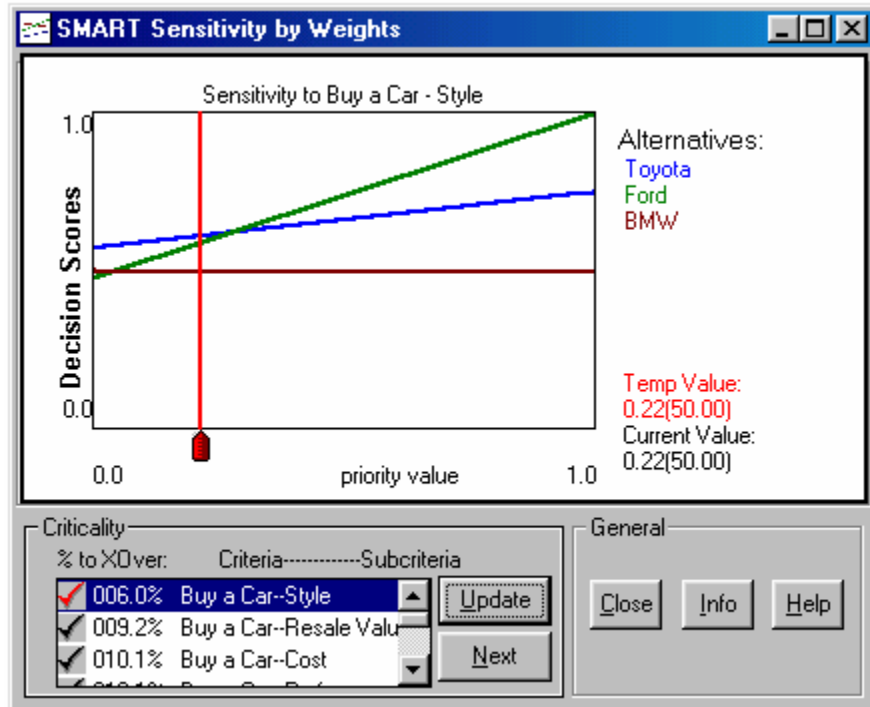
Display the Sensitivity by Weights Window

1. In the Hierarchy window, select the Analysis menu.

- From the Analysis menu, select Sensitivity by Weights to display the Sensitivity by Weights window.

Sensitivity by Weights Window Description

The two primary parts of the window are the Sensitivity Plot and the Criticality areas.



Sensitivity Plot

Priorities Each weight is identified by the subcriterion (in our example, this is Cost) whose weight it is, and the parent criterion (in our example, Buy a Car) with respect to which its value is assigned. The horizontal axis actually shows the priority of that weight, that is, the effective weight (from 0 to 1) the model uses in calculating

decision scores. The vertical axis shows the decision score for each alternative. The plot shows how changing the priority value of the current weight would affect the decision scores if it is varied over all possible values (0 to 1) when all other weights are fixed. The decision scores change linearly, so that each alternative is represented by a color-coded straight line.

Vertical Red Line The vertical red line is at the **Current Value**, the priority corresponding to the value of the weight you entered earlier in the Criterion Rating window. The value of that weight, in its own units, is shown to the right of the graph in parenthesis.

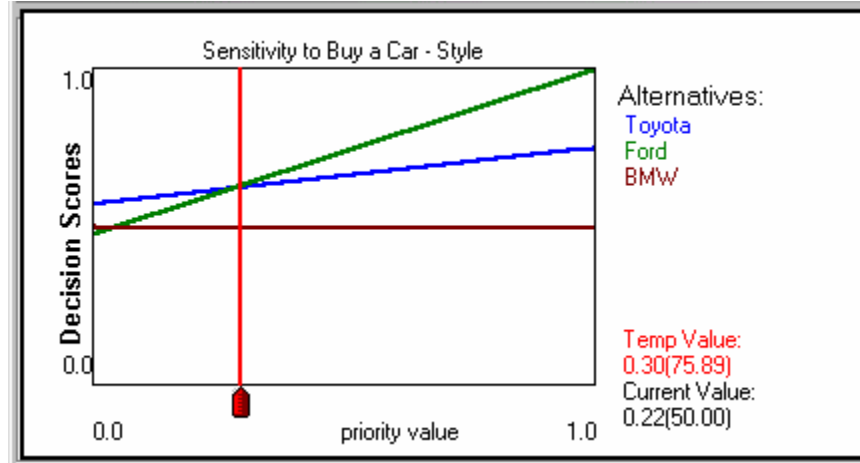
Decision Scores The height of the intersection of the vertical red line and the alternatives' lines gives the decision score that is current for each alternative (and as shown in the Decision Scores window). The plot shows only lines for five alternatives. If there are more than five alternatives in the model, it shows the current preference and the four alternatives that would supersede that preference for the smallest changes in the weight's priority.

Criticality Area

One useful way to understand the importance of the sensitivity analysis is to calculate how much the current value of the priority can change before the model's preferred alternative is superseded by a different alternative. At that value, the lines corresponding to the top alternative and the upstart alternative will intersect on the Sensitivity Plot. We call this a crossover point, and there may be many or none in the Sensitivity plot for a given weight. We calculate the change in priority values from the current value to the closest crossover point, then calculate that change as a percentage of the total priority scale. We refer to that percentage as the crossover percentage for a given weight, and it provides a useful measure of how critical that weight is to the outcome of the model.

The Criticality List Box The list box shows all weights in the decision model, as identified by that weight's Criterion/Subcriterion pair. Beside each pair is the percentage crossover value. In the list box, the weights are shown in order of decreasing criticality of their

priorities, beginning with the lowest percentage (most critical) crossover point. This means that when you open the Sensitivity by Weights window, and click the Update button, the plot you see is for the weight with the *most critical* priority in the model. If your model is stable (meaning that the current preference does not change with small



changes in the value of that priority) with respect to that most critical priority (such as when the percentage crossover is greater than 5%), then it is stable to changes in ALL other priorities in the entire model.

The Priority Value Slider Crossover points on the plot are the critical points in the decision, especially if they are near the current decision point (the red line). The percentage crossover number represents the nearness of the closest crossover point. Lower numbers indicate a close crossover. By dragging the slider at the bottom of the red priority line, you can see directly how changes in the chosen weight's priority affect the decision scores of each of the alternatives. As you drag the slider, the temporary value is shown in red to the lower left of the graph, and the corresponding weight value is shown in parentheses.

OS - Off Scale Because of the relative (AHP) normalization (see the discussion on Calculating Decision Scores earlier in this chapter), used in the model for criteria above the lowest criteria, the relationship between a weight and its corresponding priority is not linear. In particular, a priority value of 1 for a given weight can only be attained if

- all other weights in the rating set take their minimum scale value or
- the weight has an infinitely large value.

Neither situation is common. All scales have an upper limit beyond which a weight is not supposed to take values. When such a large priority value is reached that only a weight value beyond the scale maximum could produce it, that off-scale value is still shown in parenthesis but followed by the notation “-OS”.

Watch the Decision Scores window

To watch changes to the decision scores directly, open the Decision Scores results window and position the sensitivity window so that both are visible on your screen. As you move the slider in the Sensitivity window, the Decision Scores window shows the updated (based on the temporary priority value) score values. (See the discussion at the end of the Sensitivity Plot item above).

Note: The value you give the priority using the slider is not saved. When you leave the Sensitivity window, or choose to look at a sensitivity plot for a different weight, the weight, and hence all, decision scores revert to their true values. Even while you are moving the slider, only the decision scores window reflects the results of the temporary weight change.

Reviewing Most Critical to Least Critical in Order

You can view all the criticalities in the model weights one at a time. For each criterion-subcriterion relationship, a plot in the Sensitivity by

Weights area of the window shows you the sensitivity of your decision to the weights. DecisionPlus lists these relationships in order from the most critical to the least critical.

1. Click on the drop-down list box arrow in the Criticality area.
2. Select the weight (criterion/subcriterion pair) you want to review. The plot in the Sensitivity by Weights area changes to show the sensitivity of your decision to this weight.

Note: You may also use the Next button to select the next most important weight in the decision. When you have reviewed all of them, a message tells you there are no more to review.

Determining Values on the Plot

You can display the x and y values of any point on the plot by simply clicking the Graphical area with your mouse.

1. To see the values of the weight's priority (x-axis) or of the decision score (y-axis) anywhere on the plot, move the cursor to the spot you want and click.

To Copy the Sensitivity Graph

To copy the actual sensitivity graph to the Windows Clipboard, for insertion in other applications, do the following.

1. From the Edit menu in the Sensitivity by Weights window, choose Copy. A bitmap copy of the graph area is copied to the Windows clipboard.
2. In your target application, paste the bitmap (see that application's relevant documentation)

To Close the Sensitivity by Weights Window

1. Click the Close button. This closes the window and returns to the Hierarchy window.

Viewing Tradeoffs of Lowest Criteria Window

In any difficult decision, many of the criteria conflict - you desire the highest quality at the lowest price. The essence of the multicriteria decision is the tradeoff between criteria. For the lowest criteria (or attributes), these tradeoffs can often be explicitly calculated in terms of the scale units of those criteria. In DecisionPlus, you can see these tradeoffs directly in the Tradeoff of Lowest Criteria window. Validating these tradeoffs is key to accepting the reasonableness of the decision model.

Display the Contribution by Criteria Window

1. In the Hierarchy window, select Analysis from the menu bar.
2. Select Tradeoffs of Lowest Criteria to display the Tradeoffs of Lowest Criteria window.

The tradeoff table shows by how many units an Attribute rating must change in order to alter the decision score of the highest scoring Alternative, "Toyota", by the same amount that a change of one unit in the Reference Attribute produces.

Reference Attribute:

Tradeoff	Scale Units	Worst	Best	Relative Wei	Name
1.00	K\$	50.00	10.00	100%	Initial
0.73	100\$/Year	15.00	5.00	100%	Maintenance
-1.92	mpg	25.00	55.00	114%	Miles Per Gallo
2.39	0 to 60mph (s)	40.00	15.00	76%	Acceleration
1.15	30mph to 0 (s)	20.00	8.00	76%	Braking

Close Info Help

Tradeoffs by Lowest Criteria Window Description

The Contribution by Criteria window has two primary areas: an area allowing you to select the Reference Criterion, and a tradeoffs Table area.

Reference Criteria In this drop-down list box, you can select the lowest criterion (attribute) you wish to use as a Reference Criterion against whose scale units all other lowest criteria's scale units will be traded off. When a selection is made, the corresponding row in the Tradeoffs Table is highlighted.

Tradeoffs Table This display lets you see how you are trading-off the lowest criteria against each other. This can be a very good test of the reasonableness of your decision model. The Table is divided into five columns:

- **Tradeoff** This column gives the numerical value of the tradeoff - how many units of each criterion's scale are equivalent to 1 unit of the Reference Criterion's scale. A negative value indicates that this criterion's scale is defined in a negative sense to that of the Reference Criterion - e.g., an increase in the score of the best alternative under the Reference Criterion is equivalent to a decrease in its score under the criterion of interest.
- **Scale Units** This column gives the name of the units for each lowest criterion's scale, which you defined when rating the criterion (as described in Chapter 10). If the scale used was a verbal scale, the default numerical scale (0-100) would be used instead.
- **Worst** The value of the scale you defined as the worst possible.
- **Best** The value of the scale you defined as the best possible.
- **Relative Weight** The ratio of the Model Weights of the criterion over that of the Reference Criterion. This indicates the relative influence of each lowest criterion on the decision.

- **Name** The name of the lowest criterion (attribute).
- **Info** Access names of your criteria and any attached notes you entered earlier in Brainstorm or Hierarchy.

To Close the Tradeoffs of lowest Criteria Window

- Select the Close button. This closes the window and returns to the previous window.

Selecting the Reference Criterion

You can select a Reference Criterion in the Tradeoffs of Lowest Criteria window in either of the following ways:

- In the Reference Criterion list box above the tradeoffs table, select the lowest criterion against which you wish to analyze the tradeoffs of the other criteria.
 - In the Tradeoffs Table, to select a lowest criterion as the Reference Criterion, simply click any part of the corresponding row.

If you click the down arrow at the right of the listbox to see a list of the Lowest Criteria, you may notice that the name of some are followed by the notation (N/A), for Not Available. DecisionPlus does not perform a tradeoff analysis for lowest criterion that are not fully rated, or for lowest criteria that have been rated using pairwise comparisons. If you click on an entry that is listed as Not Available, a message will pop up to explain why this is so.

Analyzing the Tradeoffs Numerically

The numbers in the Trade-offs Table show the required increase in the weight/rating of the preferred alternative under a given lowest criterion/attribute to produce the same change as that produced by a change of one unit in the weight under the Reference Criterion.

For example: In a decision involving, among other criteria, the initial cost of a car in thousands of dollars, and the mileage of the car in miles per gallon, the decrease in the decision score of the leading

alternative incurred by decreasing the mileage performance by 1 mpg, might be equal to the decrease incurred were the price to be raised by \$500. If Mileage was chosen as the Reference Criterion, the tradeoff value in the row corresponding to Initial Price would be recorded as 0.5 ($\$500 = 0.5 \times \1000).

The actual values of the tradeoffs depend on the Relative Weights of the lowest criteria, the scales limits (Best, Worst) and the chosen decision methodology (AHP or SMART). If SMART is chosen, and only Linear Value Functions are used, the tradeoffs are independent of the alternatives. In all other cases, the inherent non-linearity of how the user-defined scales are converted into the internal priority scale implies that the tradeoff values are specific to each alternative. In DecisionPlus, tradeoffs values are based on the preferred, or highest scoring alternative.

Adjusting a Tradeoff

If, on reflection, you decide that a tradeoff is unacceptable, there are a number of different ways by which you can adjust the value to be more acceptable.

1. Changing the Relative Weights - by returning to the Ratings window and adjusting the weights directly.
2. Changing the Scale limits - by returning to the Edit Scale dialog and changing the Best/Worst values. Widening the scale will *reduce* the value of the individual unit
3. Altering the Value Function (if using SMART) by returning to the Value Function window, you can adjust the slope of the curve around the value associated with the best alternative. Making the slope steeper around that value will make each scale unit of that criterion have a greater impact, increasing its tradeoff value for the preferred alternative.

To Copy the Tradeoffs to Lowest Criteria Data

To copy the actual numbers underlying the tradeoffs to the Windows Clipboard for insertion in other applications, do the following.

1. From the Edit menu in the Tradeoffs to Lowest Criteria window, choose Copy. A tab-delimited copy of the underlying data is copied to the Windows clipboard.
2. In your target application, paste (see that application's relevant documentation) the bitmap or data table.

Relationship between Tradeoffs Analysis window and Direct Tradeoffs

If you are using the Direct Tradeoffs Hierarchy Rating technique, you may be surprised to see that the Tradeoffs Analysis screen may seem to show tradeoffs with different values than those you directly entered in the Rating window.

This can happen because the Tradeoff Analysis window allows you to select a Reference Criterion against which all other lowest criteria are traded off. However, you may be using a different reference criterion (see the section "Choosing a minimal set for Direct Tradeoffs technique" in Chapter 10) or even a manually chosen minimal set. If all priority vectors are linear, all methods should produce the same tradeoffs, but if not, you may well see discrepancies in the results from different methods. Two common sources of non-linear priority transformations are 1) using non-linear Value Functions in SMART or 2) using AHP for your alternatives' rating technique.

Note: the Tradeoff Analysis window (which was also in Version 2.0) only updates itself when clicked. So if you change the tradeoffs in the Ratings screen with the Real-time Update option on, the decision score screen and Contribution by Criteria window will update with every change, but not the Tradeoff of Lowest Criteria Analysis screen.

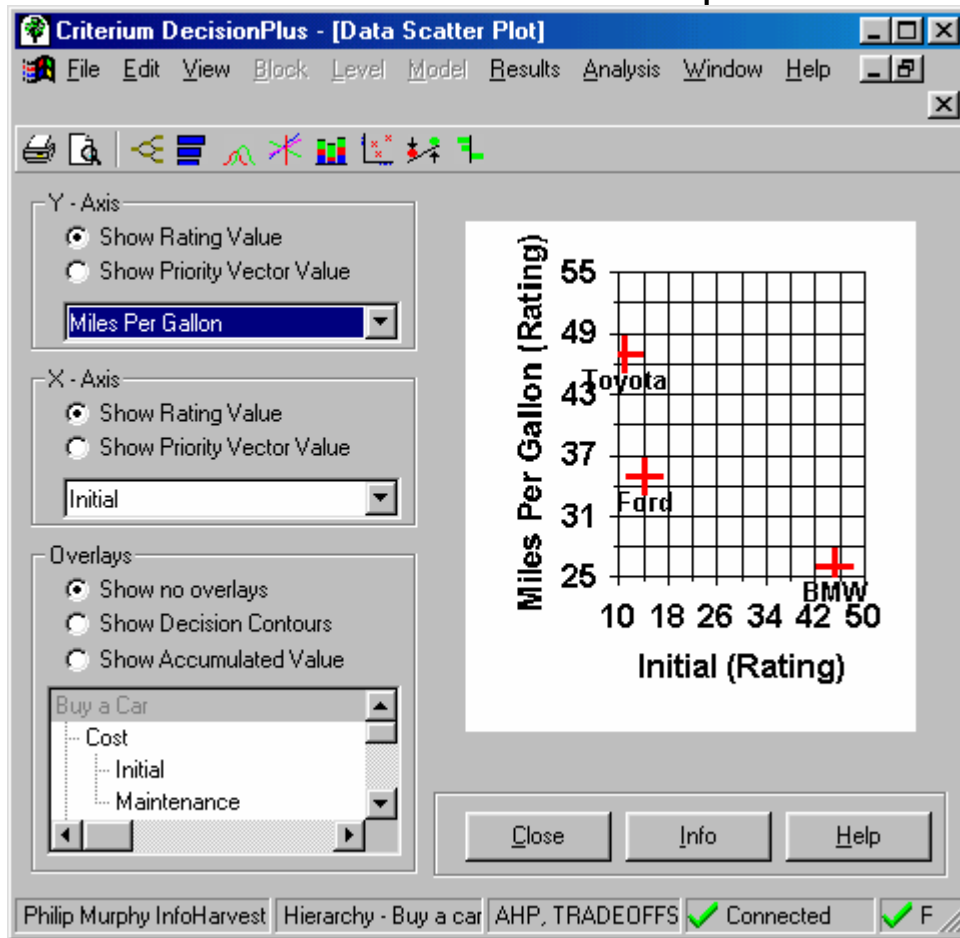
Viewing Alternatives Data Scatter Plot

Understanding the distribution of alternatives in your decision is very important if you are to be able predict how much impact a new alternative might have. To this end, CDP has the Alternatives Data Scatter plot. This plot helps you understand how your alternatives are distributed relative to their scores on the various lowest criteria. In addition, it also shows how the scatter of alternatives correlates with high decision scores.

To open the Alternatives Data Scatter Window Window

1. In the Hierarchy window, select Analysis from the menu bar.
2. Select Alternatives Scatter to display the Alternatives Data Scatter Window.

Alternatives Data Scatter window Description



Scatter Plot To the right is the 2-D scatter plot itself. It shows how the alternatives are distributed with respect to their values on the X and Y-axis.

X,Y Axis Here you choose what you want the X and Y-axes to show. You can choose any Lowest Criterion or the Decision Scores independently for each axis. You can choose to show the actual ratings of alternatives against that lowest criterion, or the priority that score

represents. (For an explanation of the important concept of priorities, see the section “How Decision Scores are Calculated” in Chapter 12.)

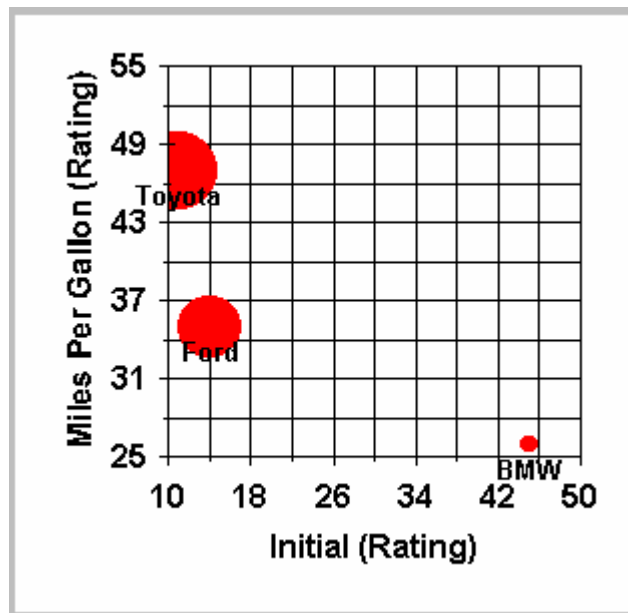
Overlays Initially each alternative is represented by a single cross on the scatter plot. You can choose to overlay the scatter plot with either bubbles representing accumulated values OR decision contour lines.

Setting the axes to Lowest Criterion Ratings

1. Select Miles Per Gallon from the Y-axis listbox. Click Show Rating value so that the Y-axis uses the end user’s rating scale.
2. Select Miles Per Gallon from the Y-axis listbox. Click Show Rating value so that the Y-axis uses the end user’s rating scale.

Showing Costs as a Bubble parameter

A “bubble”, i.e., an opaque red disc, appears at each alternative position. You select an accumulated value (such as a decision score)



that the bubble reflects. The radius of the bubble is proportional to the value. This allows you to see clear correlations between alternative

ratings and model outcomes. To select which accumulated value you wish the bubbles to represent, simply click the appropriate node in the tree outline area.

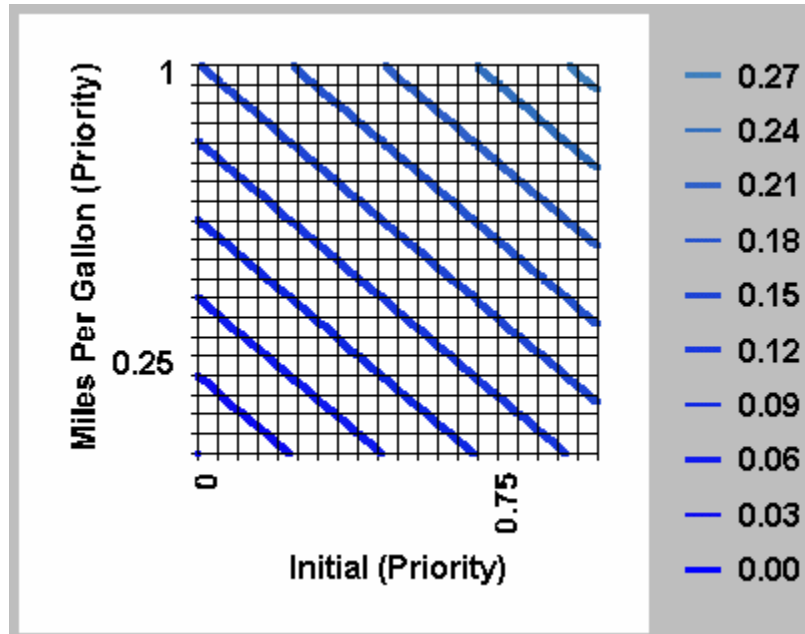
1. Click the Show Accumulated Values option under Overlays
2. Click the node Cost in the tree outline. You get the graph above.

Decision Contours

Alternatively, you can see how the decision contours are driven by particular lowest criteria. If you look again at the section “How Decision Scores are Calculated” in Chapter 12, you will see that if you consider two Lowest Criteria, the Decision Score could be written as

$$S = AW1 * PV1 + AW2 *PV2+ OC$$

Here AW1 stands for the accumulated weight of Lowest Criterion 1,



PV1 the priority of Lowest Criterion 1, and similar for AW2, PV2

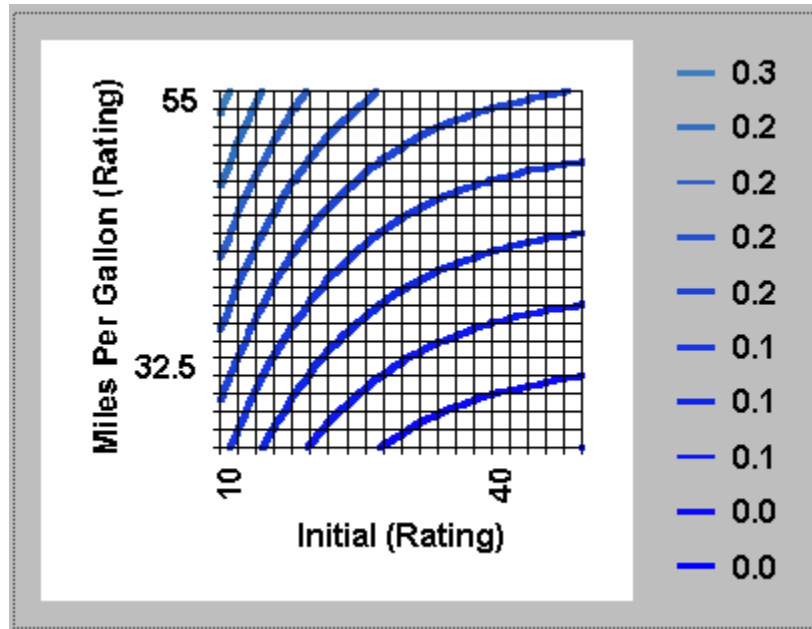
being those of Lowest Criterion 2. OC stands for the contribution from other lowest criteria. So if you graph only the sum

$$C12 = AW1 * PV1 + AW2 * PV2$$

This would be linear in terms of PV1 and PV2, which means contours of C12 would be parallel, straight lines (as they appear in the graph above).

