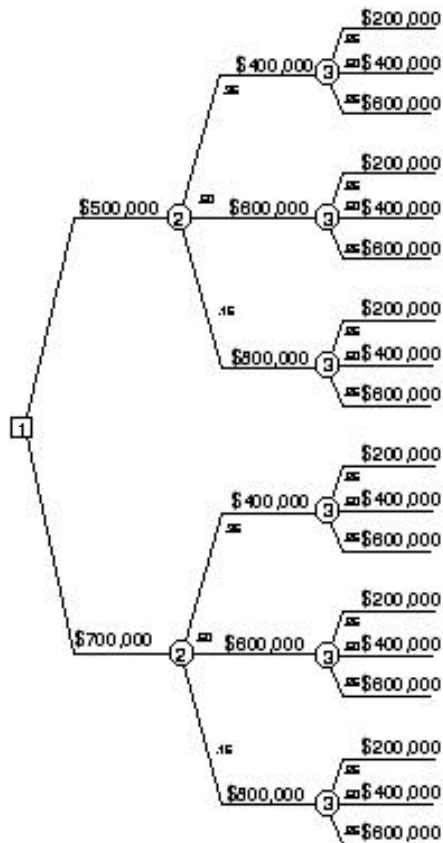


# Bidding Decision Example



In this chapter, we demonstrate Supertree using the simple bidding problem portrayed by the decision tree in Figure 5.1.

The situation: Your company is bidding on a job and trying to decide whether to bid \$500K or \$700K. You are faced with two uncertainties: What will the competitor bid? How much will it cost to produce and deliver the product, if you win the bid?

Node 1, a decision node (indicated by a box), is called BID, and its two branches both lead to node 2—COMPBID—since the competitor’s bid will be the same in either case.

Node 2 is a chance node (indicated by a circle). Each of the branches of node 2 lead to node 3—another chance node that represents your company’s COST should it win the bid.

Figure 5.1

# Entering the Problem

In Supertree, you build the decision tree node by node, using the Input or Change Node Data command from the Structure menu. Supertree asks you for the number of the node (enter 1), the type of node (enter *Decision*), and the number of branches (enter 2). Use the mouse or the Tab key to move from field to field to enter the information for node 1. The screen should look like Figure 5.2 when you have finished. (Leave Rewards at “0.”)

Outcome	Reward	Successor Node
500	0	2
700	0	2

Figure 5.2

Click OK or OK, Next... to enter the information for other nodes. If you make a mistake and want to discard the information and start over, click Cancel.

Use the same procedure to enter the information for nodes 2 and 3 (remember that these are chance nodes rather than decision nodes and you need to assign probabilities to the branches). Even though nodes 2 and 3 are repeated in the tree, you only have to enter the information once—Supertree can figure out the structure of the entire tree.

When you get to node 4—which is an endpoint node—choose the Basic program and enter in the Expression box the Basic-syntax expression  $(BID - COST) * (BID < COMPBID)$ .

## Entering the Problem

This Basic expression calculates the profit or loss resulting from winning or losing the bid.  $(\text{BID}-\text{COST})$  is the profit (or loss) you would incur with this bid. However, the profit (or loss) is zero if you do not win the bid.  $\text{BID}<\text{COMPBID}$  is a logical expression that returns a “true” or “1” if the bid is won and a “false” or “0” if the bid is lost. Multiplying  $(\text{BID}-\text{COST})$  by this expression results in a zero value if you lose the bid and  $(\text{BID}-\text{COST})$  if you win the bid. (For a detailed discussion, see *Decision Analysis for the Professional*.)

Although we used a Basic programming language expression to calculate the endpoint values, you need not know computer programming to use Supertree. Most users link Supertree to a result calculated in an external spreadsheet model, which provides the values needed. (This alternative method is described at the end of this chapter.)

Supertree will also ask you to enter the numbers of the nodes upon which the endpoint depends as the program needs to know which nodes are required to calculate the result. Enter 1 2 3, since the endpoint needs to use Bid, Compbid, and Cost.

When you are done entering all the information for node 4, your screen should look like Figure 5.3.

