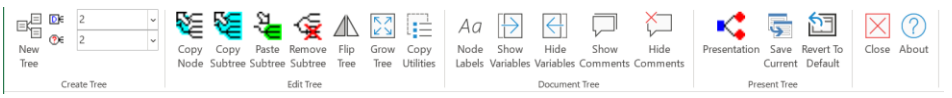
XLTree™ 3.0

XLTree is a Decision Tree add-in for Excel 2016 or higher. It was originally developed for Decision Making with Insight, a textbook on Management Science by Dr. Sam L. Savage. Version 3.0 has been updated to include a Tool Ribbon, and capacity limited only by the size of Excel.

Ribbon and Dialog Boxes

Once XLTree.xla is loaded, the **Tree** menu and Ribbon will appear.



Create Tree

- **New** opens a new worksheet, prompts the user for the number of state variables (optional), and starts a new tree.
- **Add Decision Fork** adds a specified number of decision branches to the selected node in the tree.
- **Add Uncertainty Fork** adds a specified number of uncertainty branches to the selected node in the tree.

Edit Tree

- **Copy Node** copies the selected node.
- **Copy Subtree** copies the selected node and the subtree belonging to it.
- **Paste Node/Subtree** pastes the node or subtree that was most recently copied.
- **Remove Subtree** deletes the portion of the tree extending from the selected node.
- **Flip Tree** changes the structure of symmetric trees by interchanging specified levels of the tree.
- **Grow Tree** copies the topmost subtree to lower branches with empty nodes. This is useful for creating large symmetric trees in just a few steps.
- **Copy Utilities** copies a utility function of the state variables from the topmost leaf of a tree into all other leaves.

Document Tree

- **Node Labels** allows the user to add descriptions to nodes and to include state variables when creating a presentation of the tree. *Note*: the node labels are stored as cell comments.

- **Variables (Show or Hide)** shows or hides state variable and joint probability columns.
- **Comments (Show or Hide)** copies a utility function of the state variables from the topmost leaf of a tree into all other leaves.

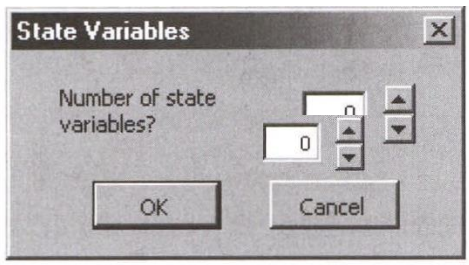
Present Tree

- **Presentation** creates a graphical representation of the tree on the current worksheet based upon the formatting specified in the Presentation Format worksheet. The tree is created on a new worksheet labeled " Presentation."
- **Presentation Format (Save Current or Revert to Default)** allows the user to set the current formatting specified in the Presentation Format worksheet as the default, or to revert from a previously saved formatting back to the default formatting.

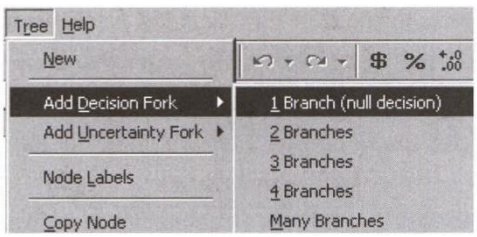
Miscellaneous

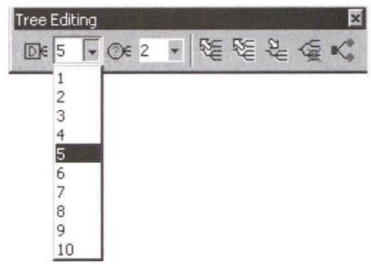
- **Close** closes XLTree.xla and removes the Tree menu and the Tree Editing toolbar.
- **About XLTree.xla:** Designed by Sam L. Savage.

New. When the New command is invoked, the user is prompted to enter the number of state variables, if any, in the dialog box shown below. State variables, which will be discussed later, are not required for simple trees, in which case the field can be left at zero. When you click OK, a new worksheet containing the root of the new tree will be created.