Non-linear Priority Vectors = Curved Contours

If PV2(S2) is not a linear function of the end user’s rating S2, or PV2(S1) is not a linear function of the end user’s rating S1, then C12 will have a non-linear relationship with S1 and S2.



In the example above, Initial has an exponential value function, so that its priority vector is non-linear.

A quick comparison of the curved contour graph to the original, no-overlay scatter plot, shows that the Toyota is contours ahead of the Ford when looking at MPG and Initial price. As the number of

Alternatives increase, this information can be very revealing as to what type of alternative tend to push the decision boundaries.

View Options for Alternatives' Rating Window

When you are dealing with many alternatives, the names of the Alternatives quickly overlap and become unreadable. You can hide the names of the alternatives by

1. Choose the Hide Alternatives Names item in the View menu.

Viewing Contributions to Uncertainty Window

When you include uncertainty in your decision, you can analyze how each uncertainty distribution you assigned contributes to the overall uncertainty in the decision scores. This provides you with a better understanding of how the decision scores are affected by uncertainty.

To Select the Contributions to Uncertainty Window

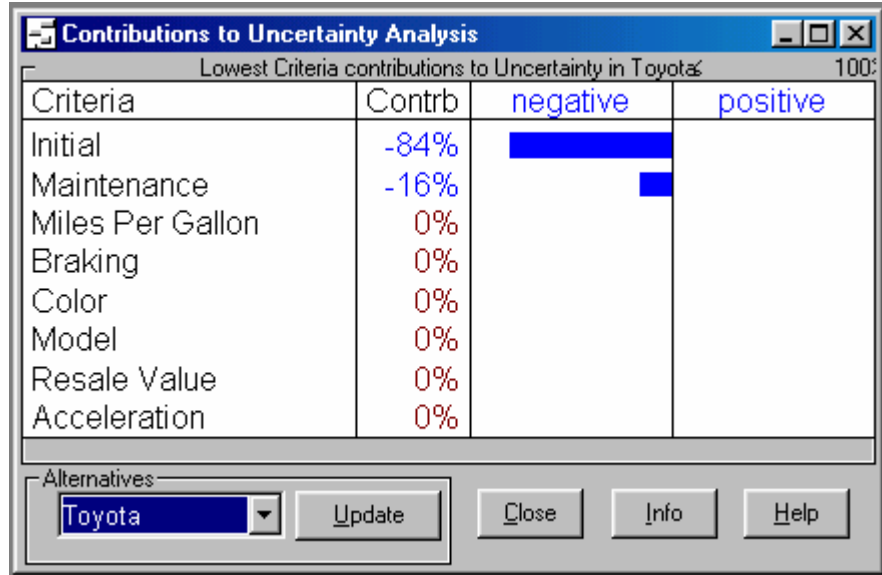
1. In the Hierarchy window, select Analysis from the menu bar.
2. Select Contributions to Uncertainty to display the Contributions to Uncertainty Analysis window.

Note: You must have already calculated the uncertainty in decision scores or this window will not open or update if already open.

Contributions to Uncertainty Window Description

This window shows the contribution of the individual uncertainties you entered for a single alternative. Initially, the preferred alternative and its uncertainty are presented.

Criteria Your lowest criteria are listed in this column.



Contrib (Contributions) This column shows the percentage of the uncertainty contribution for the adjacent criterion.

Positive/Negative Correlations The graphical bars show the contribution either positively correlated (for weights/ratings which, when increased, produces an increase in that alternative’s decision score) or negatively correlated (where an increase in the weight/rating produces a decrease).

Alternatives You can select other alternatives to review by using the drop-down list at the lower left of the window.

Note: In order to view the contributions, you first must update the results by selecting the Update Results button. The colors of the contribution bars for an alternative are the same as the first five alternatives in the uncertainty results window.

To Select Another Alternative to Review Contribution to Uncertainty

1. Click the drop-down arrow in the Options part of the window.
2. Select the alternative you want to view.

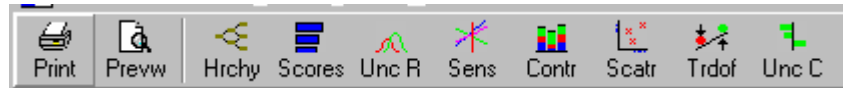
To Copy the Contributions to Uncertainty Graph

To copy the Contributions to Uncertainty graph to the Windows Clipboard, for insertion in other applications, do the following.

1. From the Edit menu in the Sensitivity by Weights window, chose Copy Graph. A bitmap copy of the graph area is copied to the Windows clipboard.
2. In your target application, paste the bitmap (see that application's relevant documentation)

The Analysis Windows Toolbar

When you are in any of the results or analysis windows, and the toolbar is visible, you will notice that it is different than when you were in the Hierarchy window.



The icons, left to right, are:

34. The Print Icon. Brings up the Print Dialog window.
35. The Print Preview icon. Brings up the Print Preview of whatever window you are in.
36. The Hierarchy Icon. Brings the Hierarchy Window to the fore.
37. The Results window. Opens the Decision Scores window
38. The Uncertainty Results window. Opens it.

- 39. The Sensitivity Analysis window. Opens it.
- 40. The Contributions window. Opens it.
- 41. The Alternatives Scatter window. Opens it.
- 42. The Tradeoffs of Lowest Criteria window. Opens it.
- 43. The Contributions to Uncertainty window. Opens it.

Hiding Toolbar icons and/or text

As usual, checking the menu item Show Toolbar on the View menu determines whether the toolbar is visible or not. If the toolbar is visible, checking the Show Toolbar Detail determines whether the text label appears under each toolbar icon.

What's Next?

Once you have checked the reasonableness and robustness of your decision, if you decide your decision is acceptable as structured, you can go to Chapter 14, Document the Results, and print your results. If, on the other hand, you decide the results are not reasonable, or you feel your model needs a little fine-tuning, you can adjust the structure of your model in Chapter 9, Build the Hierarchy, or adjust your ratings in Chapter 10, Rate the Hierarchy.

Chapter 14

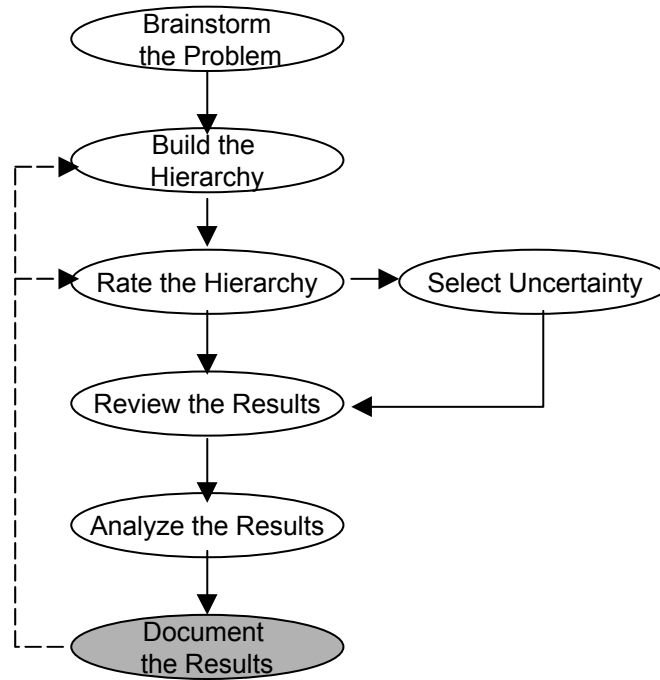
Document the Results

In This Chapter

- Documenting the Results as Part of the Decision Process
- Printing Support in DecisionPlus
- Displaying the Print Dialog Window
- Displaying the Print Preview Window
- Page Setup
- Displaying the Print Setup Window
- Printing Brainstorm Models
- Printing Decision Models
- Printing Decision Model Reports
- What's Next?

Documenting the Results as Part of the Decision Process

Where are you? You are in the shaded part of the Process Diagram below:



Process Diagram

Printing Support in DecisionPlus

DecisionPlus provides a full range of printing support. You can print your Brainstorm, Hierarchy, all results and analysis window contents, graphics or data. All underlying information, such as notes, weights, scores, scales etc., can also be printed. You can print such information as single items or as part of custom reports. You can preview your print work, add file names, page numbers, and model names to your page setup, and assign different printers. This Chapter will show you how.

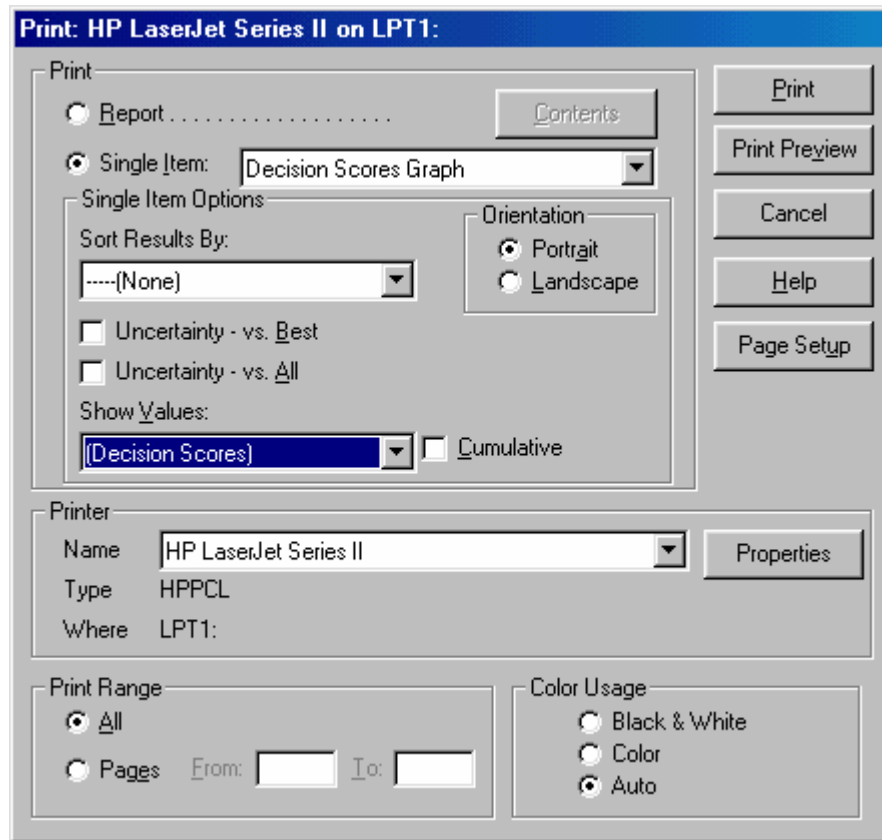
Displaying the Print Dialog Window

Whether you are in Brainstorm or Hierarchy, or one of the Results or Analysis windows of Hierarchy, you can access the Print Dialog window wherever you see the Print command on the File menu.

In Brainstorm, you can print your results in one of three ways: Graph, Outline, and a List of criterion names and notes.

In Hierarchy, you can print your results many different ways, including the Hierarchy graph, a spreadsheet view of that graph, criterion names and notes, as well as all the results and analysis graphs and data that are generated from a Hierarchy model.

1. Select Print from the File menu. The dialog below displays.

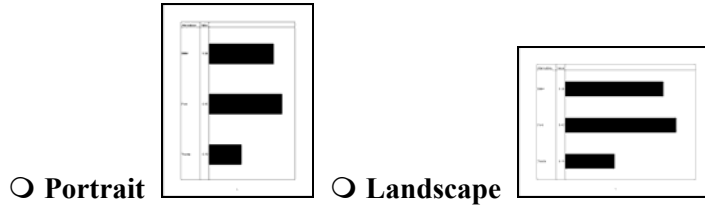


General Print Options

Some of the options on the Print Dialog window are the same for all Brainstorm and Hierarchy items. Those options are listed below:

- **Single Item:** Select this option to make one selection at a time to print. In Hierarchy, you either select this option or the Report option.
- **Report:** This option is available only in Hierarchy. It allows you to select and save a combination of the reports you might use often. If you select this option, the Single Item is deselected.

Orientation This option allows you to select the orientation of your printout.



Zoom Allows you to reduce or increase the size of your printout proportionately. You might want to use this to get larger printouts onto a single page or to enlarge printouts for illustrative purposes. (Not available for all items.)

Print Range Allows you to select to print all the pages in your file, or specific pages.

Print Setup Allows you to select a printer and printer-specific options.

Page Setup Allows you to set page headings, footers, and margins. See the section on “Page Setup” later in this chapter.

Print Preview Allows you to see a screen view of your printout before it prints. See the section on “Page Setup” later in this chapter.

Color Usage The printer will automatically (Auto) attempt to identify if your printer can handle color, and if so, will utilize color. You can override its assessment by choosing the Black and White or Color option.

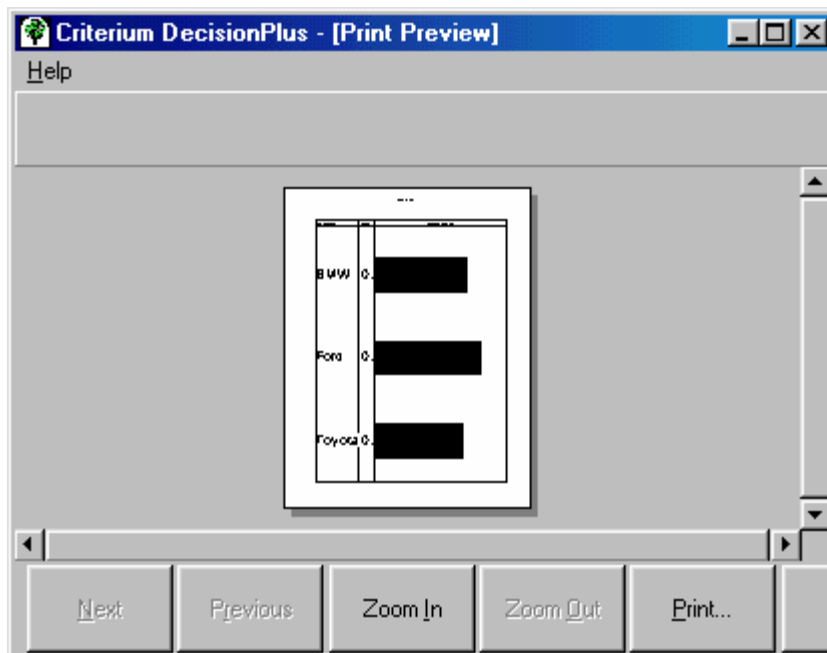
Options configurable using the check boxes depend on the item being printed, and will be described below.

Displaying the Print Preview Window

If you are looking at an analysis, results, Brainstorm or hierarchy window, the simplest way to see the corresponding print item is to look at the print preview window. To display the Print Preview window:

1. Choose Print Preview from the File menu
- or
1. Click the Print Preview button on the Print Dialog window.

What the Print Preview shows is exactly what you will get when you print.



Next/Previous Clicking these buttons will take you to the next or previous page in your item or report. The Page number is shown to the upper right. The buttons are disabled when there are no further pages.

Zoom In/Zoom Out Zoom In magnifies the display by a factor of two, allowing better inspection. Zoom Out restores to the full page magnification.

Print The Print button opens (or returns you to) the Print Dialog described above. From there you can proceed to print your work. The Print Preview does not close. If you want to change any options (e.g., paper orientation), use this button to access the Print Dialog, change your option settings, then click the Print Preview button on that window to see the changes.

Close Clicking the Close button closes print preview and returns you to the usual DecisionPlus windows. A recalculation may occur.

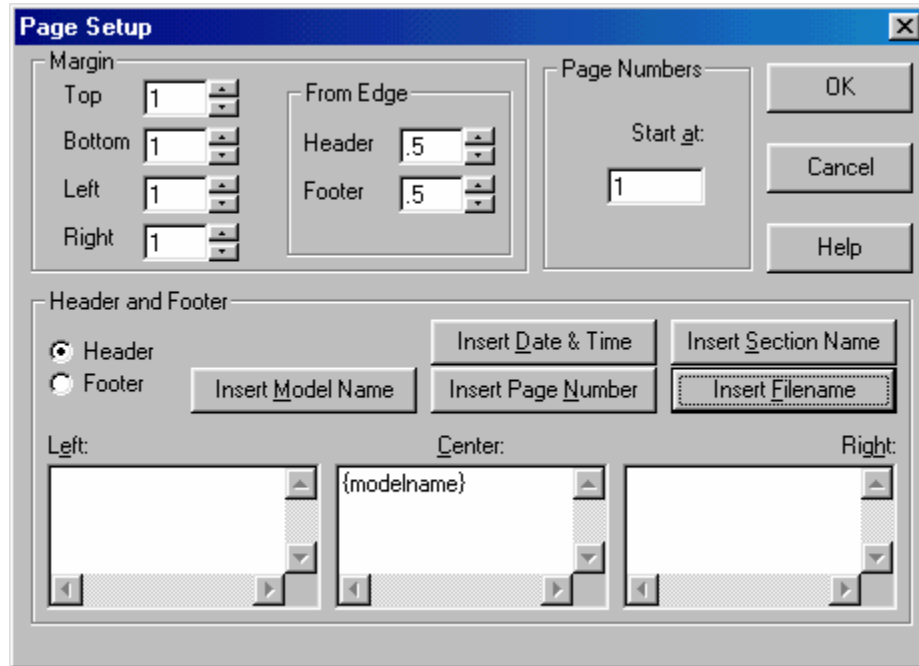
Clipboard Clicking this button will copy the print preview image (the part on the white background).

Note: Print Preview places a heavy demand on your memory resources. You may get an error message warning of insufficient memory. Follow the suggestions of the message to free up memory.

Display the Page Setup Window

To insert specific headers and footers in your print items and reports:

1. Select the Page Setup button in the Print Dialog window to display the Page Setup window. The Page Setup window, shown below, is the same for Brainstorm and Hierarchy and effects all printed items. Your settings are lost when a session is ended.



Margins: Enter the margins in inches from top to bottom, left to right. The default is 1 inch for all margins.

Distance From Edge: Indicate how far from the edge of the paper you want your header and footer to print.

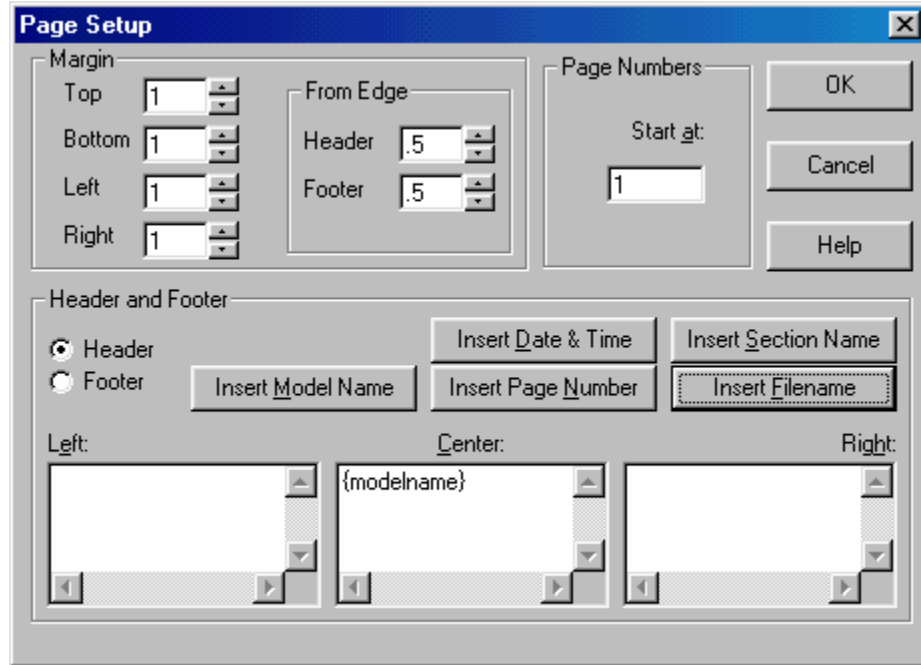
Page Numbers: If you want your page numbers to begin at a point other than 1, enter that number here.

Header and Footer: Select the one you want to work with from the Select Header/Footer drop-down list box. Then enter the appropriate information in the three scroll boxes at the bottom of the window for Left, Center, and Right.

Left, Center, Right: These refer to the areas of your printed page. Here you can enter information you want printed in either the header

or footer. Or, you can click in one of these boxes, then select one of the buttons described below to insert model information automatically.

Insert Filename, Insert Model Name, Insert Page Number: If you want DecisionPlus automatically to insert your model's Filename, Model name, or page numbers, click in the appropriate text box (Left, Center, Right) and select one of these buttons at the bottom of the window. Model Name is only available when printing from Hierarchy.



Displaying the Print Window

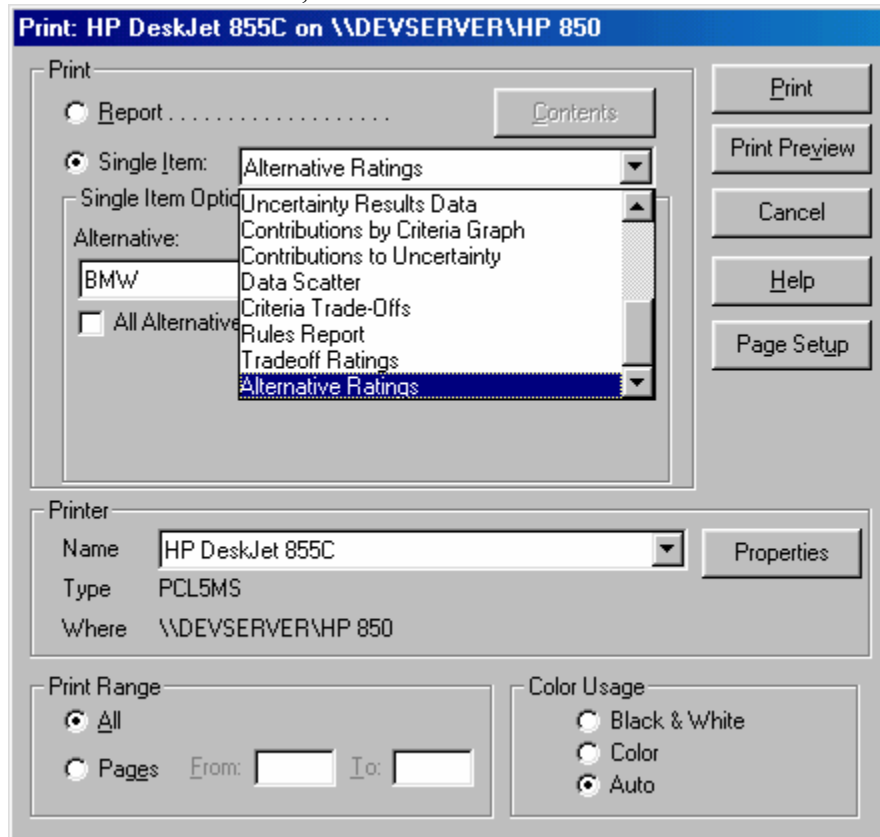
Through the Printer dialog, DecisionPlus allows you to change printers and adjust your printer settings on the fly. The window caption of the

Print Dialog tells you to which printer you are sending your print tasks. To display the Print dialog:

1. From the File menu, choose Print.

or

1. From the toolbar, click the Print icon.



Report For Hierarchies, allows you to create reports from single items.

Single Item Selection drop down Allows you to select a single item to print, and choose how you want it printed.

Printer Allows you select and alter the options (e.g., Paper source, Paper size, etc.) of any available (local or networked) printer. The exact options vary with the printer.

Print Range Do you want all pages printed or a particular range?

Color Usage Let CDP to print in color if your printer supports color printing or make your own choice.

Printing Brainstorm Models

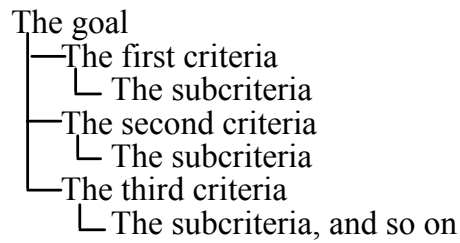
Having dealt with the general printer support that DecisionPlus provides, we now present a description of each available print item, and the options available to each item, starting with Brainstorm models.

Brainstorm Print Dialog Window Description

Brainstorm Graph Prints a duplicate of your Brainstorm canvas, excluding the alternatives. Specific options are as follows.

- Print Boxes Around Nodes** Adds frames around your criteria
- Fit To One Page** Sizes your model so it all fits on one page.
- Print Goal Tree Only** Prints only criteria connected to the Goal.
- Print Crop Marks** On very large models, prints on several pages, crop marks (corners) help you line up each page when you assemble the pages.