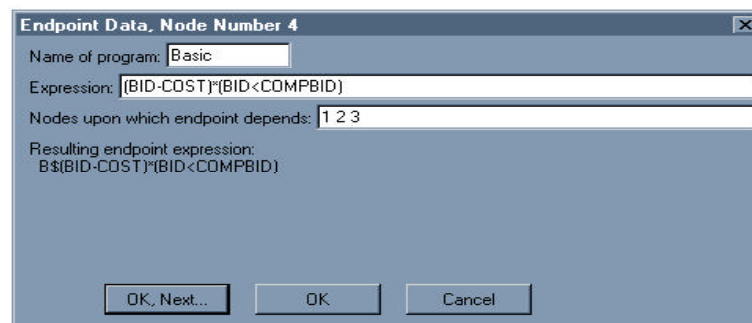


Figure 5.3

## SUPERTREE EXAMPLE

# Entering the Problem

When you have finished, use the Show Tree Structure option from the Structure menu to view a summary of the information entered. Supertree will display the information as shown in Figure 5.4.

Show Tree Structure			
Tree name: Bidding Tree			
STRUCTURE	NAMES	OUTCOMES	PROBABILITIES
1D2 2	BID	500 700	
2C3 3 3	COMPBID	400 600 800	.35 .50 .15
3C4 4 4	COST	200 400 600	.25 .50 .25
4F	B\$(BID-COST)*(BID<COMPRI&D)	Depends on 1 2 3	

Figure 5.4

Under STRUCTURE, the first column shows the node number, the second column shows a one-letter abbreviation for the node type (Decision, Chance, or Endpoint), and the next columns show the number of the successor (or following) nodes for each branch. For instance, 2 C 3 3 3 means "Node 2 is a chance node with three branches, all of which lead to node 3." The rest of the information (NAMES, OUTCOMES, and PROBABILITIES) is taken directly from the input screens. For node 4, the B\$ in front of the expression indicates that this is a Basic expression.

Another way to display the data is to use the Show Schematic Tree option from the Structure menu. Supertree will display the data as shown in Figure 5.4a.

Schematic Tree			
Tree name: Bidding Tree			
Node 1	Node 2	Node 3	Node 4
BID	COMPBID	COST	
500    .20 2 700    .35 2	.35 400    3 50 600    3 .15 800    3	.25 200    4 50 400    4 .25 600    4	B\$(BID-COST)*(BID<CO MPBID) Depends on 1 2 3

Figure 5.4a

# Evaluating and Analyzing the Tree

## Evaluating the Tree

To calculate the values at the end of the tree, select Evaluate Tree from the Evaluate menu and answer Yes when asked if you wish to continue with the evaluation.

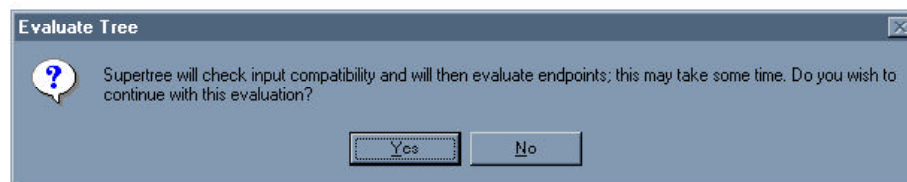


Figure 5.5

Supertree will calculate and store the values at the endpoints and provide the display below.

Total of 18 models run.  
Endpoint values assigned: 2/23/99 17:40 Bidding Tree

To avoid losing the stored endpoint values you should always save the file after the evaluation is complete.

## Analyzing the Tree

After Supertree has calculated and stored the endpoint values (“Evaluated the tree”), you can begin to analyze the results to determine the preferred decision. To obtain the preferred decision, Supertree rolls back the tree from right to left, calculating the expected values at each chance node (the probabilities multiplied by the values and then summed) and selecting the branch with the highest expected value at the decision node.

Select Rollback Tree from the Analyze menu. When Supertree asks you for the new order of nodes, enter *1 2 3*—or just press Enter. Supertree will then calculate and display the expected value of the preferred decision. You can use Display Tree in the Analyze menu to look at the entire tree—this is shown in Figure 5.6.