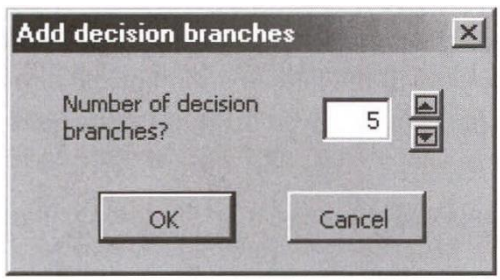


Add Decision Fork. From any empty leaf node (cell containing an asterisk"*") you can add a decision fork using either the **Tree** menu or the toolbar as shown in the following figure.

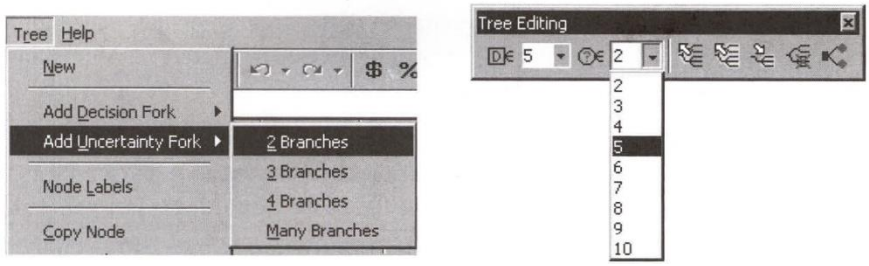




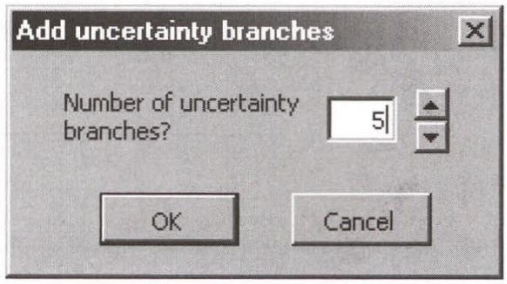
If you use the **Many Branches** option the following dialog box is displayed. ***Note:*** The Standard edition of XLTree is limited to 3 branches.



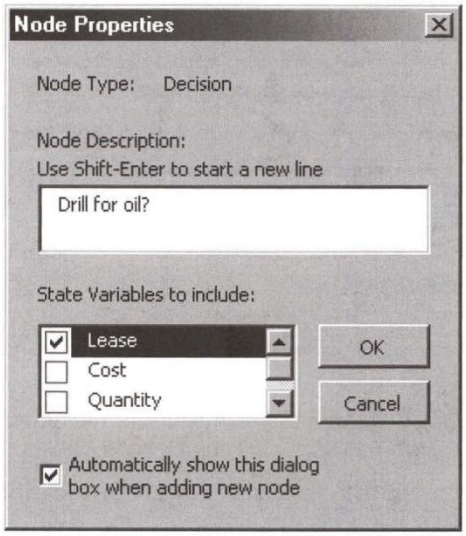
Add Uncertainty Fork. From any empty leaf node (cell containing an asterisk"*") you can add an uncertainty fork using either the **Tree** menu or the tool bar as shown in the following figure.

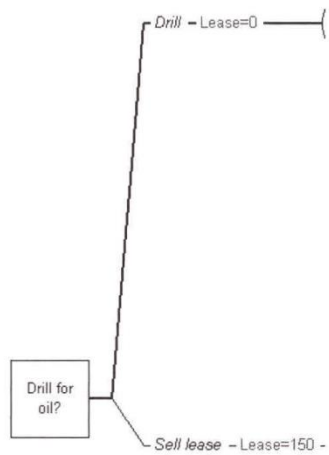


If you use the **Many Branches** option, the following dialog box is displayed. ***Note:*** The Standard edition of XLTree is limited to 3 branches.



Node Labels. Node labels are used to display text and the values of state variables on nodes in presentations. Select a node in the tree and invoke the **Node labels** command to bring up the Node Properties dialog box below and enter a node description.