Brainstorm Outline Prints the contents of your Brainstorm model in the form of an outline beginning with the goal as in the following illustration.



- Print Goal Tree Only** Prints only criteria connected to the Goal.
- Print Crop Marks** On very large models, which print over several pages, crop marks (corners) help you line up each page when you assemble the pages.

Brainstorm Notes Prints the goal and each criterion with any notes attached.

- Print Alternatives' Notes** Prints Notes for alternatives as well as those for criteria.
- Print Goal Tree Only** Prints only notes of criteria connected to the Goal.
- Print Pasted Data** Prints the scores of Alternatives pasted directly into Brainstorm (if any).

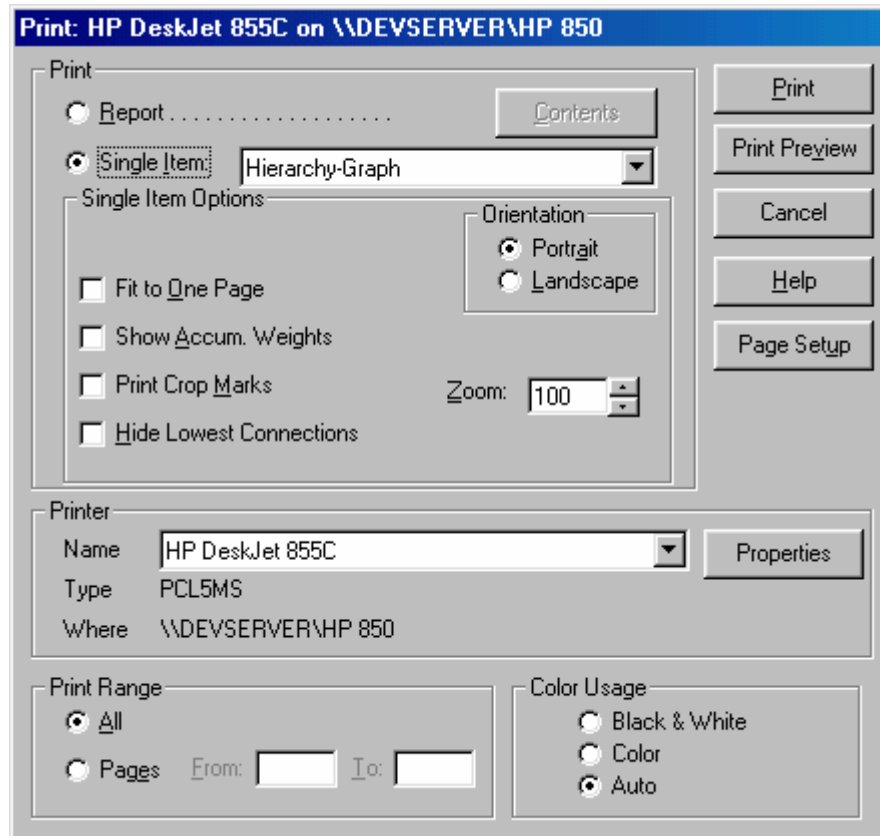
Report: This option is available only in Hierarchy. See the section “Hierarchy Reports” in this Chapter.

Printing Decision Models

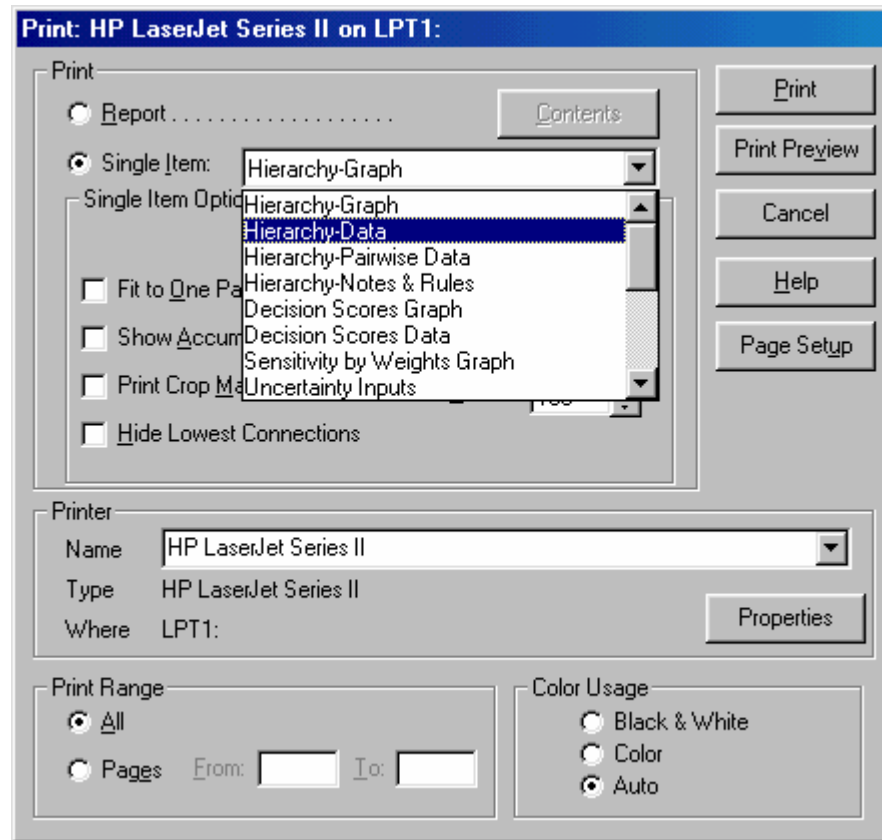
As in the case of Brainstorm models, all printing is effected through the Print Dialog window.

1. From the Hierarchy window, or one of the results or analysis windows such as Decision Scores, select Print from the File menu.

Or, from the toolbar, click the Print icon.



2. The Print options window below appears.



In the Hierarchy, you have fourteen more choices to select from the Single Item drop-down menu in Hierarchy than in Brainstorm. The default is the item corresponding to the window you were viewing before you opened the Print Dialog.

When you select an item from the Single Item list, a corresponding set of options appears below the list box. In addition to the general options (orientation, color, etc.) discussed earlier options specific to each item are described below.

Hierarchy - Graph

- Fit To One Page** Sizes your model so it all fits on one page. Use Print Preview to see if Landscape or Portrait is the better choice.
- Show Accumulated Weights** - Adds the accumulated weight of each block as a prefix to its name.
- Print Crop Marks** On very large models, prints on several pages, crop marks (corners) help you line up each page when you assemble the pages.
- Hide Lowest Connections** - Lines connecting lowest criteria to alternatives may become too dense for some printers - this option suppresses those lines.

Hierarchy-Data Prints a spreadsheet view of the Hierarchy.

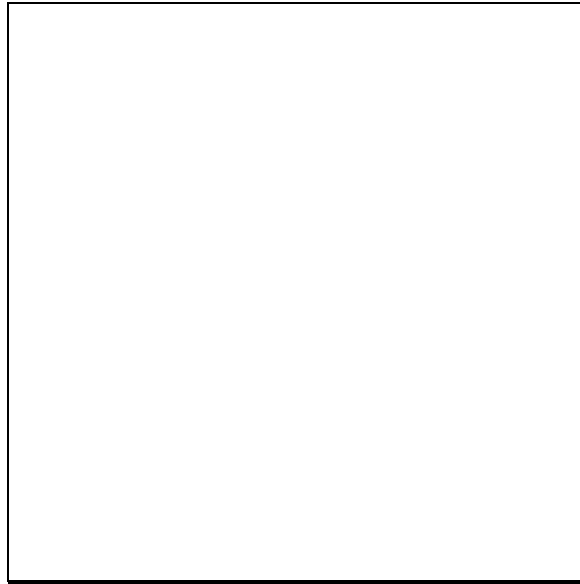
- Weights and Ratings Only** Spreadsheet of criteria and their ratings, alternatives and their scores.
- Weights, Ratings, Priorities** Same as above, but also shows priorities. Takes up a lot of space.

Goal/Lev	Weight	Prioritized	Rating Sel	Level 2	Weight	Prioritized	Rating Sel	Laurel Criteria	DMV's Ex	DMV's Prior
Desig Car	50.00	0.254	Cost	Cost	50.00	0.500	Initial	Initial	45.00	0.000
	50.00	0.348	Performance	Performance	50.00	0.500	Maintenance	Maintenance	44.00	0.100
	50.00	0.247	Style	Performance	47.50	0.423	Miles Per Gall	Miles Per Gall	26.00	0.000
	40.00	0.374	Resale Val	Style	40.00	0.200	Maintenance	Maintenance	37.20	0.000
				Style	40.00	0.200	Color	Color	38.00	0.000
					50.00	0.500	Model	Model	0.00	0.000
				Resale Val			Alternatives	Resale Value	32.00	0.000

Hierarchy Pairwise Data Prints tables of pairwise comparisons. Exact format depends on primary view used.

Hierarchy-Notes & Rules Prints a list of each block's name, its associated notes, scale information (if not an alternative), Rules (if block is a lowest criterion and if defined) and value functions (if SMART is used, and the block is an attribute).

- Print Notes Only** - Prints only name and text notes in hierarchy order and indented format.



- Print All** - Prints extensive information about a block; Notes, Scales, Rules.

Decision Scores Graph Prints a bar graph of your decision scores similar to the Decision Scores results window.

- Sort Results By* - List includes None (default), Decision Scores, 5% score, mean score, 95% score and accumulated values at any criteria.
- Uncertainty Vs All* - Shows how often each alternative would be the top scorer in light of the given uncertainties.
- Uncertainty Vs Best* - Shows how often each alternative would have a higher scorer than the leading alternative.
- Show Values List* - Determines what numerical values will be shown. List includes Decision Scores (default) and all lowest criteria.

- Cumulative** - Cumulatively sum (and display) the values starting from the top of the screen.

Decision Scores Data Prints a spreadsheet view of the Decision Scores and Uncertainty (if available) results.

Lowest Level	BMW	Ford	Toyota	Model Weights
Initial	0.32	0.51	0.17	0.07
Maintenance	0.23	0.49	0.29	0.12
Miles Per Gallon	0.47	0.35	0.18	0.10
Acceleration	0.18	0.51	0.32	0.18
Braking	0.70	0.29	0.01	0.02
Color	0.66	0.33	0.01	0.06
Model	0.35	0.45	0.19	0.10
Resale Value	0.51	0.33	0.16	0.35
Results	0.40	0.41	0.19	

Sensitivity by Weights Graph Prints a copy of your Sensitivity to Weights analysis window.

- critierion-subcritierion* - From the list you can choose the weight for which you wish to run the sensitivity analysis.

Uncertainty Inputs Prints *all* the Uncertainty distributions (curves) you specified for all lowest criterion.

C:\CRINCAR.CPD

Buy a Car

1

Uncertainty Assumptions

Uncertainty for: Initial
 For: **0.00%**
 Uniform distribution with parameters:
 Minimum: 0.00
 Likelihood: 33.33
 Maximum: 62.43



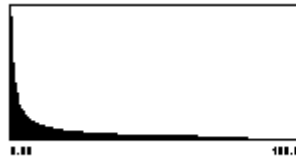
Uncertainty for: Fuel
 For: **4.00**
 Normal distribution with parameters:
 Minimum: 0.00
 Likelihood: 80.00
 Maximum: 100.00
 Std. Deviation: 10.00



Uncertainty for: Initial
 For: **7.00%**
 Triangular distribution with parameters:
 Minimum: 58.52
 Likelihood: 52.00
 Maximum: 57.32



Uncertainty for: Maintenance
 For: **0.00%**
 LogNormal distribution with parameters:
 Minimum: 0.00
 Likelihood: 50.54
 Maximum: 80.42
 Std. Deviation: 10.00



- Sorted by Criteria* - The uncertainty distributions are ordered by lowest criteria, then by alternatives, both taken in Hierarchy Order.
- Sorted by Alternatives* - The uncertainty distributions are ordered first by alternatives, then by lowest criteria, both taken in Hierarchy Order.

Uncertainty Results Graph Prints a copy of the Uncertainty in Decision Scores results window.

- Density Curves** - All the distributions are shown as probability density distributions.
- Cumulative Curves** - All the distributions are shown as cumulative probability distributions.
- Reverse Cumulative Curves** - All the distributions are shown as reverse cumulative probability distributions.

Uncertainty Results Data Graph Prints the statistical data and curve points of the Uncertainty in Decision Scores Results window. The options for this page are as for the Uncertainty Results Graph (above).

Contributions by Criteria Graph Prints a copy of the Contribution by Criteria Analysis results graph.

- Criterion** - The listbox allows you to select the target criterion you wish to analyze.
- Level** - The listbox allows you to select the level whose criteria's contribution (to the accumulated values of the alternatives at the target criterion) you wish to analyze.
- Tag Level** - The listbox allows you to select the level with whose criteria's names you wish to prefix the names of criteria in lower levels.
- Tag By First Letter** - In the interests of space tag with only first letter of Group Tag Level's criteria names.
- All Alternatives** - The print functionality for Contributions by Criteria by default, only prints the stacked columns for the first five alternatives. If you have more than five alternatives, and need a graph showing all alternatives, check the All Alternatives box. The resultant graph may be too dense to be of use.
- All Criteria** - The print functionality for Contributions by Criteria by default, only prints the first 6 criteria as bands of a stacked column. If you have more than seven criteria in the contributing level, it lumps the contributions from the seventh

and above into a single band labeled others. If you desire a graph showing bands from all criteria, check the All Criteria box. The resultant graph may be too dense to be of use.

- **View – Graph Style** - From the list you can select whether you want to set options for the Graph Style, Legend position or Alternatives labels' orientation. In each case the options are shown in the area to the right of the listbox.

Contributions to Uncertainty Prints a copy of the Contributions to Uncertainty Analysis results window.

- **Alternative** - From the list you can select the alternative whose uncertainty you wish to analyze.

Data Scatter

See Chapter 13 for a description of each option.

Criteria Tradeoffs Prints a copy of the tradeoffs between lowest criteria Table.

- **Reference Criterion** - You can select the lowest criteria you wish to designate as the reference criterion.

Rules Report Prints a summary of all the rules and an account of the alternatives that failed them (if any).

- Print Failed Rules** - Prints only an account of rules that were failed by alternatives.
- Print All Rules** - Prints all the rules (whether failed or not) and an account of rules that were failed by alternatives.

Trade-off Ratings Prints all Direct Tradeoffs (if any) entered by user. No options other than Portrait or Landscape.

Alternative Ratings

Analysis results window.

- Alternative** - From the list you can select the alternative whose attribute values you wish to print.
- Print All Alternatives** - Prints attribute values for all alternatives.

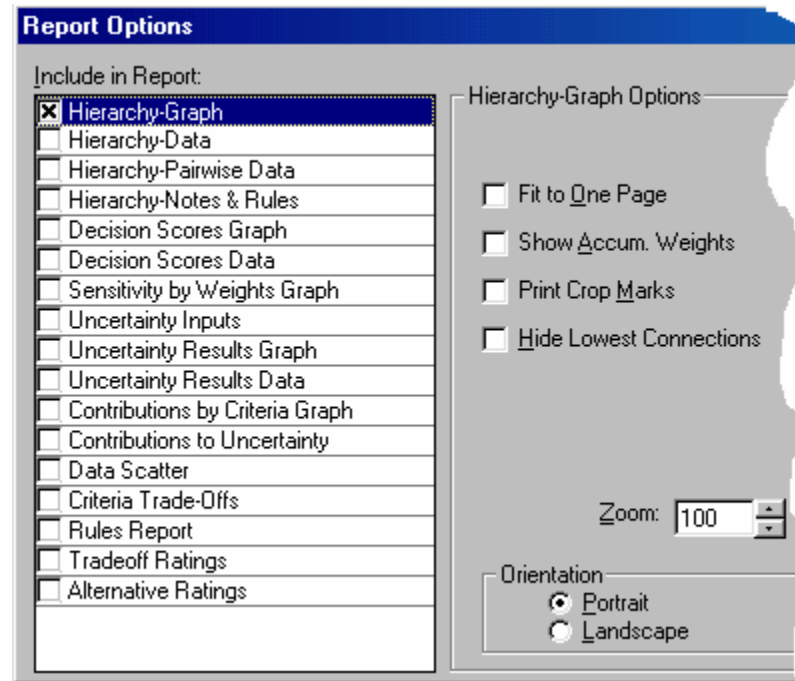
Printing Decision Model Reports

Printing reports allows you to select, save, and print a combination of the print items you might use often. The report is saved with the data file (*.cdp). While the Report is printed directly from the Print dialog window, you choose the contents of the report in the Report Options window.

To Display the Report Options Dialog Window

To open the Report Options dialog from the Hierarchy or any results or analysis windows:

1. Choose Print from the File menu to open the Print Dialog.
2. Select the Reports Option, located at the top of the dialog window. The Contents button is enabled.
3. Click the Contents button, and the Report Options window



appears.

This allows you to select the combination of items you want in your report and enter the specific manner in which you want them to print. The dialog contains an Include in Report area and an Options area.

Include in Report

The left-hand list contains all available print items for a decision model. By clicking the name of any item, the Options Area is populated with the appropriate formatting options. *To add an item to the report, you must click the check box to the left of the item name.* Un-checking an item removes it from the Report.

Options Area

The options here are exactly the same as those for the single items, as discussed above in the section “Printing the Decision Model.” Setting these options here does not effect options for the Single Items printing. The option settings for one item in the report do not affect settings of other items in the Report.

Saving a Report

Clicking the OK button saves the report unless you choose not to save the file when closing the entire model.

To Print a Report

1. From the File menu choose Print.
2. In the Print Dialog window, click the Report button.
3. Still in the Print Dialog window, click the Print button.

To Preview a Report

1. From the File menu choose Print.
2. In the Print Dialog window, click the Report button.
3. Still in the Print Dialog window, click the Preview button. Use the Next and Previous buttons to walk through the report.

What's Next?

You can return to any part of your decision model and update the information. At that point you can save it to the current file, or save it to a new file.

If you want to learn some of the more advanced functions in decision analysis, we recommend turning to the References section for suggested literature on decision analysis techniques.

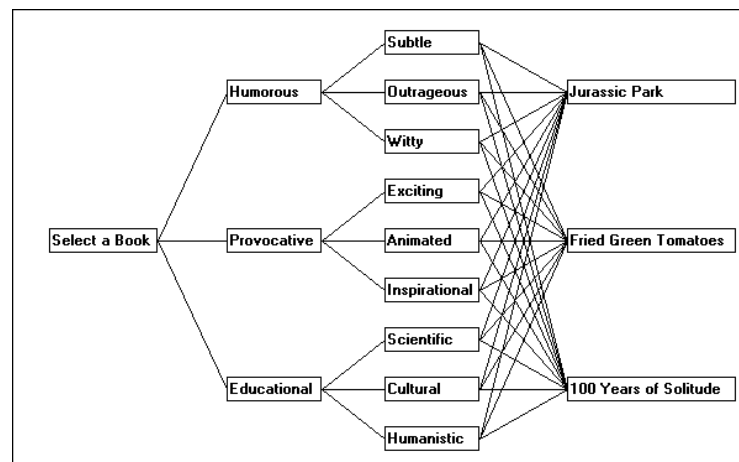
Part IV

Tutorial for Creating a Decision Model



What Will You Get from this Tutorial?

This section contains a series of steps in a five-part tutorial. The tutorial, Select a Vacation Book, is meant to get you started using DecisionPlus by having you use only a portion of the functions to enter, structure, weight, and document a very small decision model. We provide just enough detail to accomplish this task and to help you understand some important concepts. Below is an illustration of the model we help you build in this tutorial.



You'll need more detail to build a complex decision model than you'll get using this tutorial alone. But, you might use the tutorial along with

the chapters in Part III, Designing Your Own Decision Model, and successfully build your own decision model. We recommend that you refer to the chapters in Part III any time you want more detail about what we discuss in this tutorial.



Chapter 15 – A Tutorial:

Select a Vacation Book

In This Chapter

- I Brainstorming the Problem
- II Building the Hierarchy
- III Rate the Hierarchy
- IV Selecting the Best Alternative
- V Reviewing the Results

A Step By Step Tutorial

Our tutorial acquaints you with DecisionPlus as we assist you through your first decision-making process using this program. This tutorial assumes you have little or no prior experience with decision making tools. For this reason, we selected a simple model that, although you may not need a decision analysis tool to solve, will build confidence in your decision making process and in using DecisionPlus. You'll use many of the features in DecisionPlus to make a preferred decision.

Tutorial Overview

This tutorial has all the necessary parts to reach a preferred decision. The five parts of the tutorial are: Brainstorming the Problem, Building the Hierarchy, Rate the Hierarchy, Selecting the Best Alternative, and Reviewing the Results.

I - Brainstorming the Problem

In the first part, you'll use the brainstorming capability where you'll type your ideas about the problem onto a canvas. On the canvas, we'll show you how to associate similar ideas with each other. We call these ideas *criteria*. This is also where you'll enter your alternatives (the choices you have available).

II - Building the Hierarchy

Next, you'll build your hierarchy and make any necessary adjustments to criteria or alternatives. You'll learn techniques such as how to add and delete criteria, expand and contract your model, and navigate through your model.

III - Rating the Hierarchy

Then, you'll rate your criteria and alternatives using various rating methods and rating scales.

IV - Selecting the Best Alternative

Here you'll calculate the preferred alternative, and interpret and present the results.

V - Reviewing the Results

Finally, you'll analyze how sensitive your results are, see how contribution affects the results, and determine if the decision is stable.

Supporting Sample Files

When you installed DecisionPlus, two sample tutorial files were copied to the DecisionPlus directory on your system (usually c:\criplus). The file, **bookttrl.bst**, contains the brainstorm file for this tutorial as it should look after you have finished the first part of this tutorial, I - Brainstorming the Problem. The file, **bookttrl.cdp**, contains your hierarchy file as it should be after you have finished part III - Rating the Hierarchy. You can use these two files to skip parts of the tutorial if you wish.

Select a Vacation Book

Imagine you are packing for a tropical vacation and you want to take along one of your new books. You have three great books in mind, but room for only one in your luggage. Will it be Jurassic Park, Fried Green Tomatoes, or 100 Years of Solitude?

I - Brainstorming the Problem

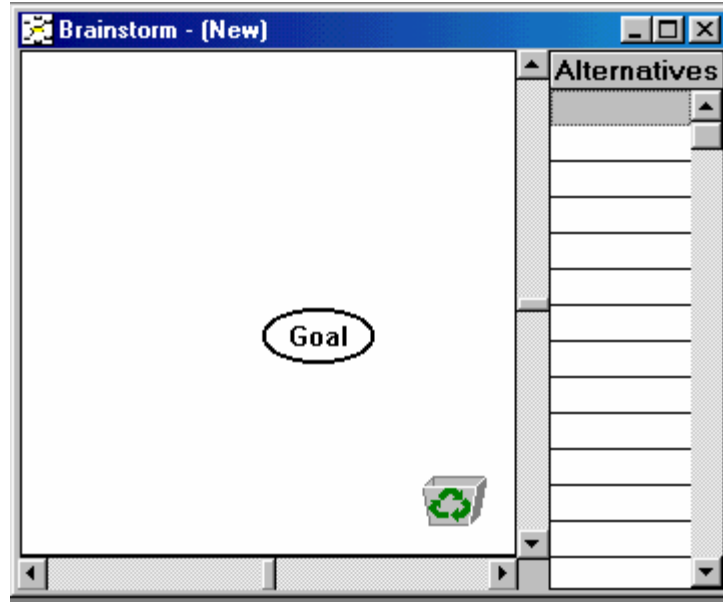
The first step in building your decision model is to display the brainstorming window so you can enter and organize your ideas on the “canvas.” This is also where you’ll list your book choices.



This part of the tutorial takes 20 to 40 minutes, depending on your learning style.

Step One: Display the Brainstorming Window

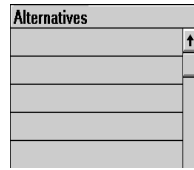
- From Program Manager, double-click the DecisionPlus icon. The Brainstorm window displays with a blank canvas, except for the word “Goal” inside a centered circle.



The goal circle in the middle of the canvas is where you'll type your decision goal. If you move your cursor to the goal circle it turns gray. This feature tells you when you've made contact with items on the canvas.



The recycle bin in the lower right corner stores ideas you may not want to work on for the time being. You can drag words to the recycle bin and retrieve them at a later time during the same session.



The gray area to the right of the canvas is where you'll type your choices. In this case, the choices are the books from which you'll choose. We call these alternatives.

Step Two: Enter Your Decision Goal

Goal

1. Click once inside the circle to select it. A box surrounds the goal circle.
2. Click once again inside the circle on the word "Goal" to highlight it.
3. Type *Select a Book*.

Note: Type your text in Brainstorm the same way you would in any Windows application using the same procedures.

Because the circle was only large enough to accommodate the word "Goal," only parts of your typing show as you type.

ct a

4. Press ENTER or click outside the circle. Your whole name appears inside the circle.

To move the goal circle anywhere on the canvas, click on the circle and drag it to another position.