# Analyzing the Tree

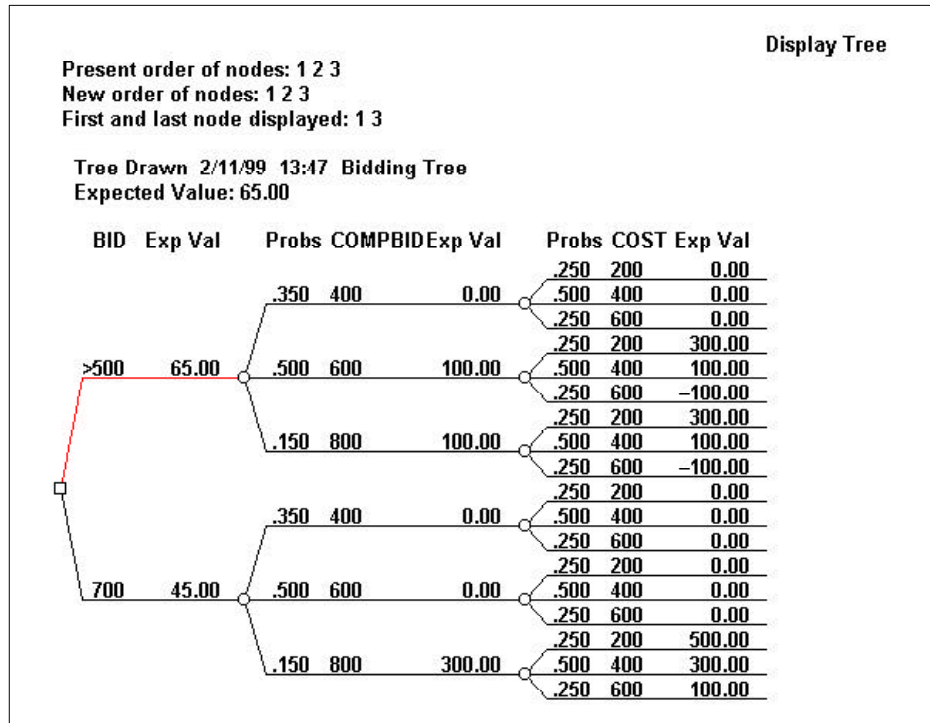


Figure 5.6

In Figure 5.6, the model has calculated the values shown at the end of the tree. The value is 0 when you did not win the contract and (BID-COST) when you did.

When the tree has been fully rolled back, node 1 (the decision node) shows that bidding \$500K is preferable to bidding \$700K (indicated by the > placed before 500). This is because the top branch has a higher expected value (\$65K) than the bottom branch (\$45K).

# Analyzing the Tree

## Displaying Probability Distributions

The number to the left of each node is the expected value for the probability distribution at that point. Additional insight can be gained by examining the probability distribution. Supertree can display the distribution as a histogram or as a cumulative probability distribution.

## Histogram Plot

To display a histogram, select Plot Distribution from the Analyze menu and respond to the two dialog boxes as shown in Figure 5.7. The first dialog box will ask you for order of nodes (1 2 3), node at which to plot the probability distribution (1), type of plot (histogram), distribution (single) and label for axis (Profit (000s)). Click OK.