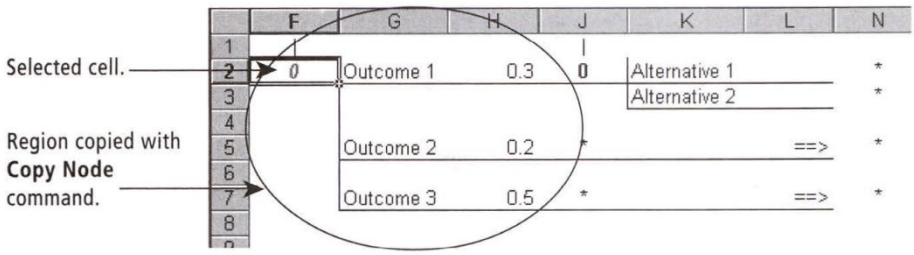




The figure on the previous page shows the root node of the wildcatter problem from Chapter 6. A short description of the decision node is added to the node, and appears in the presentation view of the tree if the appropriate formatting options are set on the Presentation Format worksheet. The "Lease" state variable is selected which allows the value of that variable to be displayed when a presentation is created.

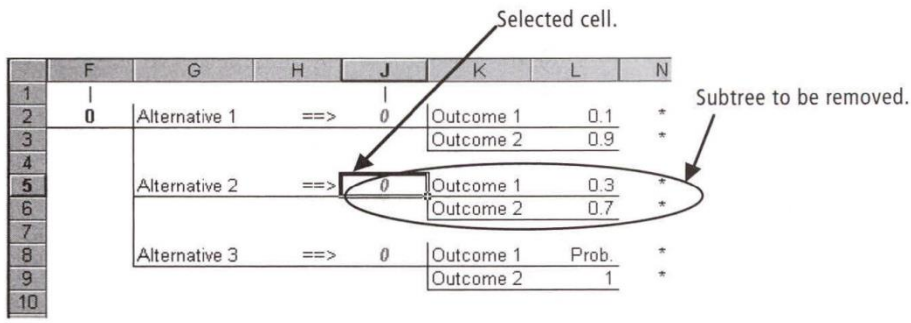
Copy Node. This command copies the selected node, but not the nodes below it. The node can then be pasted using the **Paste Node/Subtree** command.

Copy Subtree. This command copies the selected node and all the nodes below it. The nodes can then be pasted using the **Paste Node/Subtree** command. In the figure below, with cell F2 selected, everything circled would be copied.



Paste Node/Subtree. Select an empty node (cell with asterisk"*") and invoke this command to paste the node or subtree that was most recently copied.

Remove Subtree. Select the topmost node in the subtree to be removed, then invoke the **Remove Subtree** command or use the tool bar button.



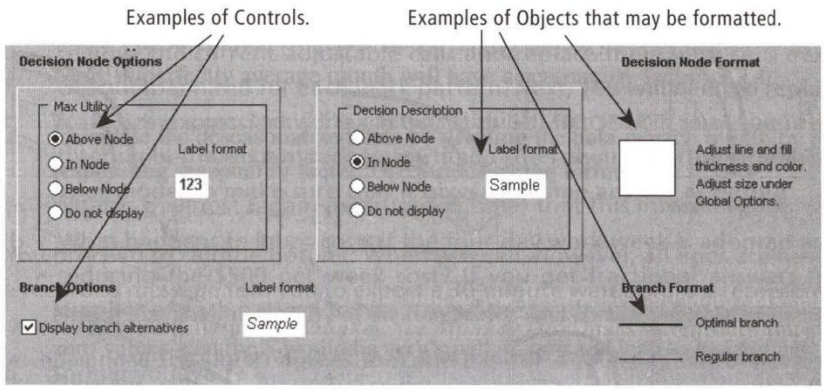
Variables (Show or Hide). When state variables are used, the **Variables, Hide** command can be used to hide the columns containing state variable s and joint probabilities, making the structure of the tree easier to view. The **Variables, Show** command un-hides the state variable and joint probability columns.