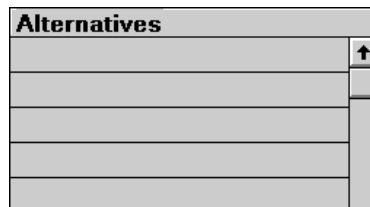
Step Three: Save Your File

1. From the File menu, select Save.

2. Select a drive and folder.
3. Type *book*.
4. Click OK, or press ENTER.

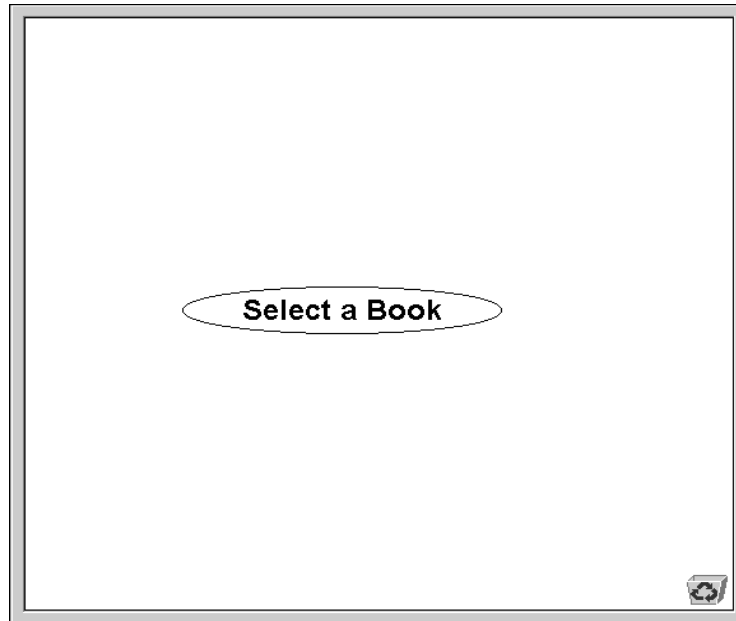
You'll find your files with the extension *.bst*. For example, this file is *book.bst*.

Step Four: Enter Your Alternatives



Your alternatives are the three books from which you will choose.

1. To the right of the window, under the word Alternative, click once in the first gray block.
2. Type *Jurassic Park*.
3. Press ENTER. When you press ENTER, the insertion point drops down to the next gray block and is ready for you to make an entry.
4. Type *Fried Green Tomatoes* and repeat #3.
5. Type *100 Years of Solitude* and repeat #3.
6. Click once anywhere on the canvas area to get out of Alternatives.

Step Five: Enter Decision Criteria

If you organize easily while you think, you might choose an organized way to enter information on the Brainstorm canvas. However, because the Brainstorm function can be used to help you form and organize ideas, we show you a less organized approach to entering your criteria.

Let's say you like books that are at least exciting, humorous, and educational, but you also like mysteries. These criteria can be entered anywhere on the canvas. The following steps are a quick way to make your entries:

1. Double-click in the top left corner of the canvas away from the decision goal circle. An empty block appears with an insertion point inside.
2. Type *Exciting*.
3. Press ENTER to accept your criteria and to create another empty block.

4. Type *Humorous* and repeat #3.
5. Type *Educational* and repeat #3.
6. Type *Mystery*. This time, click outside the block to get out of the empty block creation mode.

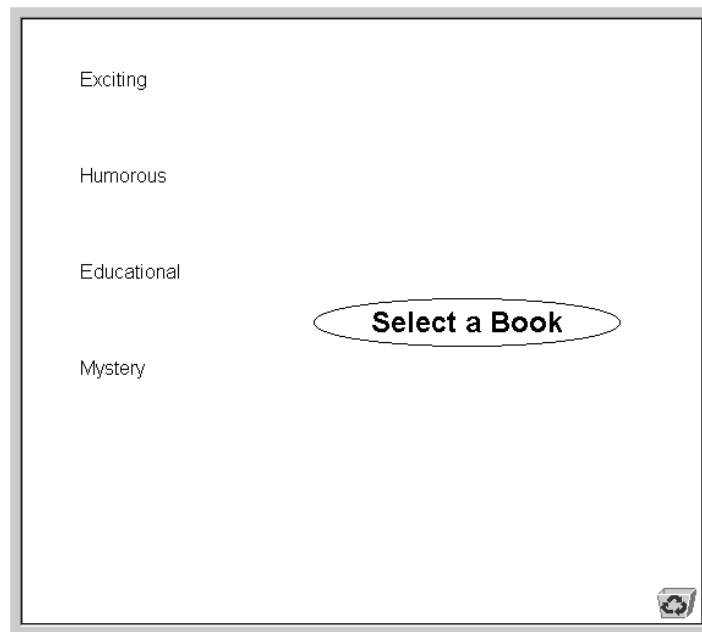
Note: If you prefer, another way to create a new block is to click outside each block after entering your criteria, then double-click in any area of the canvas.

Step Six: Save Your File

1. From the File menu, choose Save and name your (*.bst) file.

Step Seven: Create Canvas Space

If you followed numbers 1-6, your decision criteria are all queued one below another.



To make room for related criteria, move one to each of the four corners of the decision goal.

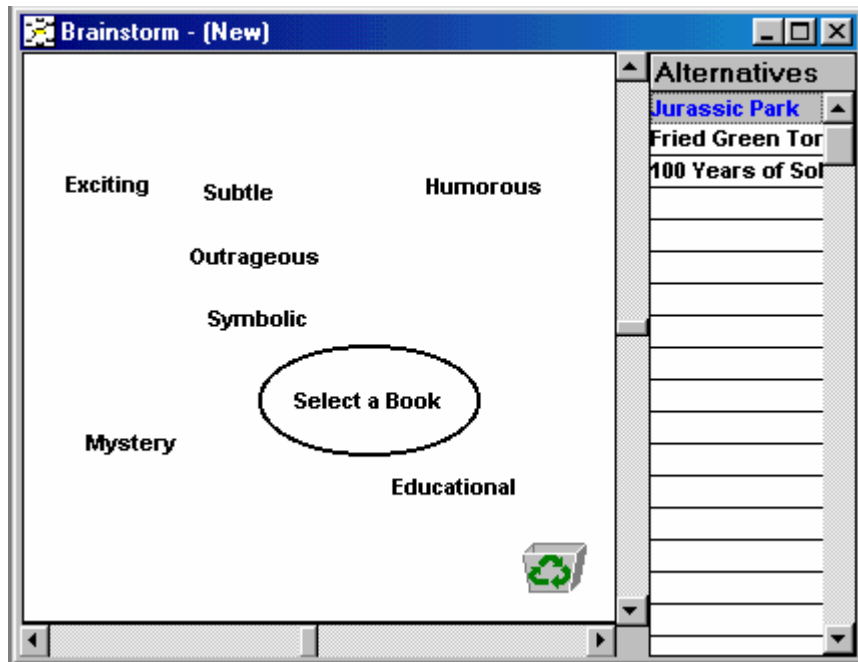
1. Click and hold down the left mouse button on *Humorous*. The criteria becomes surrounded by a gray shaded box. If you release the mouse button before we tell you, you'll have a surrounding handled box instead. That's okay.
2. Drag *Humorous* to the top right side of the canvas and release the mouse button. A gray box outline follows your cursor to the new spot. When you release the mouse button, *Humorous* appears in the new area with a surrounding handled box.
3. Click on *Educational* and repeat #2, dragging it to the lower right side of the canvas, below the goal.

Step Eight: Enter More Decision Criteria

Now that you think of it, you have several more ideas about what criteria influence your decision to read certain books. Of course there are different types of humor, education, and excitement that influence your decisions.

1. Double-click anywhere on the canvas to create an empty block. The area next to *Exciting* looks roomy, so let's put it there.
2. Type the following and press ENTER after each entry: *Subtle*, *Outrageous*, and *Symbolic*.

3. Click once outside the last block.



By now, you have all kinds of ideas you want to consider in your decision. To create even more space, turn off the Alternatives area of the window.

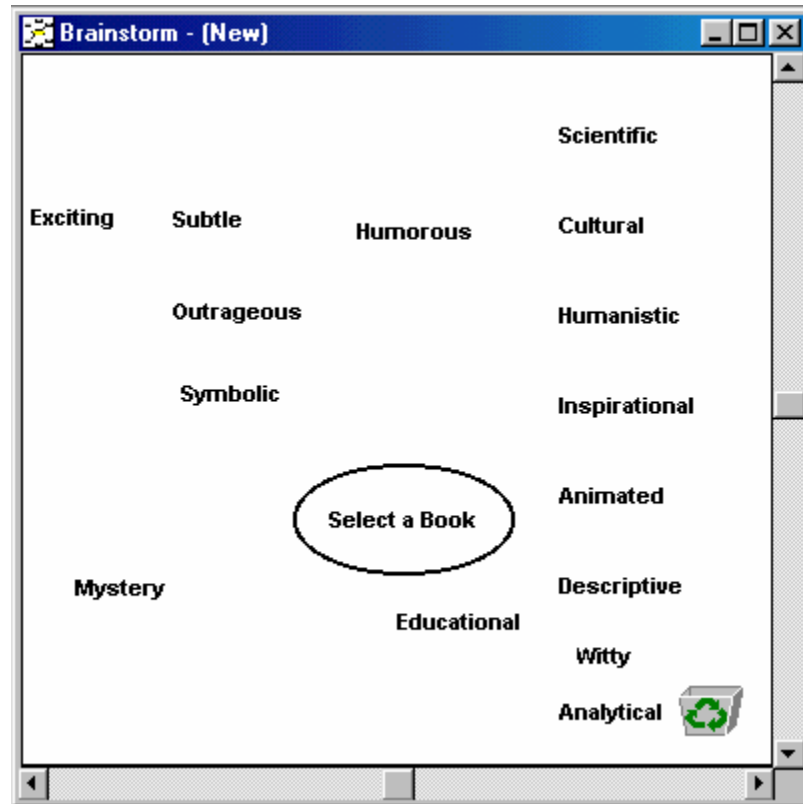
- From the View menu, click Alternatives. The right side of your canvas fills again with the list of alternatives.

Step Nine: Enter the last of your criteria

Note: Because PCs vary, more or fewer words may fit on your Brainstorm canvas before the window begins to scroll. If you find yourself running out of room to type, you can always click in another clear spot on the canvas and make your entries there. You can click and drag your criteria to make your model look like our illustrations.

1. Double-click in the top right side of the window where Alternatives used to be to create an empty block.
2. Type the following criteria and press ENTER after each entry: *Scientific, Cultural, Humanistic, Inspirational* (for some of you, your window will scroll up after this entry), *Animated, Descriptive, Witty, Analytical*. (For some of you, the goal has scrolled up off the window and you may be typing off the window. See “Tip” below.)

3. Click once outside the last block.



Tip: There are several ways you can handle the model if some of it has scrolled off the window:

- 1) Select Fit to Screen (or one of the % options) from the Zoom command on the View menu.
- 2) Use your scroll bars on the right and at the bottom of the window to recenter your goal on the canvas. However, your last entries might scroll off the bottom of the canvas.

- 3) Click and drag the last entries back up closer to the goal.
- 4) Use the Find Block option under the Edit menu. This option finds and centers the specified block, which means other entries scroll off the canvas.

Step Ten: Enter Notes

You could actually enter notes about your goal, criteria, or alternatives at the time you enter these items into your decision model. But you can also enter them at any time. If you want, follow the steps below to enter your notes, or go on to Step Eleven.

To Select Your Goal

- Click once on your goal to display a surrounding box.

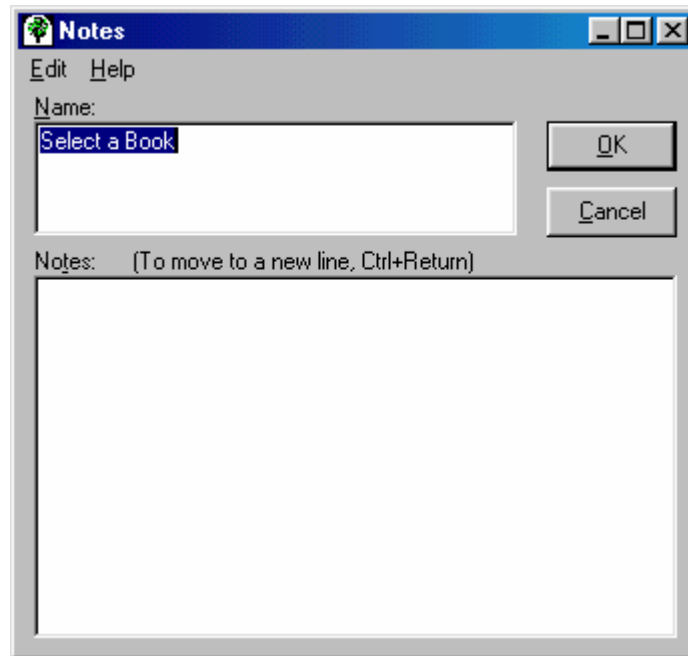
To Select a Criterion

- Single click *Humorous*, or any criteria, to get a box around it.

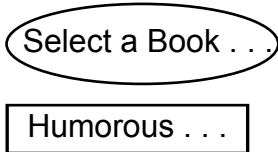
To Select an Alternative

- Click once in the gray block that says *Jurassic Park*, or any alternative, to get an insertion point inside the block.

To Display the Notes Box and Type Your Notes



1. With your item selected, press Ctrl+N to display the Notes box. The name of your goal, criteria, or alternative appears in the Name area and is highlighted.
2. Tab to or click in the Notes area to get an insertion point.
3. Type your message or notes.
4. Press ENTER or click OK. Your goal, criteria, or alternative appears back in their blocks followed by three dots that indicate they have notes attached. See the following examples.

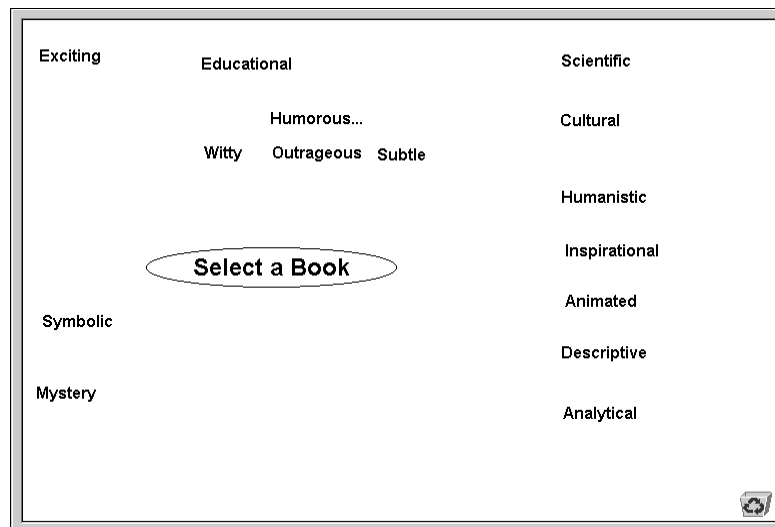


Step Eleven: Form Groups of Similar Decision Criteria

At this point, you feel your entries represent most of the criteria you want to consider in selecting a book. You can start forming groups and relationships of similar criteria. Some will be main criteria (parents), some will be subcriteria (children of the parents). Now we show you how to group and connect these criteria.

Witty, *Outrageous*, and *Subtle* are words you used to further describe *Humorous*. So, *Humorous* is a main criterion, or the parent, and the other three are subcriteria of *Humorous*. Let's make that association on the canvas.

1. Click and hold down the left mouse button on *Witty*, drag the word under *Humorous*, and release the mouse button. Do the same for *Outrageous* and *Subtle*.



2. Now, click and hold down the left mouse button on *Witty* and drag it to *Humorous*.
3. When the word *Humorous* lights up gray, release the mouse button. The word *Witty* resumes its original position, but now has a line connecting it to *Humorous*. (If it doesn't have a connecting line,

the connecting lines feature may be turned off. Select Connecting Lines from the View menu.)

4. Repeat #2 and #3 for *Outrageous* and *Subtle*. If you need to make room, you can drag out of the way any blocks necessary.

Step Twelve: Save Your File

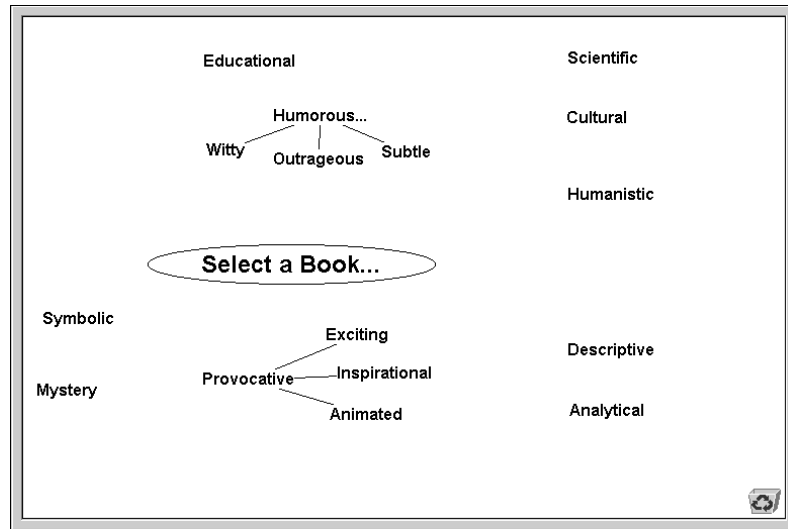
Step Thirteen: Group Subcriteria with Parent Criterion

Some ideas, or criteria, on the canvas may seem closely related to each other, but don't have a parent criterion to connect to them. They are orphans. *Exciting*, *Inspirational*, and *Animated* seem closely related to each other. Let's give them the parent "*Provocative*."

The following steps show you how to move *Exciting*, *Inspirational*, and *Animated* to a clear area on the canvas under *Select a Book*. Then we show you how to select them and give them their parent.

1. Click on *Exciting*, hold the left mouse button down, drag the word under *Select a Book*, and release the mouse button. Do the same for *Inspirational* and *Animated*, queuing them vertically.
2. To select *Exciting*, *Inspirational*, and *Animated*, click once on *Exciting* to get a box around it.
3. Move your cursor to *Inspirational*, press Ctrl and click once.
4. Move your cursor to *Animated*, press Ctrl and click once. Each criterion should have a box around it.
5. From the Edit menu, select Group. A Group Information box appears.
6. In the Name area, type *Provocative*.
7. Press ENTER or click OK.

Exciting, Inspirational, and Animated are now connected to and are subcriteria of the parent *Provocative*, which appears just to the left.



Step Fourteen: Save Your File

Step Fifteen: Store Unneeded Criteria in the Recycle Bin

At this point, you decide some of your criteria aren't really needed in this part of your model. For the time being, let's can store them in the Recycle Bin. You can drag them all at once, or one at a time. To drag them all at once:

1. Click once on *Descriptive* to display a box around it.
2. Hold down the Ctrl key and click once on *Analytical*.
3. Repeat #2 for *Symbolic* and *Mystery*.
4. When they are all enclosed in boxes, drag one to the Recycle Bin at the bottom of the canvas. The Recycle Bin displays paper in the top of the bin to indicate items are stored inside.
5. To see your recycled information, double-click on the Recycle Bin, or select Recycle Bin from the View menu.

Step Sixteen: Establish Remaining Relationships

Now that you've seen a couple of ways to connect criteria and form criterion-subcriteria relationships, we'll have you connect the remaining criteria to each other and to the Goal.

Note: DecisionPlus remembers the order in which you drag one block onto another, and makes the criterion-subcriterion identification based on that order. Always drag the block you wish to be the subcriterion onto that block you wish to be the parent criterion.

1. Click and drag *Educational* closer to the goal circle. When you reach the position you want, release the mouse button.
2. Click and drag *Educational* over the goal oval. When the goal turns gray, release the mouse button. *Educational* resumes its original position, becomes gray large letters, and has a line connecting it to the goal. It is now a main criterion of the goal, *Select a Book*.
3. Click and drag *Cultural* to a spot above *Educational* and release the mouse button.
4. Repeat #3 for *Scientific* and *Humanistic*. dragging them above *Educational*, near *Cultural*.
5. Click and drag each subcriterion, one at a time, to *Educational* to connect them.

For the purposes of this tutorial, drag in this order: *Humanistic*, *Cultural*, then *Scientific*. This determines the order in which they appear in the Hierarchy window, which we will talk about soon.

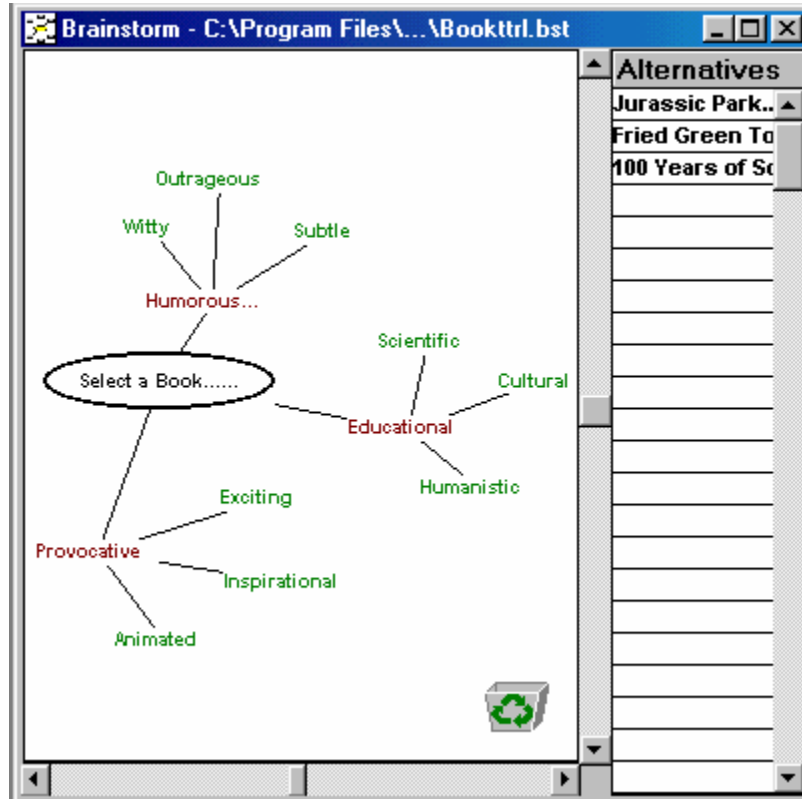
After each connection, the subcriteria turn to large green letters and are subcriteria of the parent criterion, *Educational*.

6. Click and drag *Provocative* over the goal circle as in #2 above. Its entire family of subcriteria becomes connected to the goal. *Provocative*, being the highest level criterion, is in large gray letters. *Exciting*, *Inspirational*, and *Animated*, the subcriteria of *Provocative*, are in large green letters.

- Click and drag *Humorous* over the goal circle as in #2 above. Its entire family also becomes connected to the goal.

Step Seventeen: Rearrange and Print Your Model

Your canvas may not look quite like ours, but that’s okay. You can click and drag anything on the canvas area until your canvas looks



similar to the illustration below. It isn’t necessary to rearrange your model before you can create a hierarchy, but you may want a readable copy if you print the Brainstorm results.

- To redisplay the Alternatives area, select Alternatives from the View menu.

2. To reduce the model to fit onto the canvas area, select Fit to Screen from the Zoom command on the View menu.

If you want to print your Brainstorm model,

1. Select Print from the File menu.
2. Select the options Single Item, Hierarchy Graph, Fit to One Page, Portrait.
3. Select Print.

Congratulations! You have finished formulating your ideas into your own decision model. You are ready to build your hierarchy in section II.

● Stopping Point

If you want, you can stop here and start again another time. Save your Brainstorm file and close the Brainstorm window.

- To save your document, select Save from the Brainstorm File menu.
- To close Brainstorm, select Close from the File menu, or select Close from the Control Menu.
- To close DecisionPlus, select Exit from the File menu.

If you want to continue now, save your Brainstorm file, but *do not* close your file or the Brainstorm window, and proceed with II - Building the Hierarchy, below.

II - Building the Hierarchy

The second part in building your decision model is building your hierarchy. In DecisionPlus, you can do this in two ways: you can generate it from a brainstorm file, or you can create it directly in the Hierarchy program.

In this tutorial, you “generate” the hierarchy from the brainstorm file you just created. Your Brainstorm file must be open.



This part of the tutorial takes 10 to 20 minutes, depending on your learning style.