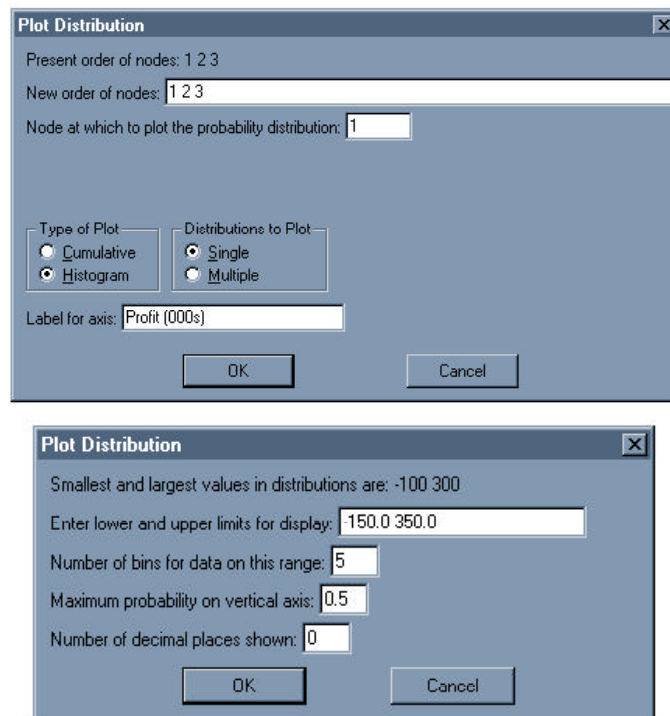


Figure 5.7

## Analyzing the Tree

The histogram plot in Figure 5.8 displays the probabilities in “bins,” which are interpreted as: “There is a 16.25 percent chance that the value ranges between -\$150K and -\$50K, a 35 percent chance it ranges from -\$50K to \$50K, a 32.5 percent chance it ranges from \$50K to \$150K, no chance it ranges between \$150K and \$250K, and a 16.25 percent chance it ranges between \$250K and \$350K.”

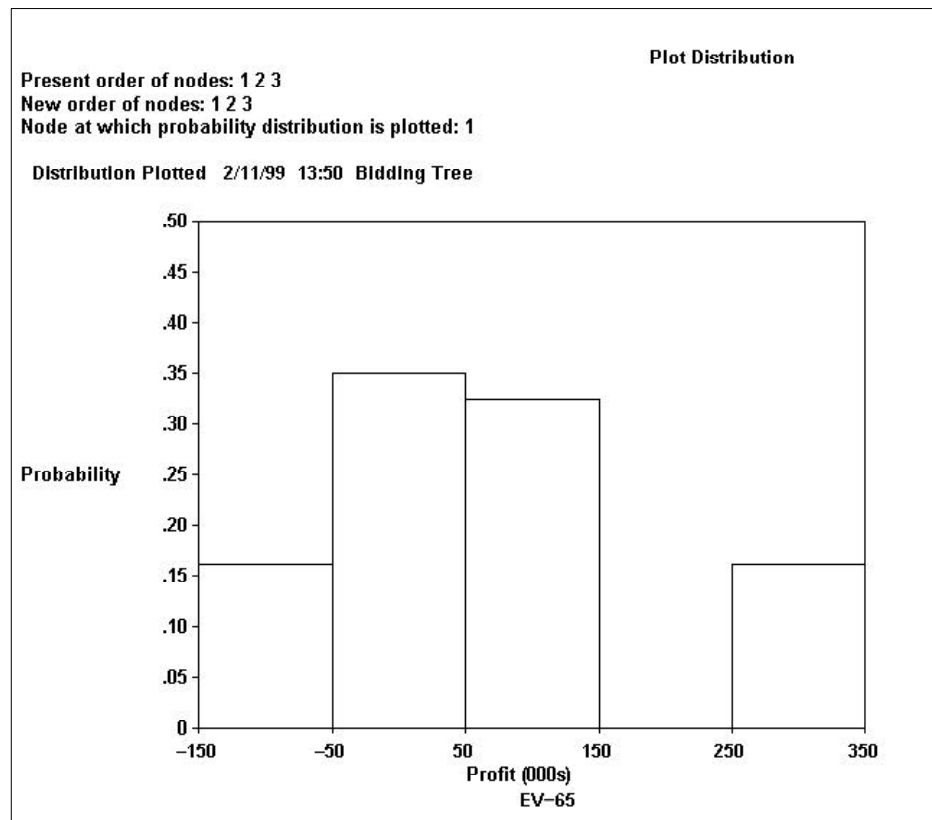


Figure 5.8



# Analyzing the Tree

Many analysts consider the cumulative probability plot to be a more efficient means of presenting information for decision analysis, because it answers most of the questions a decision-maker might ask.

## Cumulative Plot

To view a cumulative probability distribution, select Plot Distribution from the Analyze menu and respond to the two dialog boxes as shown in Figure 5.9.