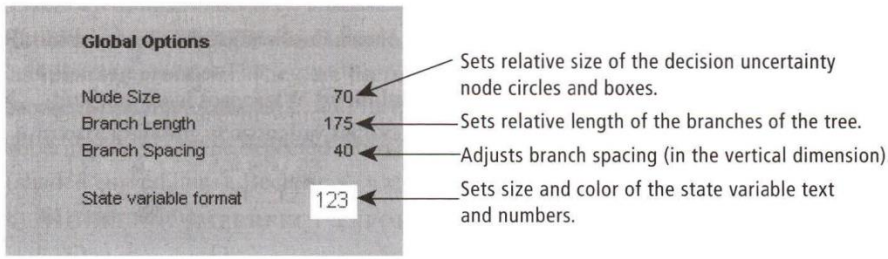
Comments (Show or Hide). These commands are used to show or hide all comments that are attached to any cell in the workbook. It can be useful to show all comments to quickly edit the node description text in multiple nodes.

Presentation. This command creates a graphical representation of the tree on the current worksheet, based upon the formatting specified in the Presentation Format worksheet. The tree is created on a new worksheet labeled "Presentation".

The Presentation Format worksheet (below) allows for a wide variety of formatting options. There are three ways in which the format of the presentations may be changed:

1. Controls such as Radio Buttons and Check Boxes for specifying various options.
2. Excel formatting commands which may be applied to text and graphic objects in the Presentation Format worksheet using the Excel Drawing Toolbar.
3. Global Options





Note: If any utility values or state variables do not appear as they should (e.g., they appear as "##") when you create a presentation, check to make sure the columns which hold the original values on the Tree worksheet are wide enough to accommodate the formatted number. Also, in order for the joint probability values to appear on the presentation the **Variables, Show** command must first be used on the Tree worksheet.

The user is urged to thoroughly explore the Presentation Format worksheet and experiment freely with changing formats.

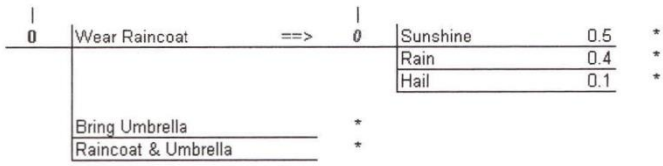
Presentation Format. When you find a presentation format that you particularly like you may save it as the new default. The **(Save Current or Revert to Default)** allows the user to set the current formatting specified in the Presentation Format worksheet as the default, or to revert from a previously saved formatting back to the default formatting.

Flip Tree

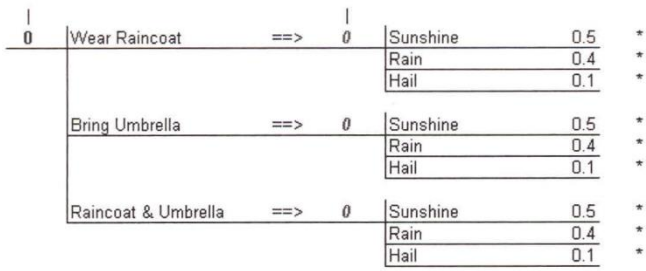
Flip Tree is used to interchange change levels within a symmetric tree (seeTree Flipping on page 342).

Grow Tree

Grow Tree is useful when creating large symmetric decision trees that have many similar branches. For example, suppose you are modeling a decision about which of three types of weather protection to use in the face of three types of weather. You could build this tree by filling in only the topmost branches as follows.



The **Grow Tree** command quickly completes the tree as shown below.



This command may also work on some asymmetric trees. A copy of the current tree is pasted into another worksheet named "_OldTree_" in case the grown tree does not come out as expected.