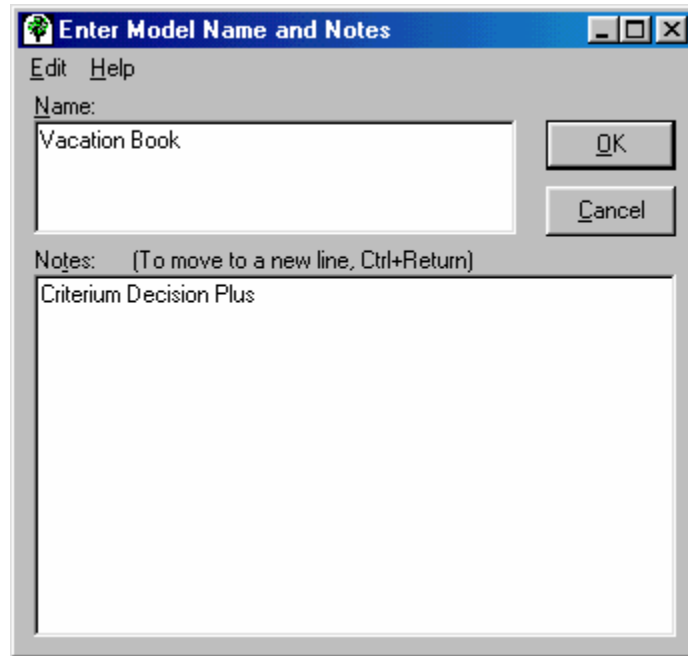
Step One: Display the Hierarchy Window

If you closed your Brainstorm file and are starting the tutorial again, open your Brainstorm file before proceeding. Select the .cdp file from the Open command in the File menu.

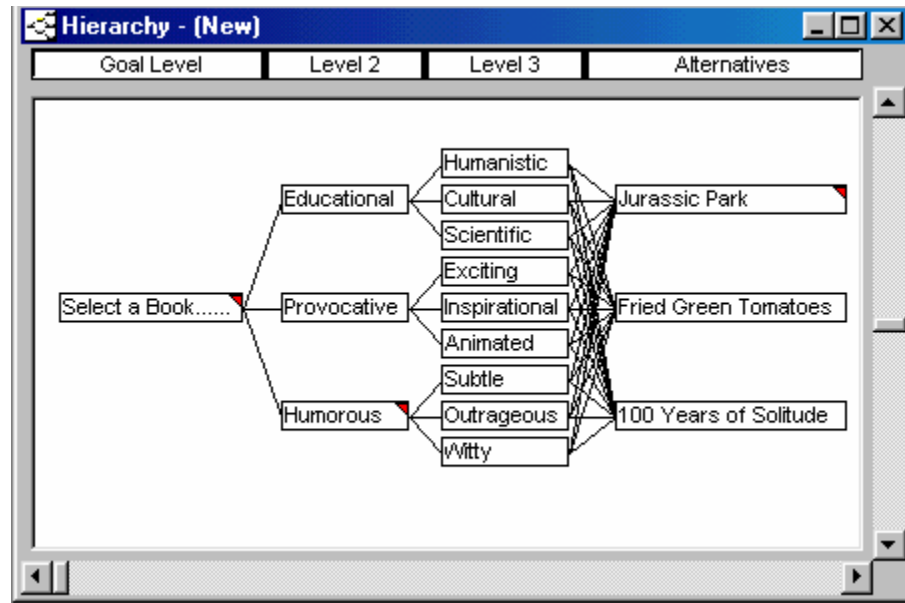
1. From the Brainstorm window, select Generate Hierarchy from the View menu. This automatically closes your Brainstorm file. If you did not save your Brainstorm file, you are prompted to save it.

The first window you see is an optional “Model Name and Notes” dialog box where you can name your Hierarchy model. Although you can name your model later if you prefer, let’s name your model now.

2. In the Name area, type *Vacation Book* and press ENTER or select OK. (Enter notes if you like.)



The following window displays with your model converted into a hierarchy according to your formulation in Brainstorm. The top of your window shows your model name, Vacation Book.



This hierarchy is not stored until you save it in Hierarchy and create a *.cdp* file. If you like, you can close this window *without* saving it, even if you already named your model, and reopen your Brainstorm file. Just select Close from the File menu (you'll be prompted to save and you can say No).

If you make changes in Brainstorm that you want reflected in the Hierarchy window, you'll need to regenerate a hierarchy. Once you save this file in Hierarchy, you have two separate files. Updating one does not update the other. You can use the same *.bst* file to create as many new hierarchy files as you want.

Note: If you connected some of your criteria a little out of order, your window may not look exactly like ours. However, the remaining instructions refer to the illustration above.

Step Two: Review Your Model

This is the point at which you can review your model to see if you included everything, to see if relationships between blocks make sense, and to see if your connections are sufficient. You can edit your decision model easily in the Hierarchy window by moving, adding, deleting, and renaming criteria and alternatives, and by adding and deleting levels.

The Hierarchy window lists your decision criteria in columns of levels. At the top of each column is a modifiable heading: Goal Level, Level 2, Level 3, and Alternatives. In columns from left to right is your goal *Select a Book*, followed to the right by the second level of your decision model, *Educational*, *Provocative*, and *Humorous*. Next is the third level of your decision model, the subcriterion of *Educational*, *Provocative*, and *Humorous*, followed by the last level, your alternatives. The lines between the blocks of criteria represent the connections you made in Brainstorm.

Step Three: Save Your New Hierarchy File

We think your model looks pretty good. If we were going to fine-tune the basic structure, this is where we'd do it. But first, you should save your file. Your filename can be the same as the one you used for the brainstorm file because this one will be saved with the .cdp extension.

Step Four: Add Criteria to Your Decision Model

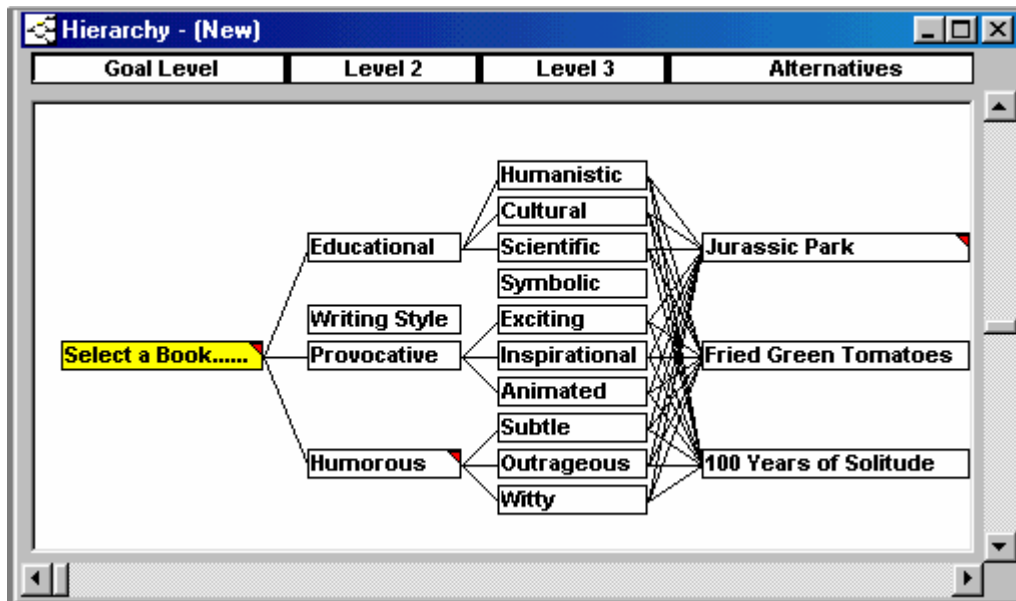
As you look at your hierarchy, you begin to wonder how your decision would turn out if you considered the *writing style* of the book. You can add this criterion easily in Hierarchy, so let's add it.

Where will you put *writing style*? First, consider what level of importance *writing style* might take on. Is it as important as *Education*, *Provocative*, and *Humor*, which are at Level 2, or is it perhaps a subcriteria of these criteria, which would have the same importance as criteria in Level 3. You decide it's just as important as *Education*, *Provocative*, and *Humor*, so let's enter it in Level 2.

1. Double-click just above *Provocative* in the Level 2 column. A yellow block appears with the word “Name” highlighted.
2. Type *Writing Style* and press ENTER.
3. Now double-click in the space between *Scientific* and *Exciting* in Level 3 (or, if your model is slightly different, between the third child of *Educational* and the first child of *Provocative*) to create another block.

Note: To make more space between these two blocks, all the blocks above the space you clicked move up. If these blocks were below the center of your model, all the lower blocks would move down.

4. Type *Symbolic* and press ENTER.



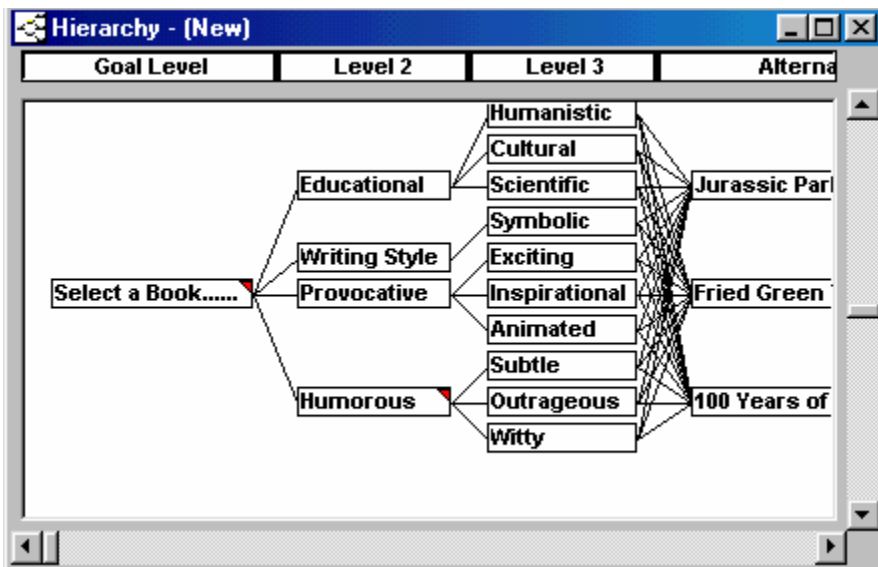
Step Five: Connect New Criteria

1. To connect *Writing Style* to the goal, click and drag until *Writing Style* overlaps the goal, and release the mouse button (in

Hierarchy, blocks don't turn gray when approached by the cursor or another block). A line appears, connecting the two blocks.

2. To connect *Symbolic* to *Writing Style*, click and drag either block to the other.
3. To connect *Symbolic* to the three alternatives, click once on the heading "Alternatives" to highlight all three alternatives, and drag one alternative block to *Symbolic*. Lines connecting *Symbolic* to all three alternatives appear.

Note: You can break these connections by repeating the same steps you used to connect the blocks.

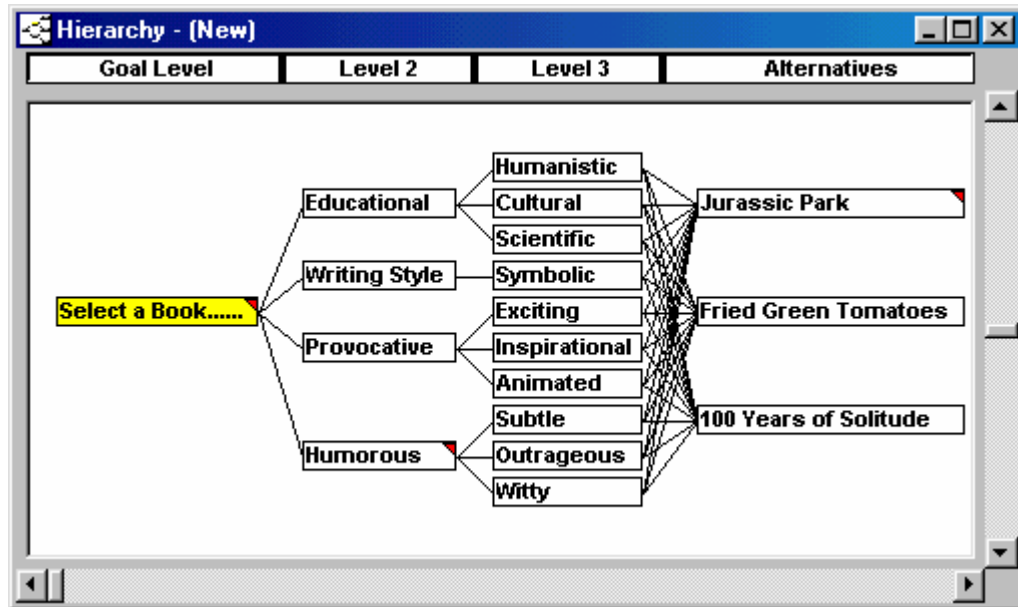


Step Six: Rearrange Your Model

Now, you'll notice that parts of the model have moved just a little off center (such as *Educational*). We can take care of that by rearranging the model.

Note: If at any time your model scrolls right off the window, to recenter your model, select Navigator from the View menu. Then follow the steps in “View the Navigator” in Step Eight later in this chapter.

1. From the View menu, select Arrange Blocks.



Step Seven: Delete the Writing Style Branch

On second thought, you don't really need to include *Writing Style* in your decision because you know that all three authors have a writing style you like. You can delete this branch easily.

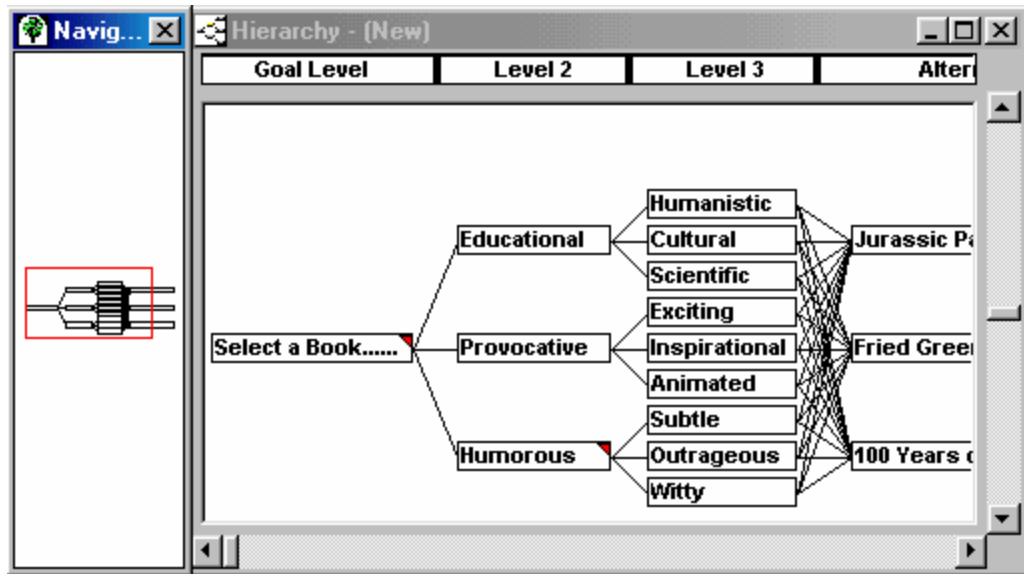
1. Click once on *Writing Style* to highlight it.
2. Move your cursor to *Symbolic*, hold down the Ctrl key and click once to highlight it also.
3. Release the mouse button.
4. Press the Delete key, or use the Delete Selection Command on the Edit menu. This leaves gaps in your model.

5. Select the Arrange Blocks option from the View menu. Your model should now look like it did upon first opening Hierarchy. Normally, if you were making several permanent changes, you'd save your file often.

Step Eight: View the Navigator

The Navigator is a small version of your model that you can display in the lower left corner of your Hierarchy window. This feature is useful for several reasons. You can see entire larger models that don't fit in the Hierarchy window. You can click in any area of the Navigator and the corresponding area in Hierarchy becomes centered on your window. If you've scrolled your model off the screen, a quick way to recapture it is to bring up Navigator and click on an area.

1. From the View menu, select Navigator. If you've highlighted any block in Hierarchy window, that block is also highlighted in the Navigator. You can size Navigator in the usual way by positioning the cursor on the edge of the window (the cursor will become a double-head arrow) and drag the window edge to the right size.
2. To close Navigator, select Close from the Control-Menu box in its upper left corner.



● Stopping Point

If you want, you can stop here and start again another time. Save your Hierarchy file and close the Hierarchy window.

- To save your document, select Save from the File menu.
- To close the Hierarchy, select Close from the File menu, or select Close from the Control Menu.
- To close DecisionPlus, select Exit from the File menu.

If you want to continue now, save your Hierarchy file, but *do not* close the Hierarchy window and proceed with III, Rating the Hierarchy, next.

III - Rate the Hierarchy

Your decision model looks impressive so far. It's time to start giving it some substance. We'll help you do that in this part of the tutorial by assigning weights to your model so you can produce some results. We need to decide how important your criteria are and how much weight each should contribute to the decision model. Then we need to score each alternative against those criteria.

We begin by rating the criteria directly connected to your goal, *Educational*, *Provocative*, and *Humorous*. This is called a *rating set*. Then we weight the subcriteria of *Educational*, then *Provocative*, and then *Humorous*. And finally, we score the alternatives. In this tutorial, there are a total of thirteen rating sets.

Weighting criteria and scoring alternatives requires four main activities:

- Choosing a rating method
- Selecting rating scale views
- Assigning rating scales
- Entering weights or scores



This part of the tutorial takes 30 to 60 minutes, depending on your learning style.

Step Zero: Select AHP Rating technique

This decision will be based on purely qualitative assessments of the merits of the books, and introducing new books might suggest great changes in the model. The Analytical Hierarchy Process is therefore likely to be the best technique to use in this case (see Chapter 10). Since DecisionPlus uses SMART as its default technique, let's change techniques.

1. In the Hierarchy window, click the Model menu to reveal its contents.

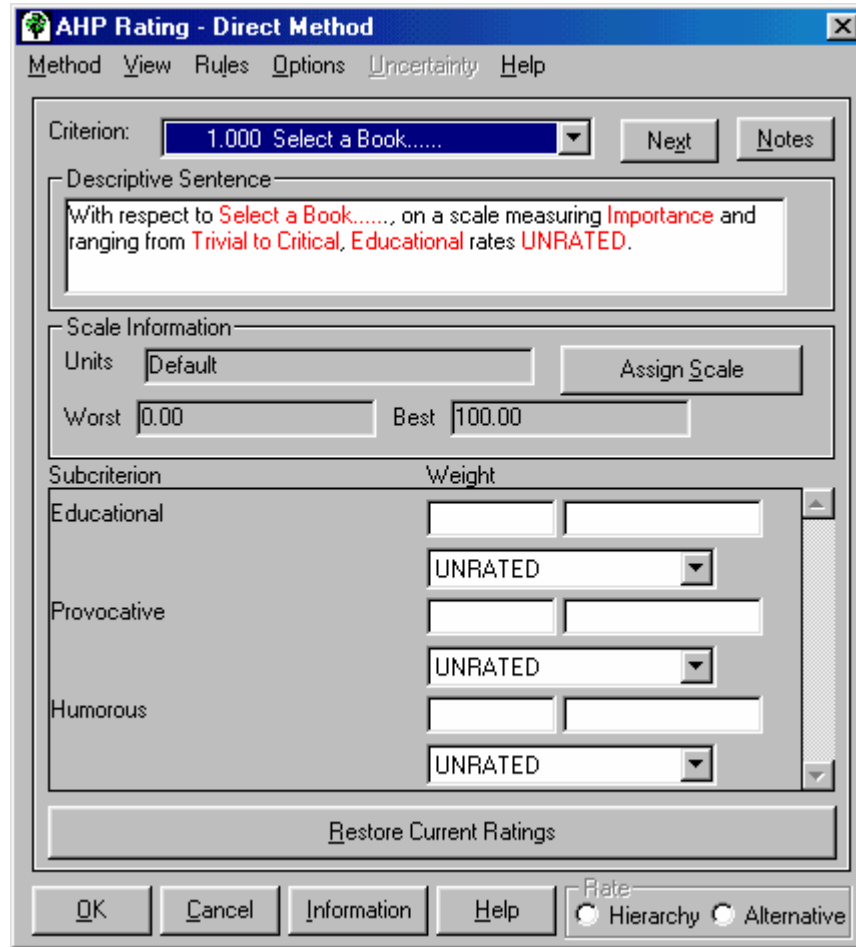
2. Click Technique and choose the AHP item.

Step One: Display the Criterion Rating Window

The Criterion Rating window is where you perform the main activities in weighting your criteria. You should have your decision model active in the Hierarchy window. If your Hierarchy model is closed, open it (your *.cdp* file) from the Open command on the File menu.

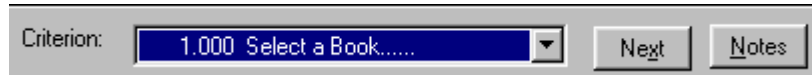
1. In the Hierarchy window, click once on your Goal block, *Select a Book*, to highlight it.
2. From the Block menu, select Rate Subcriteria. You are entering weights for the subcriteria of the goal, *Select a Book*.

Note: A criterion block must be selected before you can display the Criterion Rating window.

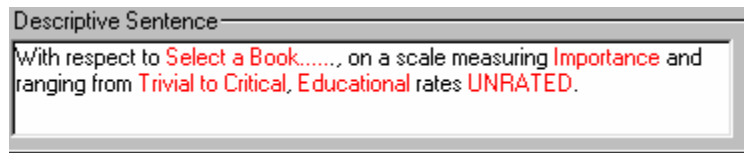


On the Title bar, the window name *AHP Criterion Rating - Direct Method* appears. (Direct Method is a rating method and is described in Step Two, “Select a Rating Method,” after this window description.)

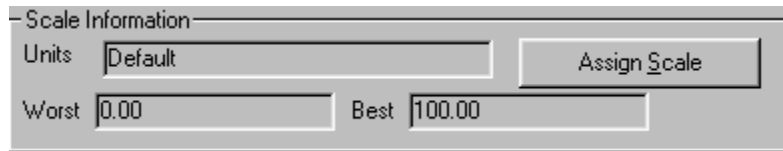
The name of your goal appears in the **Criterion** box with the number 1.000 preceding it. This represents the highest ranked of the unrated criteria and the most important of the decision model.



Below the Criterion box is the **Descriptive Sentence**, describing the rating logic of the verbal rating scale you assign. The Importance scale is the default scale. In this example, no criteria are rated yet, which is reflected in the Descriptive Sentence on your screen. Our illustration below shows a rated example. If you do not have Verbal Scale view selected, the Descriptive Sentence does not display.



The next area shows the **Scale Information** of the scale for the primary view you have chosen (or in this case, the default numerical scale). You choose the scale you want to assign through the **Assign Scale** button.



The major portion of the Criterion Rating window is the **Subcriterion/Weight** area where you enter weights and are able to view them in up to three different ways. You can view your weights in

Numerical, Verbal, or Graphical views, or in all three at once, as is shown when you first enter the window.

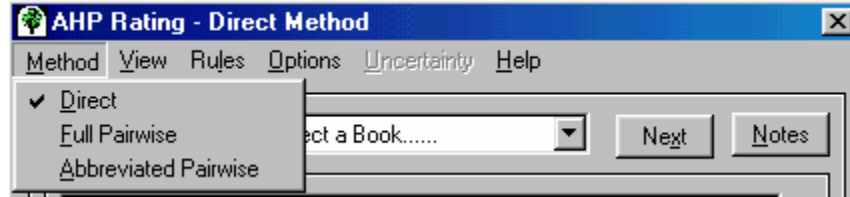
Educational	<input type="text"/>	<input type="text"/>	UNRATED
Provocative	<input type="text"/>	<input type="text"/>	UNRATED
Humorous	<input type="text"/>	<input type="text"/>	UNRATED

Below is an illustration of all three views reflecting assigned weights.

Subcriterion	Weight		
Educational	34.34	<input type="text"/>	Unimportant
Provocative	55.87	<input type="text"/>	Important
Humorous	94.33	<input type="text"/>	Critical

- **Choosing a Rating Method**

Three rating methods are available on the Method menu: Direct Comparison, Full Pairwise Comparison, and Abbreviated Pairwise Comparison. We describe and show you how to access each method, but for this tutorial we enter the weights using only one method.



Direct Comparison is used to enter quantitative data about each criterion. Usually these values come from a previous analysis or from experience and detailed understanding of the decision problem. Direct Comparison is the default rating method for the Criterion Rating window, and is the name you see in the title bar.

Full Pairwise Comparison means comparing in pairs and is useful if you lack quantitative data about each criterion, or if you feel strongly or similarly about most of your criteria. Each criterion in a rating set is compared to every other criterion in the same set. It's easy to enter weights using this method because all criteria in the same set are verbally compared against each other, and because you can measure using a scale of 17 verbal weights ranging from Absolutely Better to Absolutely Worse.