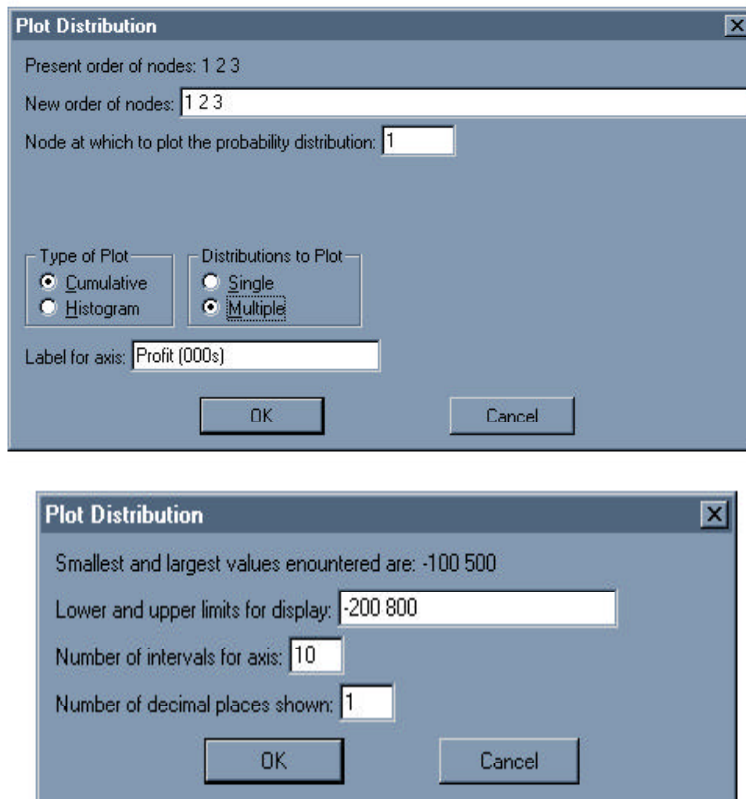


Figure 5.9

## Analyzing the Tree

Cumulative plots show the values at the end of the tree for each alternative against the probability of their being less than or equal to these values. The graph in Figure 5.10 is for two bids, \$500K and \$700K.

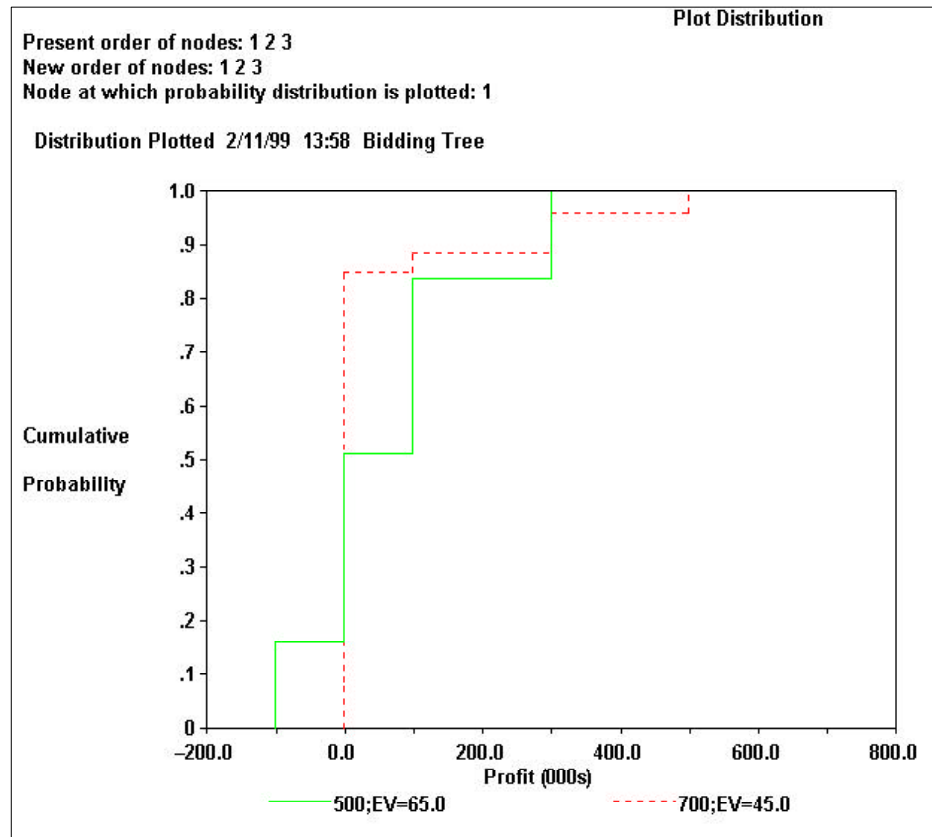


Figure 5.10

The cumulative probability distribution for the bidding decision shows that the worst case for the \$500K bid is a loss of \$100K. This occurs when the bid is won for \$500K, but the cost is \$600K. The best case for the \$500K bid results in a profit of \$300K when the bid is won and cost is \$200K.