You can then go back and edit the details of the various branches to finish the tree. If you want to go back to the version of the tree before you grew it, delete the

worksheet named "Tree" and change the worksheet named "OldTree" to "Tree". However, if you grow a tree more than once, you won't be able to go back to your original tree, only to the version of the tree prior to the last use of the **Grow Tree** command. It is a good idea to save your model often as you modify the tree.

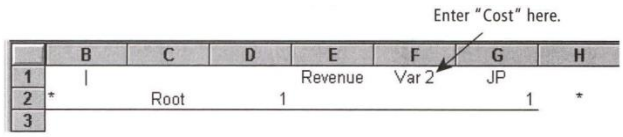
Copy Utilities. A utility function of the state variables can be entered as a formula in the topmost leafnode of the tree. With this formula in place, the **Copy Utility** command will copy it to the remaining leaf nodes. The tree will then evaluate automatically. ***Note:*** You must start with the cursor in the topmost leaf, and all leaf nodes must be in the same column to use the **Copy Utility** command. If they are not, use the 1 Branch (null decision) fork to extend leaf nodes to the same column. After the command is executed, the leaves of the tree will appear in **Bold Underlined Green** format in the Tree worksheet. Of course, they may be formatted any way you like in the presentation worksheet.

Close. The **close** command closes XLTree.xla and removes the **Tree** menu and the Tree Editing toolbar.

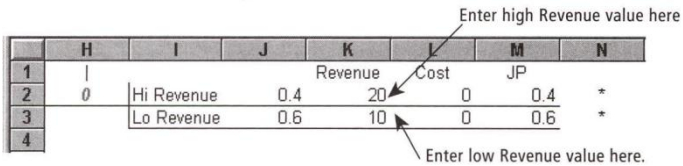
State Variables

You can use state variables to simplify the calculation of utilities at the leaf nodes of the tree. For example, suppose that utility can be expressed as Profit = Revenue - Cost, where Revenue and Cost take on different values on different branches of the tree. The following steps show how the utility can be calculated directly from the state variables.

1. In creating the tree one would specify two state variables. Varl and Var2 would then be labeled Revenue and Cost.

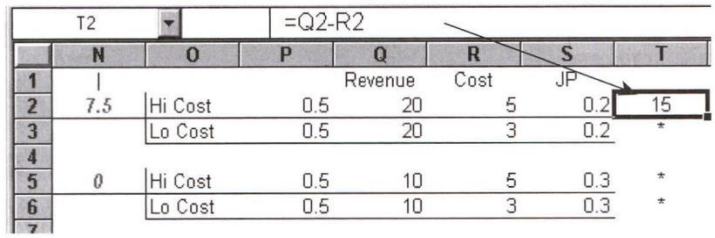


2. When a branch occurs, the associated values of the state variables are entered.



Note: All subsequent branches will inherit the appropriate values of the state variables.

3. When all branching is completed, enter a utility formula based on the state variables for the topmost leaf of the tree. In this case, it is Profit = Hi Revenue - Hi Cost.



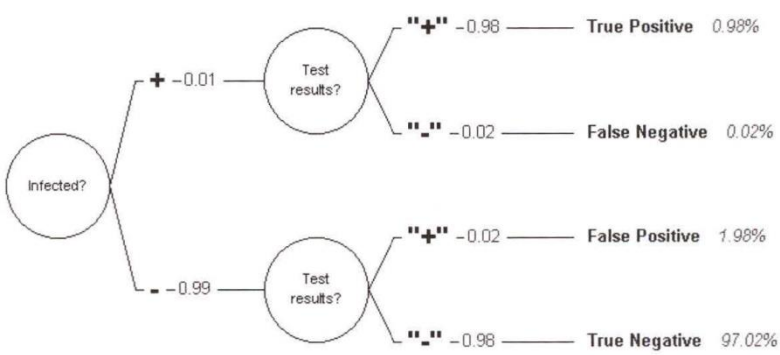
	N	O	P	Q	R	S	T
1	|			Revenue	Cost	JP	
2	7.5	Hi Cost	0.5	20	5	0.2	15
3		Lo Cost	0.5	20	3	0.2	*
4							
5	0	Hi Cost	0.5	10	5	0.3	*
6		Lo Cost	0.5	10	3	0.3	*

4. Finally, with the cursor still in the topmost leaf, invoke the **Copy Utility** command to copy the formula in the topmost leaf to all other leaves. ***Note:*** All leaf nodes must be in the same column to use the **Copy Utility** command. If they are not, use the l Branch (null decision) fork to extend leafnodes to the same column.