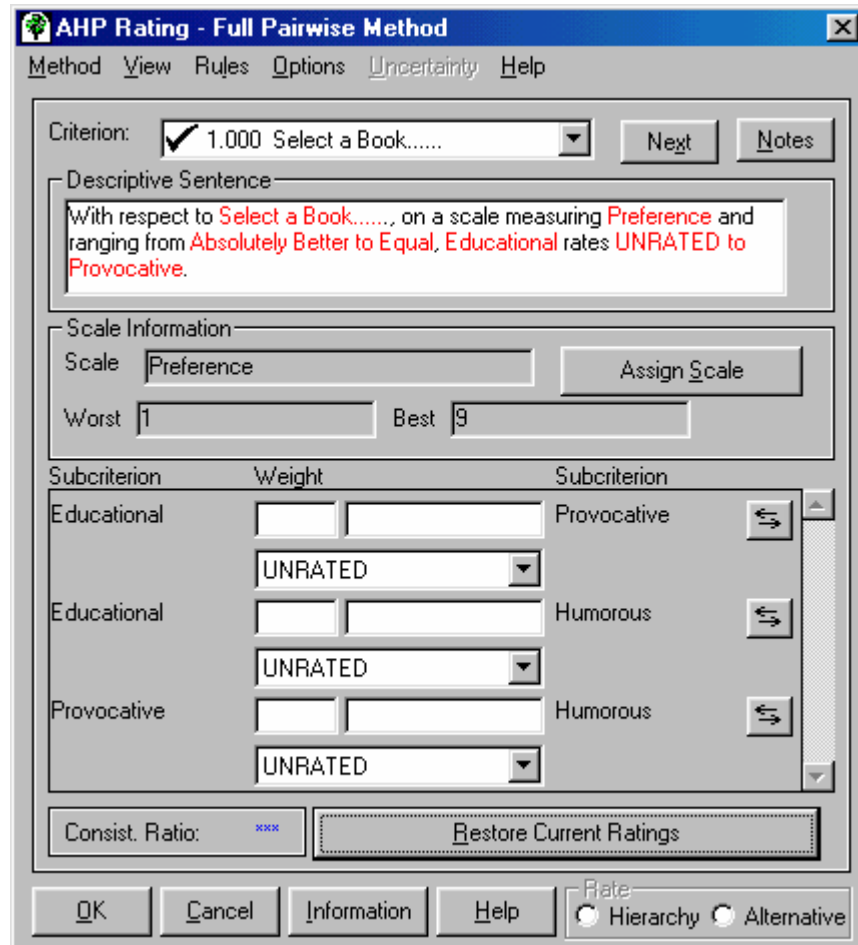
Abbreviated Pairwise Comparison is similar to Full Pairwise Comparison except that you work in smaller sets. It omits comparisons that are obvious. For example, if A is better than B, and B is better than C, then A is also better than C. The latter comparison is omitted.

Step Two: Select a Rating Method

1. From the Criterion Rating window, select the Method menu. The method we want, Direct, is already selected and indicated with a

check mark in front of it. If we were to select one of the pairwise comparisons, we would select it here.

- To practice selecting a rating method, select Full Pairwise to see how your window changes to the following illustration.

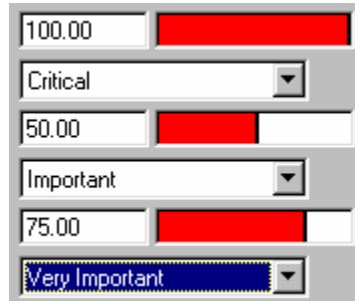


(Details about the Full Pairwise and Abbreviated Pairwise methods are in Chapter 10, Rate the Hierarchy.)

3. Select the Direct method again from the Method menu before continuing in this tutorial.

- **Selecting Rating Scale Views**

DecisionPlus provides three scale views in which you can enter your weights: Numerical, Verbal, and Graphical. All three views appear in the Criterion Rating window when you first open the window. Below, we describe the scale views.



The views show, in their own measurement, the weight you assign for each criterion. In addition to viewing these scales, this is where you actually enter the weights, which we will get to later in Entering Weights. If you change a value in one view, the other two views (if you have them displayed) reflect the equivalent value in its own measurement scale.

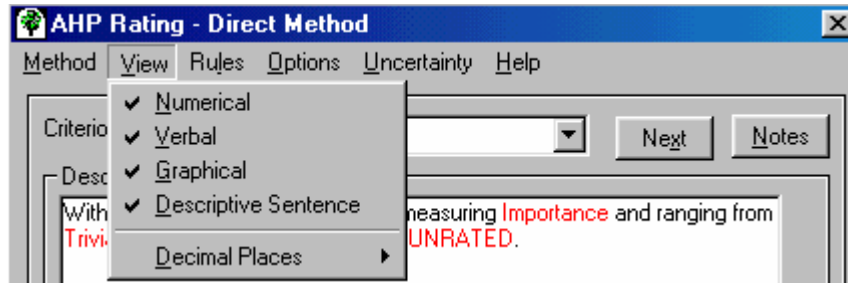
Numerical shows your rating in numbers. The illustrated numerical scale above ranges from *0.00* to *100.00*.

Verbal shows your rating in words. The illustrated verbal scale above ranges from *Trivial* to *Critical*, and corresponds to the numerical scale 0.00 to 100.00.

Graphical shows you a bar illustration of both the numerical and verbal values. You can't assign a graphical scale, it is unique.

Step Three: Select a Rating Scale View

1. Select the View menu. The views we want to use in this tutorial are already selected and are marked with a check mark.



Even though we use all three views in this tutorial, go ahead and click a couple of views to turn them on and off and observe the effect on the Subcriterion/Weight area. When you turn off Verbal, Descriptive Sentence automatically turns off.

2. From the View menu, be sure all three scale views and the Descriptive Sentence are selected and appear in the Subcriterion/Weight area before continuing with this tutorial.

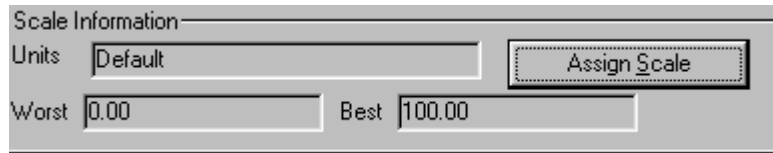
- **Assigning Rating Scales**

Numerical and Verbal have different scale measurements, called types, that you can assign. Now, we'll show you how to assign a different scale type. (Details about selecting the appropriate scales for your own decision problems are in Chapter 10, Rate the Hierarchy.)

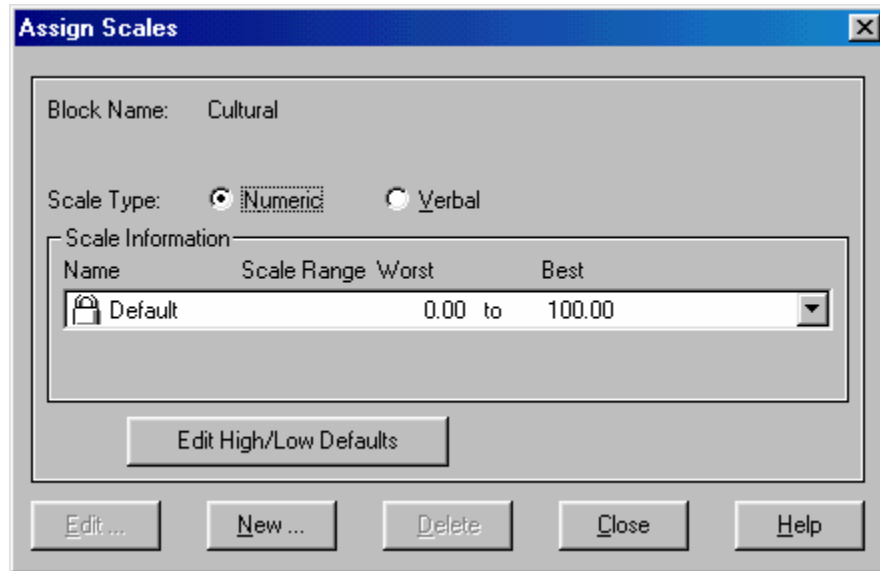
Step Four: Assign a Rating Scale

Assigning a Numerical Scale

1. Select the Assign Scale button in the Scale Information area to display the Assign Scales window.



The following window displays.



In the Scale Type area, Numeric is selected as the default and in the Scale Information area, the name and the range for the default scale appears. (If the Numeric Scale Type is not available, select Numerical from the View menu.)

2. In the Scale Information area, click once on the list box down arrow to see five system-designed numerical scales and their measurement ranges.

3. To practice selecting a scale, click once on Rank to select it.
4. Select the Close button to return to the Criterion Rating window. Your Scale Information area on the Rating window now reflects the Rank scale information.
5. Select the Assign Scale button again.
6. Click the list box down arrow again.
7. Select the Default scale. We are using this numerical scale to enter our weights.

Assigning a Verbal Scale

If you like, you can use these procedures also to practice selecting a different Verbal scale. When the Scale Type area first displays, it always defaults to Numerical.

1. For Scale Type, select Verbal. The Scale Information area changes to display the default Verbal scale, Importance.
2. In the Scale Information area, click once on the list box down arrow to display six system-designed verbal scales and their measurement ranges, then follow the steps above to select a new system verbal scale. (Your verbal scale selection also is reflected in the Descriptive Sentence area.)
3. If you practiced selecting a different Verbal scale, please return the display to the Importance scale before continuing with this tutorial.

Note: If you want to see how assigning scales affects existing weights, you can repeat Assigning a Numerical (or Verbal) Scale exercises after you enter some weights.

Assigning a Graphical Scale

The Graphical scale has only one view: the bar view. You can't assign a different graphic scale. You can adjust the bar (thereby adjusting

your weight) by clicking in, or clicking and dragging to, a different area of the bar.

Details for creating your own Numerical or Verbal scales are in Chapter 10, Rate the Hierarchy.

- **Entering Weights and scores**

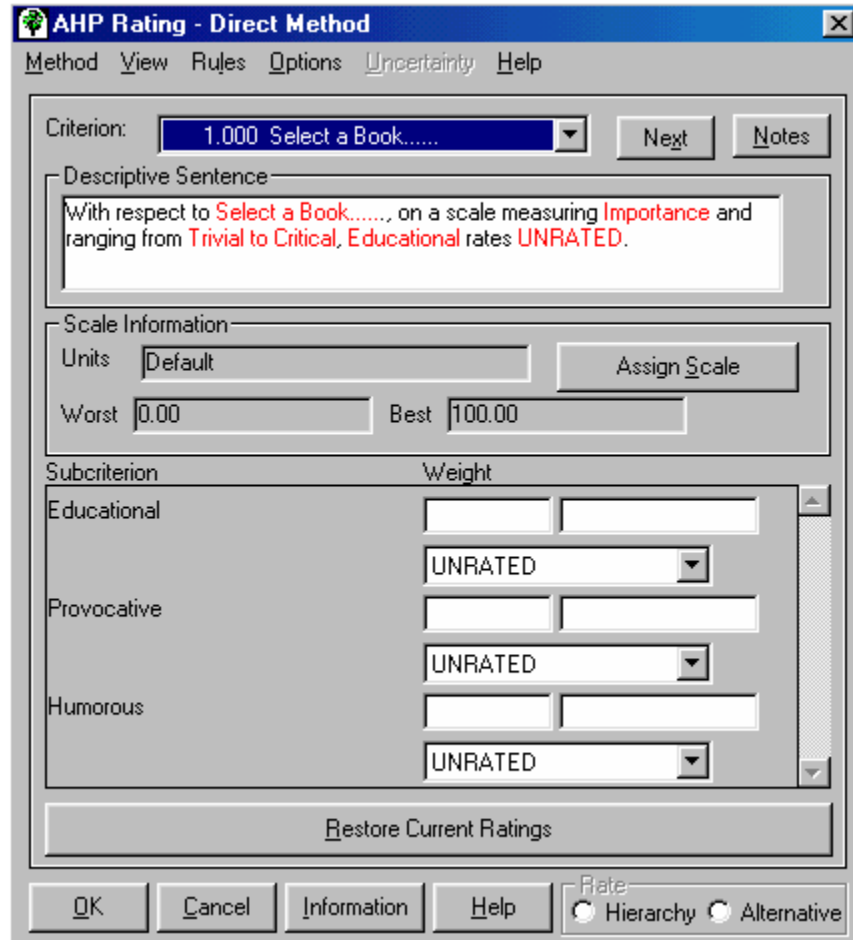
Step Five: Enter Weights for Your Criteria

Although you can begin rating (entering weights to) any rating set you want, we begin with the set ranked as the most important in your decision model, your goal. When we finish rating all the children of this set, we display and rate the next set.

Be sure all three rating views and the descriptive sentence are visible as shown in the following illustration. If they are not, select them from the View menu.

Rating Carefully

DecisionPlus doesn't let you miss a rating, but it can't tell if you've assigned the right value. If you enter a value other than the value we list, the next result may not be the same as illustrated. In this case, you can start over, or you can edit the previous rating sets. Instructions for starting over are in the next paragraph, and instructions for editing previous rating sets are described after Rating Set One.



Starting Over

If at any time you want to start over, you can use the Cancel button at the bottom of the Rating window (a message appears, asking in essence if you want to erase what you just entered — select Yes). You can also close the Rating window and return to the Hierarchy window, close the file without saving it, then reopen the file. The Restore

Current Ratings button erases your entries to the ratings set currently showing in your window.

Okay, let's roll up our sleeves and get to work. You know that selecting a good book means having one or all of the three subcriteria listed in the Subcriteria/Weight area. However, as far as their contribution to the decision, you feel the strongest about *Humorous*, less strongly about *Provocative*, and least strongly about *Educational*. Let's enter equivalent weights using the default Verbal Scale, Importance.

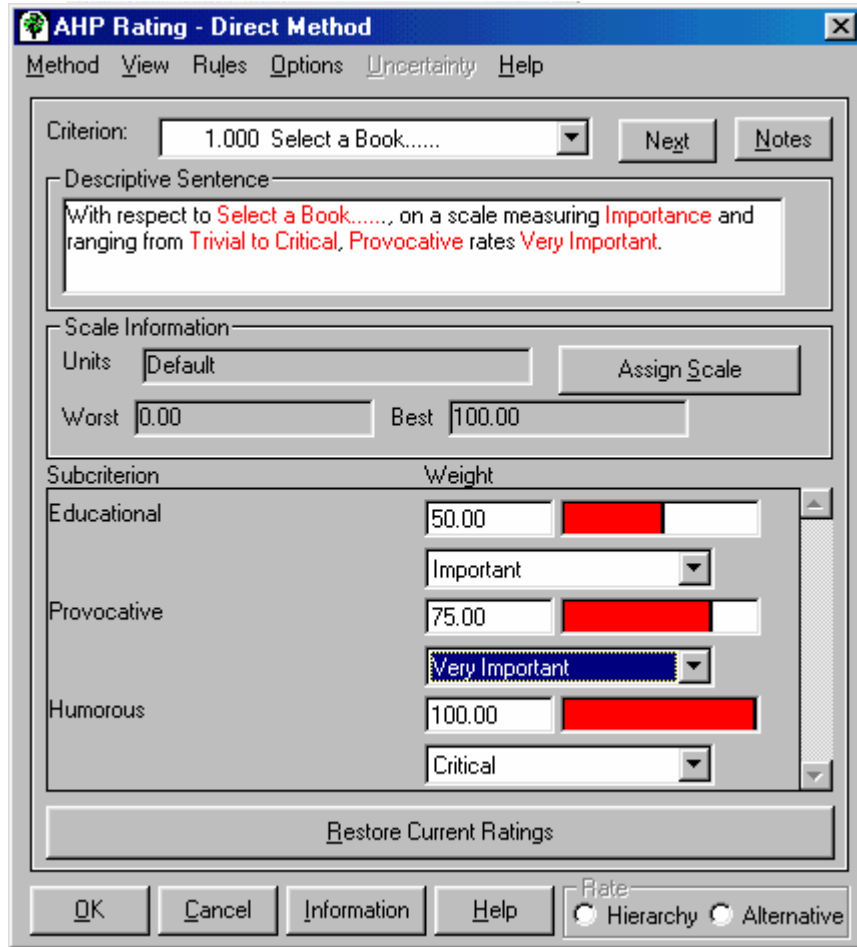
Rating Set One

Select a Book

- Educational
- Provocative
- Humorous

1. For each of the three subcriteria, we instruct you to click the list box down arrow, where "UNRATED" appears, to display the available verbal choices. If you prefer working with numbers, beginning with Rating Set Two below, we give you the equivalent numerical value to type into the Numerical scale.
2. To rate *Educational*, select Important. Important replaces "UNRATED" in the Verbal view. The Numerical view also changes, reflecting 50, and the Graphical view is filled in about half way.
3. To rate *Provocative*, select Very Important. Very Important replaces "UNRATED" in the Verbal view. The Numerical view also changes, reflecting 75, and the Graphical view is filled in about three quarters of the way.
4. To rate *Humorous*, select Critical. Critical replaces "UNRATED" in the Verbal view. The Numerical view also changes, reflecting 100, and the Graphical view is filled completely.

After you rate the last subcriterion of this rating set, Select a Book, listed in the Criterion box, gets a check mark.



Rating Set Two

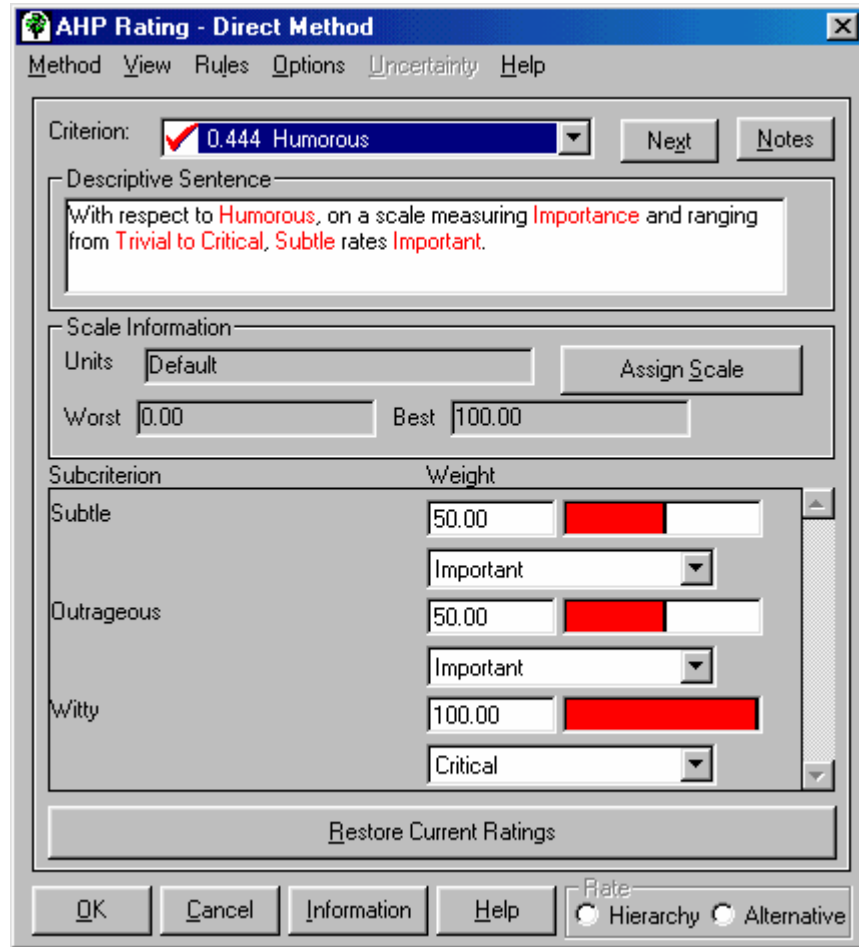
Humorous

— Subtle

— Outrageous

— Witty

1. Select the Next button at the top of the Rating window. Because you rated *Humorous* extremely high (Critical) in the first rating set, it becomes the next important criterion. Therefore, DecisionPlus assumes you want to rate its subcriteria next.
2. To rate *Subtle*, select Important or click in the Numerical view and type 50.
3. To rate *Outrageous*, select Important also, or click in the Numerical view and type 50.
4. To rate *Witty*, select Critical, or click in the Numerical view and type 100.



After you rate the last subcriterion of this rating set, *Humorous* gets a check mark beside it, indicating that it is fully rated. Click the Next button and you should find that *Provocative* is the next criterion to be rated. Go on to Rating Set Three, unless *Provocative* did not come up next.

Checking Previously Rated Rating Sets

If *Provocative* didn't come up next for you, check your previous rating set by redisplaying and editing the rating set in the Rating window. Use the following steps at any time to check previously rated rating sets.

1. Click on the Criterion list box down arrow.
2. Select the rating set you want (in this case, *Provocative*). The rating set redisplay in the Subcriteria/Weight area of the Rating window.
3. Compare your ratings against those suggested by us.
4. To change the weight of a subcriterion, click the Verbal scale down arrow and select the correct weight. Or, click in the Numerical scale box and type the correct numerical weight.
5. Select the Next button.

The correct rating set should display in the Rating window. If this is not the case, if you want, you can start over following the Starting Over instructions at the beginning of this section.

Rating Set Three Provocative

- Exciting
- Inspirational
- Animated

1. Select the Next button at the top of the Rating window. *Provocative* is the next criterion rating set, because in the first round you rated it as Very Important, second to *Humorous*, which was Critical.
2. To rate *Exciting*, select Critical (100).
3. To rate *Inspirational*, select Very Important (75).
4. To rate *Animated*, select Important (50).

Now *Provocative* gets a check mark.

Rating Set Four

Witty

- Jurassic Park
- Fried Green Tomatoes
- 100 Years of Solitude

1. Select the Next button. *Witty* is the next criterion rating set.

AHP Rating - Direct Method

Method View Rules Options Uncertainty Help

Criterion: 0.222 Witty [Next] [Notes]

Descriptive Sentence
 With respect to **Witty**, on a scale measuring **Importance** and ranging from **Trivial to Critical**, **Jurassic Park** rates **UNRATED**.

Scale Information
 Units: Default [Assign Scale]
 Worst: 0.00 Best: 100.00

Alternative	Score
Jurassic Park	[] [] UNRATED
Fried Green Tomatoes	[] [] UNRATED
100 Years of Solitude	[] [] UNRATED

[Restore Current Ratings]

[OK] [Cancel] [Information] [Help] Rate: Hierarchy Alternative

Notice some changes here. You might have expected to see *Educational* as the next rating set, but instead, you see *Witty*. *Witty* is not on the same level as *Provocative* and *Humorous* in your Hierarchy model. This change in order occurs because *Witty* received the highest rating, Critical, in Rating Set Two. DecisionPlus considers *Witty* now to have a greater contribution to the decision model than the remaining subcriteria and should be rated next.

The alternatives in the model are directly connected to *Witty*. We call criteria in this position *lowest criteria*. The rating set of lowest criteria are always alternatives. This brings us to our next point. When rating the lowest criteria in a decision model, the Rating window changes headings in the Subcriterion/Weight area. The word Subcriterion changes to **Alternative**, and Weight changes to **Score**. In AHP, when you rate alternatives, you are scoring how much of each criterion the alternatives have. In other words, we heard that *100 Years of Solitude* has a fair amount of wit. Although we should choose another verbal scale here to rate this, we can convert “fair amount of wit” to a Very Important amount of wit.

So, what happened to *Educational*? DecisionPlus assumes that because you rated it in Rating Set One as the least important of the three subcriteria, and you rated *Witty* so high in Rating Set Two, *Educational* has the least contribution to the model and can be rated later. DecisionPlus assumes your time is best spent rating the most important criteria in your decision model first.

2. To rate *Jurassic Park*, select Trivial (0).
3. To rate *Fried Green Tomatoes*, select Important (50).
4. To rate *100 Years of Solitude*, select Very Important (75).

Rating Set Five

Educational

- Humanistic
- Cultural
- Scientific

1. Select the Next button. *Educational* is the next criterion rating set.
2. To rate *Humanistic*, select Important (50).
3. To rate *Cultural*, select Unimportant (25).
4. To rate *Scientific*, select Very Important (75)

Rating Set Six

Exciting

- Jurassic Park
- Fried Green Tomatoes
- 100 Years of Solitude

1. Select the Next button. *Exciting* is the next criterion rating set.
2. To rate *Jurassic Park*, select Critical (100).
3. To rate *Fried Green Tomatoes*, select Important (50).
4. To rate *100 Years of Solitude*, select Unimportant (25).

Rating Set Seven

Inspirational

- Jurassic Park
- Fried Green Tomatoes
- 100 Years of Solitude

1. Select the Next button. *Inspirational* is the next criterion rating set.
2. To rate *Jurassic Park*, select Very Important (75).
3. To rate *Fried Green Tomatoes*, select Important (50).
4. To rate *100 Years of Solitude*, select Critical (100).

Rating Set Eight

Subtle

- Jurassic Park
- Fried Green Tomatoes
- 100 Years of Solitude

1. Select the Next button. *Subtle* is the next criterion rating set.
2. To rate *Jurassic Park*, select Very Important (75).
3. To rate *Fried Green Tomatoes*, select Important (50)
4. To rate *100 Years of Solitude*, select Trivial (0).

Rating Set Nine

Outrageous

- Jurassic Park
- Fried Green Tomatoes
- 100 Years of Solitude

1. Select the Next button. *Outrageous* is the next criterion rating set.
2. To rate *Jurassic Park*, select Very Important (75).
3. To rate *Fried Green Tomatoes*, select Critical (100).
4. To rate *100 Years of Solitude*, select Trivial (0).

Rating Set Ten

Scientific

- Jurassic Park
- Fried Green Tomatoes
- 100 Years of Solitude

1. Select the Next button. *Scientific* is the next criterion rating set.
2. To rate *Jurassic Park*, select Critical (100).
3. To rate *Fried Green Tomatoes*, select Unimportant (25).
4. To rate *100 Years of Solitude*, select Important (50).