## Analyzing the Tree

A complete discussion of cumulative and histogram displays and how to interpret them appears in Chapter 2 of *Decision Analysis for the Professional*.

### Linking Supertree with Spreadsheets

We have seen how endpoint numbers can be calculated using a Basic expression at the endpoint node. In very simple cases, endpoint numbers can also be directly assigned. Most analysts, however, link Supertree to a spreadsheet, using the spreadsheet to calculate endpoint values.

Supertree can call on Excel (Macintosh and Windows), IFPS, Lotus 1-2-3, and Quattro Pro (Windows) models. Details on how to link Supertree with these programs can be found in the “Endpoint Valuation” chapter of this guide.

In this section, we illustrate how the bidding problem could be set up in Excel and used by Supertree to calculate endpoint values. The BIDDING.XLS spreadsheet shown in Figure 5.11 calculates profit.

	A	B	C	D
1	Bid	500		
2	Compbid	600		
3	Cost	400		
4				
5	Profit	100		
6				
7				

Figure 5.11

# Analyzing the Tree

Cell B5 contains the formula  $=(\text{BID}-\text{COST})*(\text{BID}<\text{COMPBID})$ . It could also be entered as  $(\text{B1}-\text{B3})*(\text{B1}<\text{B2})$ , but it is strongly recommended that you always use range names.

To modify the existing Supertree file so that it uses the bidding spreadsheet, select Input or Change Node Data from the Structure menu and enter 4 for the node number. Supertree will show you all the information you have entered so far for this node. Go to Name of program and change it from Basic to Excel. Enter *Profit* for Result name, and AA for Column in which to store results. It will automatically default to Automatic program call.

The last thing you need to do is show Supertree where the Excel file is located. You can do that by clicking the Locate button to locate the spreadsheet called BIDDING. Windows users may also need to show Supertree where the application Excel is located. You can do that by clicking the Options button and then the Locate button to locate the Excel application. Figure 5.12 shows the completed dialog box.

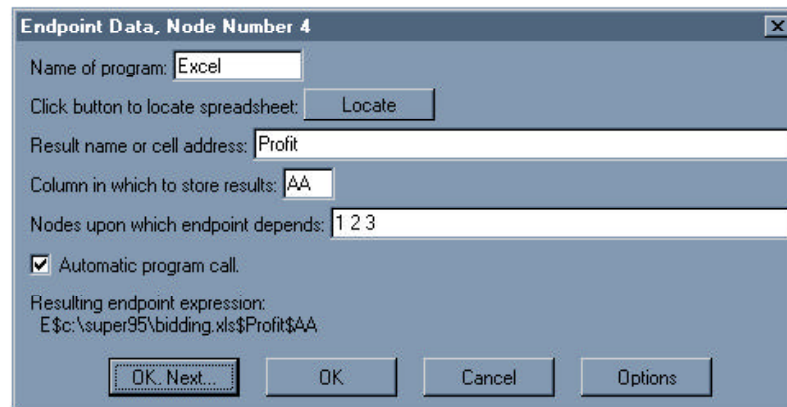


Figure 5.12

## Analyzing the Tree

When you are done making all these changes, choose Show Tree Structure from the Structure menu. Your screen should look like Figure 5.12a.

Show Tree Structure			
Tree name: Bidding Tree			
STRUCTURE	NAMES	OUTCOMES	PROBABILITIES
1D2 2	BID	500 700	
2C3 3 3	COMPBID	400 600 800	.35 .5 .15
3C4 4 4	COST	200 400 600	.25 .5 .25
4E	E\$c:\super95\bidding.xls& \$Profit\$AA	Depends on 1 2 3	
Excel options: Open linked spreadsheets.			

Figure 5.12a

### Gaining Additional Insights

Supertree enables you to obtain many other insights into your problem. For example, you can calculate such measures as the value of perfect information and the value of perfect control. (Supertree is one of the few software packages that can easily perform these operations, which are fairly complex in terms of the mathematical manipulation of the tree.) Supertree can also perform sensitivity to probability and introduce “risk attitude” into the calculations. These and other analytic tools beyond the scope of this guide are discussed in detail in *Decision Analysis for the Professional*.