	N	O	P	Q	R	S	T
1	|			Revenue	Cost	JP	Utility
2	16	Hi Cost	0.5	20	5	0.2	15
3		Lo Cost	0.5	20	3	0.2	17
4							
5	6	Hi Cost	0.5	10	5	0.3	5
6		Lo Cost	0.5	10	3	0.3	7

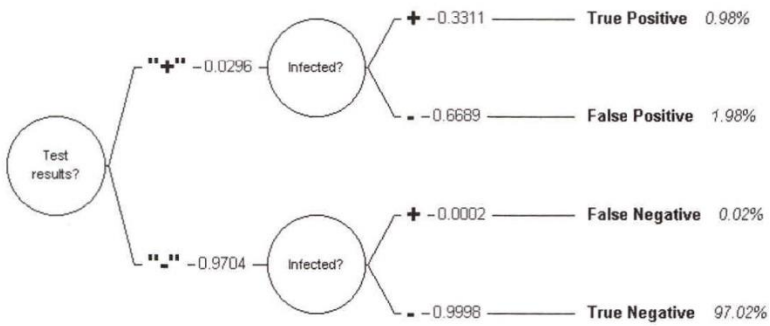
Tree Flipping

To understand tree flipping, consider the diagnostic test for Some Rare Horrible Disease (SRHD) discussed in Chapter 6. The tree below represents first, the uncertainty that a person picked at random from the population is infected (+) or not infected (-). The second uncertainty, which clearly depends on the outcome of the first uncertainty, is whether that person displays a positive test for SRHD.



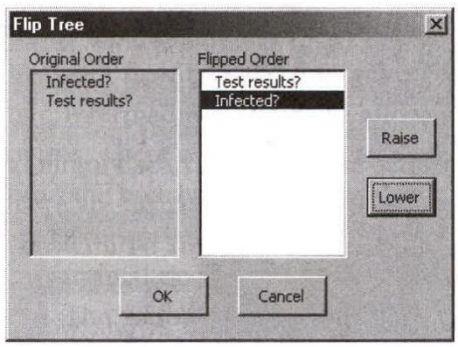
That is, the first level of the tree indicates that the infection rate in the population is only 1%. The next level of the tree indicates the probability that the test will give the correct diagnosis is 98% for both uninfected and infected members of the population. The final column on the right shows the joint probabilities of the four possible outcomes.

Suppose we wanted to know the probability that a person picked at random who tested positive was actually infected. In this case, the first uncertainty involves the test results while the second uncertainty is whether or not they are infected. The calculations of the probabilities on the branches of the flipped tree (as discussed in Chapter 6) are performed automatically by the **Flip Tree** command, and result in the tree below.



This indicates that a person picked at random who tests positive has only a 33% chance of actually being infected.

To flip a tree, first construct it in the standard manner. It is helpful to use **Node labels** to keep track of the probabilistic relations that are described by the nodes. Use the **Flip Tree** command to bring up the following dialog box:



The Node Description text appears in the list box and the **Raise** and **Lower** buttons can be used to change the order in which you want the nodes to appear in the new tree.(If you have not used Node labels the Flipped Order box will display Level 1,

Level 2, etc.). Click "OK" and a new tree will be created on a worksheet named "Flipped Tree". You can create a presentation from this worksheet, as you can from any worksheet containing a tree. However, if you want to keep any presentation you have already created remember to rename it first. Tree flipping may have unpredictable results when applied to asymmetric trees, but a backup copy of the original tree is created as with Tree Growing.