We're almost finished!

Rating Set Eleven

Humanistic

- Jurassic Park
- Fried Green Tomatoes
- 100 Years of Solitude

1. Select the Next button. *Humanistic* is the next criterion rating set.
2. To rate *Jurassic Park*, select Important (50).
3. To rate *Fried Green Tomatoes*, select Very Important (75).
4. To rate *100 Years of Solitude*, select Very Important (75).

Rating Set Twelve

Animated

- Jurassic Park
- Fried Green Tomatoes
- 100 Years of Solitude

1. Select the Next button. *Animated* is the next criterion rating set.
2. To rate *Jurassic Park*, select Critical (100).
3. To rate *Fried Green Tomatoes*, select Important (50).
4. To rate *100 Years of Solitude*, select Unimportant (25).

Rating Set Thirteen

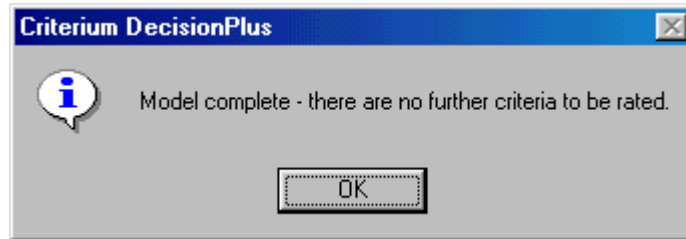
Cultural

- Jurassic Park
- Fried Green Tomatoes
- 100 Years of Solitude

1. Select the Next button. *Cultural* is the next criterion rating set.
2. To rate *Jurassic Park*, select Unimportant (25).
3. To rate *Fried Green Tomatoes*, select Very Important (75).
4. To rate *100 Years of Solitude*, select Important (50).

Step Six: Complete the Ratings

When you select the rating for 100 Years of Solitude in this rating set, you have completed rating your decision model and when you select Next, you see the following message.



1. Select OK or Press ENTER. The Rating window stays open.
2. On the Rating window, select the OK button at the bottom of the window to store your ratings. The Hierarchy window displays. Your ratings are still stored, but not saved.

Step Seven: Save Your Ratings

- Select Save from the Hierarchy File menu.

What a task! But now you have something to show for your careful work.

● Stopping Point

If you want, you can stop here and start again another time. Save your Hierarchy file and close the Hierarchy window.

- To save your document (if you have not already), select Save from the Hierarchy File menu.
- To close Hierarchy, select Close from the File menu, or select Close from the Control Menu.
- To close DecisionPlus, select Exit from the File menu.

If you want to continue now, save your Hierarchy file, but *do not* close your file or the Hierarchy window and proceed with IV, Selecting the Best Alternative, below.

IV - Selecting the Best Alternative

The results of your decision model should come out close to what you expected from the start. The book with the highest score should be the likely choice based on the criteria you weighted the highest. If you get completely unexpected results, you should check your model structure, weights and scores.

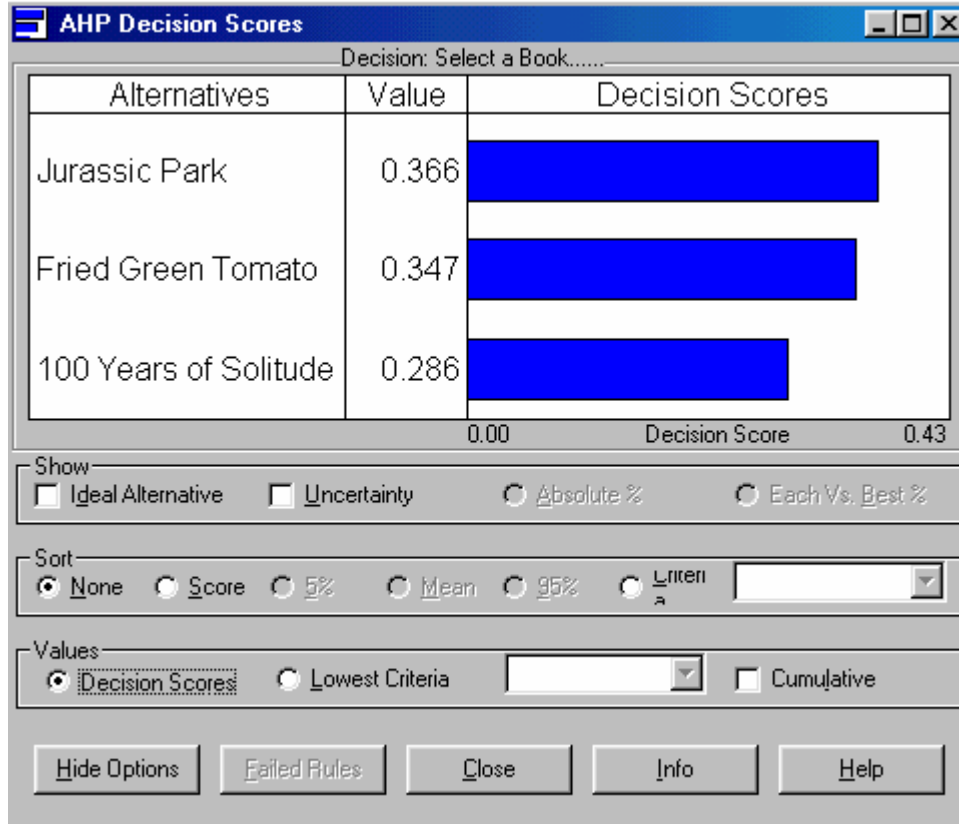
In this section, you'll have DecisionPlus calculate your results automatically when you select the Decision Scores window.



This part of the tutorial takes about 10 minutes.

Step One: Display the Decision Scores

- From the Hierarchy menu, select Decision Scores from the Results menu. The following Decision Scores window below displays showing the results of your decision model.



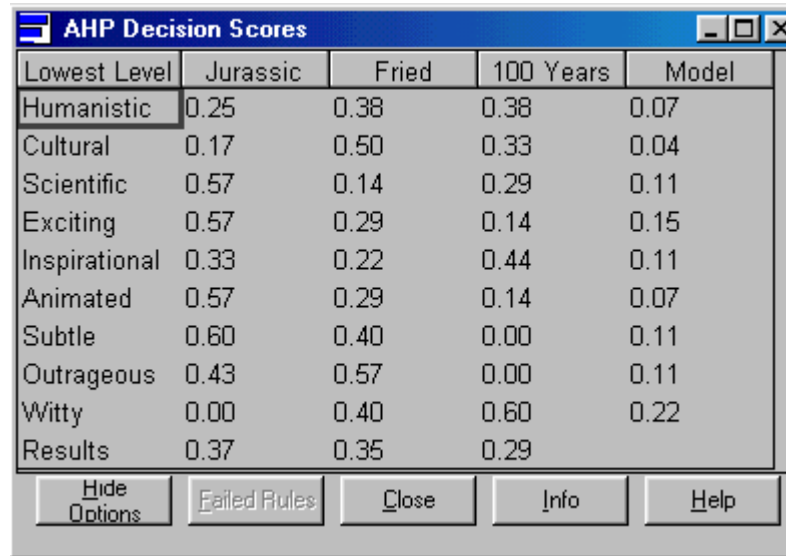
This view shows your alternatives in the order they appear (vertically) in your Hierarchy. Jurassic Park is the winner, or the preferred alternative, although not by a large margin. We'll show you what that can mean later in this chapter.

Clicking the **Scores** option in the **Sort** option rearranges your graph results from highest decision score to lowest. In this small model, they just happen to be in that order, so your display won't change if you select this option.

To Display the Results Data window

If you prefer to see the decision scores in a spreadsheet, you can do that easily by selecting it from the View menu in the Decision Scores window.

1. In the Decision Scores window, select Results Data from the View menu to display the results in a spreadsheet.



Lowest Level	Jurassic	Fried	100 Years	Model
Humanistic	0.25	0.38	0.38	0.07
Cultural	0.17	0.50	0.33	0.04
Scientific	0.57	0.14	0.29	0.11
Exciting	0.57	0.29	0.14	0.15
Inspirational	0.33	0.22	0.44	0.11
Animated	0.57	0.29	0.14	0.07
Subtle	0.60	0.40	0.00	0.11
Outrageous	0.43	0.57	0.00	0.11
Witty	0.00	0.40	0.60	0.22
Results	0.37	0.35	0.29	

Buttons: Hide Options, Failed Rules, Close, Info, Help

Your results may be arranged differently in this display, and the numbers should be close. That's okay. Major differences mean that you could have done something out of order or assigned a different value than we listed in a place that could sway the results dramatically.

To Close the Decision Scores Window

- Select the Close button in the General portion of the window.

● Stopping Point

If you want, you can stop here and start again another time. Save your Hierarchy file and close the Hierarchy window.

- To save your document, select Save from the Hierarchy File menu.
- To close Hierarchy, select Close from the File menu, or select Close from the Control Menu.
- To close DecisionPlus, select Exit from the File menu.

If you want to continue now, save your Hierarchy file, but *do not* close your file or the Hierarchy window and proceed with IV- Reviewing the Results, below.

V - Reviewing the Results

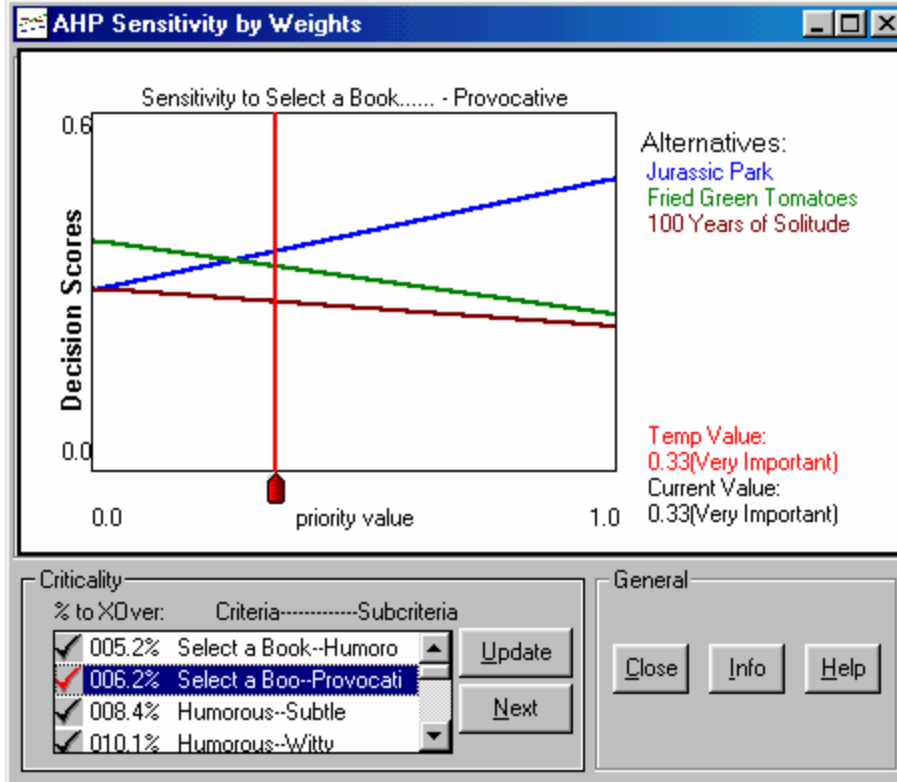
DecisionPlus provides different ways in which you can view your results. We talk about two of them. You can view how sensitive the scores of your alternatives are to changes in weights, and you can view how, and to what extent, the highest rated criteria contributed to those scores.



This part of the tutorial takes about 15 minutes.

Step One: Display the Sensitivity by Weights Window

1. In the Hierarchy window, select Sensitivity by Weights from the Analysis menu to display the Sensitivity by Weights window below.
2. Click the Update button to calculate all sensitivities.



You are looking at the sensitivity of the models to the weight of *Provocative* with respect to the goal, *Select a Book*. The identity of the weight can be seen both by the highlighted item in the Criticality list box and in the graph title. The sloping lines on the graph represent scores of the alternatives and correspond to the colors of the alternatives that are listed to the right of the graph. The vertical red line, with a red bullet-shaped pointer (we call it a slider) at its base, indicates the current **priority value** for this weight. That is to say, although the weights you entered in the Criterion Rating window might have been entered in a scale using units of dollars or miles, DecisionPlus calculates a value on a universal priority scale from 0 to 1 for each of those weights.

The point where the red line intersects an alternative line is that alternative's score (as can be verified in the Decision Scores window).

The **Criticality** list box lists all the criteria weights in the model, from those to which the results are most sensitive to, at the bottom of the list, those to which the model is least sensitive. Those at the top are the most critical because small changes in their value can change the outcome of the model. The percentage on each line is the amount of change in the priority of that weight required to change the outcome of the model. If the percentage was 5% or less, indicating that a change of less than 5% would change the preferred alternative, we would recommend reassessing your model structure, weights and scores.

When you first display the window, the **Current Value** is the same as the priority value for the red line. The Current Value is the value for the weight, 50, you assigned to the subcriteria, *Educational*, with respect to the criteria, *Select a Book*. If you select another weight in the Criticality list box, the value changes to reflect the priority of that weight.

The **Temp Value** reflects the changes you might make in this window to check results. Once you leave the Sensitivity by Weights window, your scores return to their original, or Current, value.

Step Two: Check the Sensitivity of the Scores

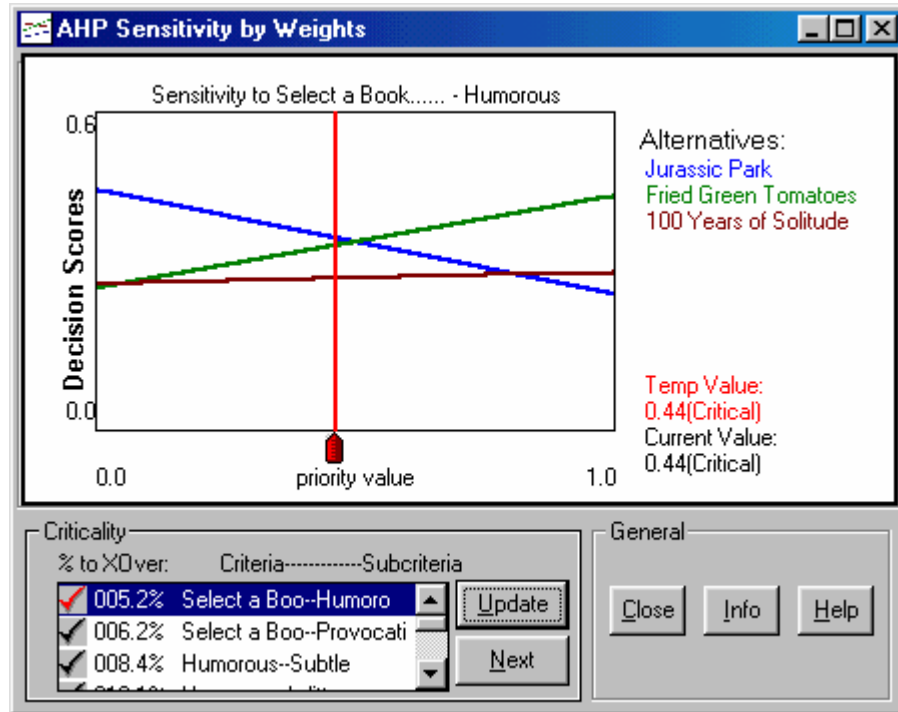
Judging from the results in this graph, we have a somewhat sensitive result. We mentioned earlier that we would show you what the close results meant. Notice in your graph that Jurassic Park remains the preferred alternative until you move the slider to the left about 8%. Try it. Hold the mouse button down and drag the slider to the left to a Temp Value of about .22.

At that point, the lines for Jurassic Park and Fried Green Tomatoes cross over, and Fried Green Tomatoes becomes the preferred alternative. You didn't have to move the slider very far before you produced a crossover. This means, that your model results are sensitive to somewhat small changes in the priority value. Because the

required change here is more than 5%, we would recommend that the model needs no reassessment.

Step Three: Select Another weight Combination

In the Criticality box, select the combination *Select a Book-Humorous* to produce the following display.



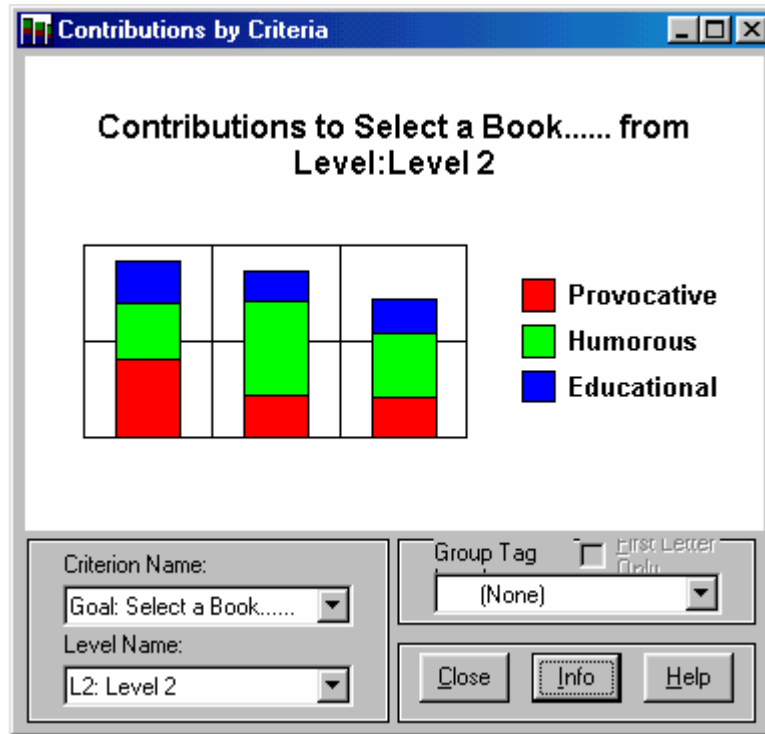
There is a crossover point between *Jurassic Park* and *Fried Green Tomatoes*. You would have to slide your priority value from .44 to somewhere around .57 to cause *Fried Green Tomatoes* to rate higher than *Jurassic Park* for the *Select a Book-Humorous* pair.

For details about sensitivity in your model, see Chapter 13, Analyze the Results.

Step Four: Viewing Contribution by Criteria

Another way to check your results is to investigate why *Jurassic Park* is preferred over *Fried Green Tomatoes*.

1. Close the Sensitivity by Weights window. The Hierarchy window redisplay.
2. In the Hierarchy window, select Contribution by Criteria from the Analysis menu to display the Contribution by Criteria window.



The colors in the bars correspond to the criteria listed to the right of the graph. (The colors on your monitor are a better example than the shades of gray and black in our illustration above.) These colors represent the amount of contribution each criterion made to that

alternative's decision score. You can immediately see that while *Fried Green Tomatoes* would be more humorous than *Jurassic Park*, *Jurassic Park*'s superiority in terms of *Provocative* and *Educational* aspects more than outweigh its lack of humor.

For details about this window, see "Viewing Contribution by Criteria" in Chapter 13, Analyze the Results.

This concludes the tutorial. According to the results you presented, you should have confidence in taking *Jurassic Park* along on your vacation.

Close the Contribution by Criteria Window

- Select the close button in the lower right corner of the window.

Saving Your Results

If you didn't save your work before viewing the results, you can do so now.

- In the Hierarchy window, select Save from the File menu.

Closing the Hierarchy window

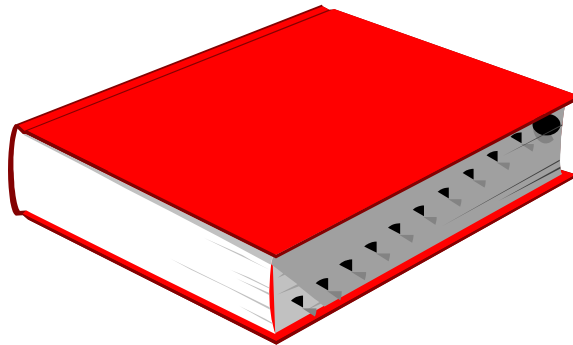
- In the Hierarchy window, select Close from the File menu.

What's Next?

Many printing options are available in which you can print your results. If you want to print your results, turn to Chapter 14, Document the Results, for a list of reports available and instructions for producing those reports.

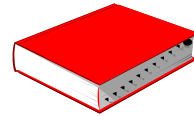
If you are ready to begin entering your own decision problem, turn to Part III, Designing Your Own Model. We suggest that you read the Building Your Own Decision Model checklist first in preparation for building your own model.

References, Glossary, and Index



Added Information

The next three sections provide information to give you a better understanding of concepts and functions, and to help you find what you need. In addition, we provide information about algorithms that we use in DecisionPlus.



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Algorithms Used in Criterium DecisionPlus

If you would like to have a brief account of algorithms used in DecisionPlus, write to us at:

InfoHarvest, Inc.
PO Box 25155
Seattle, WA 98125-2055

Or

E-mail your request to:

DecisionAnalysis@InfoHarvest.Com

Glossary

Glossary

Abbreviated Graphic Pairwise Comparisons A rating type that compares each item graphically to one other item in its rating set. Enter these ratings in the Criterion Rating Window by sliding the bar end on a bar graph toward the item that rates higher with respect to the parent block (see Abbreviated Pairwise Comparisons in this glossary).

Abbreviated Numeric Pairwise Comparisons A rating type that compares each item numerically to one other item in its rating set. In the Criterion Rating Window, enter these ratings in numbers ranging from 1 to 9 on a matrix to reflect how much one item is superior to another with respect to a common criterion

Abbreviated Pairwise Comparison Method Compares each block in a rating set to another block in the same set. Abbreviated Pairwise comparisons are quicker but not as thorough as full sets of pairwise comparisons. Use this format for a quick draft of a decision, to narrow down a large field of alternatives, or when absolute precision is not paramount (see Direct Ratings, Full Pairwise Comparisons, Pairwise Comparisons in this glossary).

Abbreviated Verbal Pairwise Comparisons This rating type compares each criterion verbally to another criterion in the same rating set. Enter these ratings by selecting a word from a supplied list that best represents the relationship between two criteria. For example, you would choose a word to accurately complete the sentence "With respect to Criterion 1, item A rates *Absolutely* better than item B."

Accumulated Values The decision score for an alternative in the model is the sum of all the ratings of that alternative against

each lowest criterion (or attribute), weighted by the importance of that criterion to the decision. If you imagine the hierarchy as a network of waterways flowing from the alternative to the Goal, the decision scores are the accumulation of all the flows from that alternative to the Goal. The Accumulated Value for *any* criterion (not just the Goal), and for a given alternative, is the accumulation of the flows along all pathways from that alternative to that criterion. The Accumulated Values for a criterion may be seen directly as the height of the alternatives' histogram bars in the Contributions by Criterion screen (where that criterion is chosen as the target criterion).

Accumulated Weights The accumulated or effective weight of any criterion in the model is the product of all the priorities along each path from the Goal to that criterion, summed over all such paths. For many models, each subcriterion only has a single parent criterion, so there is only one path to the Goal, and the accumulated weight for that criterion is just the product of the priorities of each connection from the Goal to that criterion. In the case of the Goal, the accumulated weight is always 1. The Accumulated Weight for a lowest criterion or attribute is exactly its Model Weight (see Glossary below).

Aggregation The mathematical process of calculating the results in the decision model. The basic paradigm is that of a weighted sum.

AHP The Analytical Hierarchy Method is a decision analysis technique invented by Professor T. L. Saaty (see the References section). In its original form the technique was based on the Full Pairwise Comparison Method and relative Normalization.

Alternatives Rating Technique A technique that allows the user to rate an alternative against every lowest criterion in terms of the scales of that criterion, and then normalize those ratings. Examples are AHP and SMART.

Ancestor The parents and grandparents of a particular block or criterion in the model.

Alternatives A set of options which you either wish to prioritize and/or from which you wish to choose a “best” alternative with respect to a specified set of criteria. Alternatives are always the lowest level of a decision hierarchy and are always compared with respect to the lowest criteria on every branch (see Criteria in this glossary).

Attribute The term in the SMART methodology for the Lowest Criterion in a model. The ratings of on Alternative are with respect to attributes.

Best/Worst(Scale) When defining a Numerical Scale, you are asked to decide whether the scale limit with the higher numerical value corresponds to the Best or Worst end of the scale. By assigning the higher numerical limit to Best you are indicating that higher numerical ratings on this scale correspond to a higher overall decision score for the alternative. By assigning the higher numerical limit to Worst you are indicating that a higher numerical value will result in a lower overall decision score.

Best/Worst(Uncertainties) The Best/Worst uncertainty approximation to an actual uncertainty distribution is simply a triangular distribution whose extreme horizontal points correspond to those of the actual distribution, and whose Mode corresponds to the mean of that distribution. Its area, since it is a probability distribution, is always unity. It is the simplest 3 point approximation to an arbitrary uncertainty distribution - but is often a very poor approximate, as it allows too much probability at the end limits.

Block A graphical representation of the most basic elements, such as a Criterion, Subcriterion, Attribute (SMART) and Alternative, of a decision hierarchy. The first block is always the goal (See Goal in this glossary).

Brainstorm A DecisionPlus mode allowing ideas to quickly be put into consideration when building a model. Brainstorm results can be saved and recalled when needed. Though a stand alone capability, brainstorm graphs are most often used to prepare a decision hierarchy.

Branch Any parent block in the hierarchy and all its descendants, excluding Alternatives. Except for the alternatives, every block is the parent of at least one branch. Large branches often contain many smaller branches.

Calculation Determination of results in a decision model based on the most current ratings and rules. Results comprise both decision scores (and related analysis data) and Uncertainty Results (and related analysis data). Criterium DecisionPlus calculates decision scores every time you enter a set of ratings. Uncertainty results are calculated when the user chooses to update them.

Children Child blocks are always defined with respect to a common parent block. A child block is directly to the right of its parent block, but may actually skip a level or two. A child block may also be a parent block (see Block and Parent Block in this glossary).

Compact Centered View Where parents are centered, vertically, on the screen, but not necessarily centered before their descendants (see Family Centered View in this glossary).

Consistency The measure of how consistent each rating is in relation to all other comparisons in a particular pairwise rating set. Because of how the AHP works, perfect consistency is not necessary for Criterium DecisionPlus to compute valid results.

Criteria The factors on which you base your decision—what you think is important to consider to make an informed choice. They comprise the middle blocks of a decision hierarchy, between the goal and the alternatives. Criteria are rated to

determine which is most important to the decision goal. (See Lowest Criteria.)

Criticality A metric that measures the sensitivity in a decision model. If one criterion weight is varied and causes a crossover (reversal of preferences in alternatives), then this is critical to the decision. Criticality measures the nearness of a crossover when varying a particular criterion weight. The lower the number, the closer the crossover and the more critical that particular weight is.

Crossover A reversal of preferences in alternatives. See Criticality.

Current The block, branch, or level of hierarchy where a particular function is being performed. The current block is usually highlighted. Current is also used to describe the window in which you are working.

Data Information in your decision model. Data includes block names, and your evaluations in terms of weights/ratings, rules, and notes.

DDE (Direct Data Exchange) DDE is a mechanism that allows one application running under Microsoft Windows to share information with another. DDE is effected via the Windows Clipboard, not by any sharing of data files. To what extent each application supports DDE should be determined by examining that application's documentation. (For more information on DDE and on the Windows Clipboard, see your Windows or Windows95 documentation.)

Decision Hierarchy The visible structure of a decision. Elements of a decision are organized to form a framework from left to right. At the far left of a hierarchy, the goal of the decision stands alone. Branching to the right from the goal block are criteria and subcriteria from the most general to the most specific. Branching from the last (farthest right) level of subcriteria are the alternatives under consideration (see Decision Model in this glossary).

Decision Model Model refers to the entire decision. A decision model includes the hierarchy, ratings, rules, notes, and everything that comprises the decision (see Decision Hierarchy in this glossary)

Decision Process A logical sequence of activities that facilitates the making (or not making) of a decision may be called a decision process. Many different processes have been suggested for facilitating the structuring, analysis and execution of decisions. The generic process whose implementation Criterium DecisionPlus supports, is outlined in the section Making Decisions.

Decision Scores The decision scores of an alternative is the overall score of that alternative within your decision model. Its value measures the preference of that alternative, i.e., how well that alternative meets your decision goal. Alternatives are ranked by the relative values of their decision scores. Conceptually, the decision score of an alternative is the sum of its rating against each lowest criterion, weighted by the relative importance of those criteria.

Defaults The initial or original setting, which Criterium DecisionPlus uses unless you specify a different one.

Descendant The child of a parent or the children of the child in the hierarchy model. All blocks or criteria at lower levels in the hierarchy connected to a particular block or criterion.

Device File or printer. The place where print reports are sent when Print is selected.

Direct Graphic Ratings A rating type in which each item is scored individually on a bar graph. The length of the graph bar is adjusted to reflect the ratings of the item with respect to its parent block.

Direct Numeric Ratings A rating type in which each item is scored individually on a numeric scale of your choice. Numbers representing the item's score with respect to its parent block

are entered in each item's entry field. The direct numeric rating type works best when entering hard data, like the cost of an item, the number of miles per gallon, number of years of experience, and so on

Direct Rating Method One of Criterium DecisonPlus's three rating methods. In direct ratings, data is entered about each element of a rating set individually, instead of in comparison to one or more other elements (see Abbreviated Pairwise Comparisons and Full Pairwise Comparisons).

Direct Tradeoffs Hierarchy Technique The user directly fixes the tradeoffs between two lowest criteria and their scales. This approach provides a Hierarchy Rating Technique to establishing the relative importance of all lowest criteria in a decision hierarchy. An other Hierarchy Rating Technique is to use Weights.

Direct Verbal Ratings A rating type in which each item is scored individually on a verbal scale of your choice. Verbal scales can reflect opinion, such as the Quality scale, or hard data, such as A to F.

Disconnected Blocks in Hierarchy If a block in the Hierarchy structure has a link to the Goal block (directly or through a number of other parent criteria), *and* has a link to at least one alternative (directly or through a number of other parent criteria) that block is said to be fully connected. Any block in the model that is not fully connected is said to be disconnected. No results calculation can take place if there is a disconnected block in the Hierarchy.

Distant Child A child that skips one generation.

Duplicate Block Any block that appears at more than one location on the hierarchy. The duplicated block has the same parents, children, scales as the original block.

Enabled/Disabled Certain features of the screen interface (buttons, menu items, list boxes,..) may be disabled if their function is

not compatible with the state of the application. A disabled feature is usually dimmed or greyed and will not respond to mouse clicks or keyboard prompts. The feature is said to be enabled when its normal functionality and appearance are restored.

Entry Field The portion of any window where you enter data. The current entry field is always highlighted.

Error Message A message that appears at the center of the screen when Criterium DecisionPlus detects an error or cannot perform a requested task. The user must select the OK button (or press Return) or choose other available options before proceeding.

Exporting The process of transferring a Criterium DecisionPlus spreadsheet, table or graph to another Windows application. Generally this can be effected using the Copy menu item under the Edit menu.

Family Center View Where parents are centered before their children. In family view, parents are more symmetrically distributed and usually take up more space than in Compact Centered View (see Compact Centered View in this glossary).

Filename The name you give the file of your decision model when you save or retrieve files on a disk. Criterium DecisionPlus filenames can be up to eight characters long with an optional period and a three letter extension, and can contain letters, numbers, and the underscore (_). Criterium Decision Plus Hierarchy files have the default extension (*.cdp) and Brainstorm files (*.bst). [The Windows95™ operating system supports longer filenames, and CDP will open such files. However the File Open, Save and Save As dialogs will display the names in a truncated format and this can lead to confusion.]

Full Graphic Pairwise Comparisons A rating type in which each item is compared graphically to every other item in the same

rating set. Weights are entered by sliding the graph bar toward the item that rates higher with respect to the parent block.

Full Numeric Pairwise Comparisons A rating type where each item is compared graphically to every other item in the same rating set. Ratings are entered in numbers (ranging from 1.0-9.0) to represent how much one item is superior to another with respect to their parent block.

Full Pairwise Comparison Method A full set of pairwise comparisons involves comparing every element of a rating set to every other element of that set. Full pairwise comparisons are the most extensive and precise of the rating ranges (see Abbreviated Pairwise Comparisons, Direct Rating, Pairwise Comparisons in this glossary).

Full Verbal Pairwise Comparisons A rating type in which each item is compared verbally to every other item in the same rating set. Ratings are entered by selecting the word that best represents the relationship of the two items. For example, you would choose a word that would accurately complete the sentence “With respect to Criterion 1, item A rates *Absolutely* better than item B.”

Fully Connected A criterion in the decision hierarchy is said to be fully Connected if it is connected (indirectly or not) to the Goal and (indirectly or not) to at least one alternative. The entire Hierarchy model is said to be fully connected if every criterion in it is fully connected.

Goal Block The first block in any decision hierarchy to which all other blocks relate. The goal is always the only block in the first (Goal) level of a decision hierarchy.

Goal (Decision) The decision that the user wants to make and that is based on the included criteria. The purpose of the model is to identify the alternative that best satisfies the Goal as measured by the specified, weighted criteria.

Graphic Views The most visually oriented of Decision Plus's three rating, the graphic style allows you to express your judgment of elements with bar graphs. When using pairwise comparisons, you slide the end of a bar toward the alternative that rates highest. If you are rating alternatives directly, you slide the end of the bar along the bar graph scale for each individual alternative.

Handles Black squares at the corners of an object.

Hard Data Specific quantitative data (such as top speed of a car in miles per hour) on items in a rating set. When such data is available and should appear as part of the decision process, it can be entered in one of the Direct rating types.

Hierarchy See Decision Hierarchy in this Glossary.

Hierarchy Order is an ordering for blocks, criteria or alternatives according to the visual structure of the hierarchy - by levels starting at the Goal, then by block, from the top of each level.

Hierarchy Rating Technique A technique that allows the user to establish the relative importance of all lowest criteria in a decision hierarchy. Examples are Direct Tradeoffs and Weights.

Highlight A reverse video area used on the window to indicate current blocks, commands, and entry fields.

Ideal Solution This represents the results of the perfect alternative that scores perfectly across all the criteria in the decision model. The ideal solution can be used as a reference point for evaluating how good the alternative really are.

If/Then Rule A conditional rule stating that if an alternative falls short under one criterion, it must meet a specified condition in another area to remain under consideration. These rules are created using the Rules menu item in the Criterion Weighting Window.

Inconsistency Ratio A condition that arises when the various pairwise comparisons are not entirely consistent. Although inconsistency does not necessarily mean that a model results in a bad decision, it is usually best to have consistent judgments.

Level The vertical groupings (columns) of blocks that help organize the hierarchy (branches are the horizontal groupings). Level names appear in the Level Bar at the top of the canvas. A level of the hierarchy includes all blocks in the column below that level title. Levels are often organized according to specificity, with the most general criteria branching off to the most particular.

The Goal block is always at the far left, in the level called Goal. Alternatives are always at the rightmost level of the hierarchy. Criteria, scenarios, and decision-makers fall in the levels between.

Level Bar Gray bar at the top of the Hierarchy canvas composed of cells containing Level titles. When a cell in the level bar is clicked, the name it contains may be edited. The width of levels may be adjusted by dragging the ends of the cell

Link A connection that allows the results of one file to be included in the calculations of another file's results. A link can be created, updated, and removed using the Link item in the Block menu of the Hierarchy window. (See Master File in this glossary).

Lowest Criteria Any criterion that is connected directly to at least one alternative. This could be a criterion in the level immediately preceding the alternatives, or a criterion in a higher level. In the language of the SMART methodology, these are referred to as Attributes.

Master File The file to which another file is linked (see Link in this glossary).

Method See Rating Method.

Model See Decision Model.

Model Name and Note The Hierarchy model can have both a name and a note attached to it. When you create a new Hierarchy, either from Brainstorm or directly, you are presented with the **Notes Dialog**. This is a good opportunity to enter information as to why you are creating the model, who is involved, etc.. You can choose to cancel from the Notes dialog, and enter the information later in the Hierarchy window, by choosing **Notes** from the **Model** menu. The Name and Notes will be printed with the **Hierarchy Notes and Rules** print option.

Model Weight is the effective weight of a lowest criterion or attribute in a decision model. No matter how many levels in a hierarchy, the entire model is equivalent to one containing the Goal connected directly to the lowest criteria with the Model Weights as weights. You can see the values of the Model Weights directly in the Data View of the Decision Scores screen or by choosing the Show Accumulated Weights item under the View menu in the Hierarchy.

Navigator In hierarchy, this option displays a reduced view of the entire Decision Hierarchy model in a separate window. Clicking anywhere in that reduced view, will scroll the Hierarchy to the corresponding point in the model.

Normalization A mathematical method in that allows you to handle your differing weight scales on an equal footing. All scales are converted to a common scale that takes a value between 0 and 1. Under the AHP methodology, a relative normalization approach is used where the weight of one subcriterion with respect to a given parent criterion is divided by the sum the weights of all that parent criterion's subcriteria. In SMART, Ratings of Alternatives against Attributes are normalized using user defined Value Functions. (See Value Functions in this Glossary.)

Notes Information that you attach to a block. Notes can be any information about that block, such as why you rated it the way you did, why it is included at all, a message to someone looking at the hierarchy, or other background information.

Notes Dialog The dialog window that allows you to enter the name of a Block and pertinent notes about that block. In both Brainstorm and Hierarchy, this dialog can be accessed by selecting a block, and using the key chord Ctrl-N. Model and Level Notes may be entered by selecting the Notes item in the Model and Level menus in the Hierarchy Window. Notes can be up to 64KB, and the Notes window supports cutting and pasting

Numeric Scale A numerical rating view to express your distinctions. Values for each evaluation are entered on a numerical scale. You define these by specifying the units and the values corresponding to worst and best cases. Direct Numeric rating can be the most concise rating type, if you have hard data to enter. Some comparisons lend themselves best to numeric ratings, such as cost. You might feel most comfortable expressing a distinction numerically, rather than with a word or a graph (see Graphic, Verbal in this glossary).

Numerical Scale View Text boxes in the Criterion Rating Window, representing the Numerical Scale you assign, in which numbers may be directly entered.

Orientation (Scale) When defining a Numerical Scale, you are asked to decide whether the limit with the higher numerical value corresponds to the Best (i.e. higher numerical values correspond to a higher over all decision score) or Worst (i.e. higher numerical values correspond to a lower over all decision score). In the former case, the scale is said to have a positive orientation, in the latter, a negative orientation. A numerical scale with a negative orientation may be referred to as a "reverse" scale.

Orphan A Block or criterion that is not connected or associated with any Parent Block. Not uncommon while Brainstorming.

Pairwise Comparisons Pairs of elements you choose to compare with respect to a parent criterion. Depending on how extensive a process is you wish to apply, you can select a full or an

abbreviated set of pairwise comparisons (see Abbreviated Pairwise Comparisons, Full Pairwise Comparisons in this glossary).

Parent Block In a graphical display, any block with children. The parent block of any branch of the hierarchy is the block which is at the far left of that branch (see Branch Parent and Child Block in this glossary).

Parent Criterion Any criteria with subcriteria or Alternatives. A parent can have only seven subcriteria but up to 50 Alternatives (see Criterion in this glossary).

Phantom Block When a block on one level is connected to a block two levels lower in the hierarchy, the missing block in the first lower level is called a phantom block. Double-clicking on the line at the missing block level produces a broad red line at that level indicating a phantom block.

Preference The ranking of the alternatives after calculating the results. The most preferred alternative is the one with the highest decision score. Criterium DecisionPlus calculates the decision scores of the alternatives based on the criteria and weights assigned to them in the model.

Priority Value The value of weights after Normalization. This is the effective weight the model uses in calculating decision scores. It takes a value from 0 to 1 (see Normalization in this Glossary).

Primary View The rating set of a criterion may have multiple views. However, a graph, such as that of a Value Function, must be drawn with respect to a single scale.. Therefore, in the event that there are multiple views assigned, the Primary View is used.

If the criterion has only one View, then the Primary View is that view. If multiple views are employed, the Primary View is determined in the following manner. If a Numerical View is used, then it is always the Primary View. In the absence of a

Numerical view, the Graphical View is the Primary view. In the absence of Numerical and Graphical views, the Verbal View is, by default, the Primary View.

Probability Distributions A probability distribution is a simple way to quantify uncertainties in values. In DecisionPlus, distributions are histograms defined on a scale of your choice. The height of the histogram bar tells you the probability that the value on that scale would fall in that bin. If the scale on which you estimate project lengths is in weeks, and if the histogram is highest at seven weeks, then that is the most likely length of the project. The area (the sum of all the bin heights times the bin width) under the histogram between seven and eight weeks gives you the probability that the project can be finished anywhere between seven and eight weeks. DecisionPlus uses 200 bins in each screen plot, so the histogram may appear to be a curve.

Process Diagram A diagram showing the steps and their sequencing that are involved in decision making. The balloons indicate specific activities supported by DecisionPlus, and the flow lines show where you might go next on completion of a given activity. The Process Diagram can be accessed in the on-line Help by using the key chord Shift F1.

Rank Reversal In AHP, when a new alternative is added to a model that is close to the preferred alternative in goodness it can cause a change of position in alternatives when the results are calculated (a reversal of rank).

Rating In SMART, a rating is a value you assign an alternative with respect to an Attribute. You can assign ratings through the Criterion Rating window, using any combination of three rating views, Numeric, Verbal, or Graphic, and using one of three rating methods, Direct, Pairwise, or Abbreviated Pairwise Comparison.

Rating Method A method to assign a weight to a subcriterion with respect to a parent criterion. Criterion DecisionPlus provides

for Direct, Full Pairwise and Abbreviated Pairwise Rating methods.

Rating Set All children of the same parent, including distant children (no parents in between). Elements of a rating set may be criteria, subcriteria, attributes (SMART), or alternatives. The elements of a set are rated with respect to their parent block.

Rating Type One of the ways in which you can enter evaluations. Different rating types are particularly suited to different kinds of data, decisions, and personal tastes. In the Criterion Rating window, a Rating Type is chosen by specifying both a Method and a set of Views.

Rating View A representation of the value of the weight of a subcriteria with respect to a criterion. Criterion Decision Plus supports Verbal, Graphic and Numerical Views. Any combination of the Views may be chosen when assigning weights to subcriteria.

Rating Window Where blocks are evaluated with respect to a parent criterion. After structuring the hierarchy in build mode, the next step toward a complete decision is entering ratings in a rating window. Rating sets are rated one at a time. Criterion DecisionPlus has nine different decision-making formats which are selected by choosing items for the Method and View menus.

Recycle Bin Temporarily stores ideas you would prefer to deal with at a later time. Available only on the Brainstorm Canvas.

Relative Weights tell you how important one lowest criterion (or attribute) is compared to another. Their value are the ratio of the respective Model Weights (see Glossary) and may be seen directly in the Tradeoffs of Lowest Criteria window.

Resource Tracking Often a decision is about prioritizing a number of alternatives, and choosing as many alternatives as allowed by constraints in terms of resources. A common example might be deciding which sets of projects can be afforded within a

given budget. Once the alternatives have been ordered in terms of preference, it is very useful to be able track the cumulative usage of the constrained resource(s), so that it is apparent how many of the alternatives may be afforded. This may be done in the Decision Scores window.

Right Click To Right Click a menu item, say, you would depress the Right-most button on your mouse (pointing device). This is true whether your mouse has two or three buttons. But many mouse devices do let you reprogram the buttons, so beware. In the Hierarchy window, Right Clicking a block provides fast access to relevant menu items such as Edit Notes.

Risk Analysis When analyzing a decision in terms of risk, you need to know both the likelihood of something going wrong and how much it will cost you if it does go wrong, and how much you would gain if it is successful. For example, when choosing which proposed product your company should concentrate its resources on, you could use a forecasting tool to model your expected revenue—a 20% chance of realizing a profit of over \$100,000, 50% of profits up to \$100,000, and a 30% chance of losing your development costs of \$60,000.

Such a risk analysis for each product is a key criterion in your decision, but there are invariably many other factors to be included. DecisionPlus lets you feed the results of that analysis directly into the model, and include those uncertainties with others more qualitative factors to determine which product is the best risk for your company.

Rule Allows you to set standards that your alternatives must meet in order to be considered. Alternatives that fail rules are not eliminated from calculations, but the failure is noted in the Results Window and in printed reports (see If-Then Rule, and Simple Rule in this glossary).

Save Saves or updates your Brainstorm or Hierarchy model.

Scale A scale provides an abstract measure of how much you prefer a Criterion or Alternative. Scales may be quantitative (dollars,

miles per hour) or qualitative (importance, preference) in nature (see Verbal, Numerical Scales). They have both extent, defined by Best and Worst Values, and units. It is important to choose a scale that best fits how you compare the items in question.

Scale View A portion of the Criterion Rating Window that allow the user to select the scale to be applied when entering criterion ratings.

Score The value given to an alternative with respect to a lowest criteria (see Rating).

Sensitivity Analysis A method used to test how sensitive your preferred alternative is to changes in weights of your criteria.

Sibling Blocks on the same level that are connected to the same parent block. Children that have the same parent.

Simple Rule A regulation stating that each alternative must meet, for instance, an absolute minimum score with respect to a specified criterion in order to be considered (see If-Then Rule, and Rule in this glossary).

SMART Simple Multiattribute Rating Technique. An effective implementation of the Multiattribute Utility Theory of decision analysis invented by Professor Ward Edwards (see the References section).

Stakeholders Stakeholders are individuals and groups who may not have direct control over the decision, but will be affected by the decision outcome.

Subcriteria Specific refinements of general criteria. For example, subcriteria of the criterion Cost might be Initial Cost and Maintenance Cost. On the hierarchy, subcriteria occupy the blocks to the right of their parent criterion.

Subcriterion/Weights Box Area on the Criterion Ratings window where you can input your weights and ratings. The

appearance of this area varies according to the Rating Method and Rating View chosen.

Tab Delimited Strings A Tab delimited string is a way of passing information to the Windows Clipboard that can be usefully imported to Windows spreadsheet and word processing applications. When pasted into most spreadsheets, the information will automatically arrange itself correctly across the rows and columns of the spreadsheet (though you will probably want to adjust the formatting yourself). When pasted to a word processor, the information will appear with Tabs between data points, and this can usually be immediately turned into a data table using that application's Table commands.

Tagging Because of the Branch Duplicate option added to the Hierarchy, it is now easy to create group models, with a different branch duplicated for each group member. In order to facilitate analysis, you can assign the criteria at a given level in the model, to "tag" all criteria in their respective branches. The name of that tagging block will precede the name of the actual branch criterion in all results and analysis windows. Names of Alternatives are unaffected.

From any results or analysis window, or within the Ratings dialog, a level may be chosen as the Tag level by choosing the Group Tag Level menu item under the Analysis menu item.

Tradeoffs A tradeoff tells you how many units of one criteria produce the same change in the leading alternative as an increase of one scale unit of a reference criterion.

For example, if you are evaluating a construction bid and you were to weight a criterion such as Schedule as more important than another, such as Costs, you are essentially trading off dollars against months (or years). A bid with a lower cost is attractive, but if construction takes longer it is less attractive. Knowing how much you are willing to pay in increased Costs

for a one month improvement in Schedule is key to understanding your decision.

Tradeoffs of Lowest Criteria The Tradeoffs of Lowest Criteria Window depicts a table of the number of units of criteria it takes to produce the same change in the leading alternative. This tradeoff is shown in relation to an increase of one scale unit of a specified reference criterion.

Tradeoffs Set, Minimal Tradeoffs Set A collection of lowest criteria pairs that are assigned tradedoff values. Specifying all possible lowest criteria pairs is redundant, and will lead to inconsistencies. If the collection is such that it has N-1 pairs, where N is the number of lowest criteria, and any tradeoff pair's value can be derived from the collection's pairs values, that tradeoff set is called a minimal tradeoff set.

Uncertainty The numbers you assign to weights or ratings in DecisionPlus are rarely known exactly. Often, you can estimate how they might vary. For example, estimates such as that the cost would never be more than \$100 or less than \$50, or that it will take nine months, give or take a month. You need only one more small step to formulate this type of information into a format DecisionPlus can use directly—to estimate the likelihood, or probability, of different values occurring.

Unrated The condition of any item's weight/rating before the item has been rated. You can see which criteria in a model are not weighted by selecting the Show Unrated Blocks item in the View menu of the Hierarchy window.

Value Function The mathematical function used in assigning ratings for the attributes when using the SMART technique. Criterium DecisionPlus provides a linear, exponential, and custom value functions, which can be either increasing or decreasing with respect to the scale.

Verbal Scale In verbal mode, words express distinctions between elements of a rating set. For pairwise comparisons, a list of

nine standard words are provided. When rating directly, you may choose from one of the lists supplied or make up one of your own.

Verbal Scale View In the Criterion Rating window, the verbal view representing the Verbal Scale you assign. Provides drop-down list boxes containing words you can select within the assigned Verbal Scale.

View (ratings) In the Criterion Rating window, various means are provided for you to enter your preferences: a numerical textbox, a graphical sliding bar, and a verbal listbox. The numerical, graphical and verbal expressions, together with their individual scales, are all Views of your ratings. All express the same value of your rating, and at least one, but as many as all, views may be utilized at the same time. Choosing an appropriate set of views for your decision helps you attain a more accurate assessment of your preferences.

View (window) The View menu item in a window, if present, provides a different way of viewing the information associated with that window. For instance, the Data View of the Hierarchy provides a spreadsheet view emphasizing the rating information in the Hierarchy window, whilst the Graphical View provides a visual representation of the relationships between criteria in the Hierarchy window.

Voice When individuals or factions within a group are explicitly given a branch of the decision hierarchy to weight. The contributions from each of these branches are then combined (usually by equal weighting) to provide a voted decision. See the section on Group Decision Making in Chapter 9.

Weight The value you assign to a given criterion with respect to a parent criterion. The value lies within range of the scale of the parent criterion.

Zoom In Brainstorm and the Recycle Bin, Zoom allows you to see the screen at different magnifications.

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