Analysts Guide: Treeval for Windows, Version 2.0

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Abstract

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TreeVal for Windows provides financial information and analysis to support silvicultural decisions in coast Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco). It integrates the effect of growth and yield, management costs, harvesting costs, product and mill type, manufacturing costs, product prices, and product grade premiums. Output files from the ORGANON growth and yield simulator can be read directly into TreeVal. All management actions, including pruning, are supported. Results, including product recovery information, net value, and financial analysis of silvicultural regimes, are available in both tabular and graphical forms to facilitate comparison of alternative regimes and sensitivity analysis with prices, costs, and other assumptions.

Keywords: Douglas-fir, *Pseudotsuga menziesii*, computer programs, software, computer applications, forestry, forest valuation, product recovery, ecosystem management.

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Introduction

The primary intended use of TreeVal is to evaluate silvicultural regimes for Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) plantations including the effect of those regimes on wood quality and value. The various windows in the program are structured to make it easy to conduct either a limited analysis or a highly detailed one. The capabilities of TreeVal to deal with wood quality and value can be explored with a minimum of input data by looking at the product volume and grade recovery for a single log. By adding data on bucking a tree into logs, one can look at the logs coming from a single tree or a stand of trees plus the product recovery for those logs. The next step up in complexity is evaluating a management regime that produces a stand of trees. Often what is of interest is a comparison of alternative management regimes applied to a particular stand.

This document describes how silviculturists, foresters, and analysts can use TreeVal for Windows as a tool for analyzing forest management regimes.[1] Appendix 1 describes hardware and software requirements. The **Help** topics within TreeVal provide detailed user information accessible through **Help** buttons on the screen, F1 on the keyboard, or the **Contents** and **Search** commands from the **Help** menu. To learn specific details of TreeVal components or how to conduct specific operations within TreeVal, such as creating or editing files, review TreeVal **Help** and the TreeVal tutorial.

Model Description

What TreeVal Does

TreeVal is a framework for helping users understand how stand treatments, tree growth, wood quality, and economics interact in silvicultural regimes. Users set up scenarios with input files containing silvicultural and economic data. The interaction of these factors are summarized in a series of tables and graphs showing financial return, product volumes and value, and other information. This framework facilitates the construction of scenarios with differences in tree growth, silviculture, and economics and the comparison of differences between scenario inputs and results.

TreeVal helps answer questions like:

- What financial return can I expect from my stand under a certain silvicultural regime?
- Which silvicultural treatments can I afford?
- How would the value of my stand be affected by changes in the silvicultural regime or economic conditions?
- Which of several silvicultural regimes is most valuable for my stand?

TreeVal is not designed for timberland appraisals. The bucking algorithm allocates logs to a restricted set of specified lengths and product choices. This is appropriate for long-term decisions but would suboptimize in an appraisal setting with a wider array of product and bucking choices. TreeVal produces detailed results for Douglas-fir only. Trees of other species also can be valued, but only as logs. This is because product recovery information reflecting the results of management decisions is not available for other species.

What is New in Version 2.0

TreeVal was designed to run on the Windows 95 operating system. Version 2.0 appears to be fully compatible with Windows NT, 98, and 2000 operating systems as well. Version 2.0 has improved user-friendliness and new capabilities for analyzing forest management scenarios. The Windows format offers the flexibility to approach forest

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[1] The use of trade or firm names in this publication is for reader information and does not imply endorsement by the U.S. Department of Agriculture of any product or service.

management scenarios from either a silvicultural or economic perspective. Scenarios can be developed in as much or as little detail as desired. The mouse and menu commands allow users knowing only how to use Windows to develop scenarios, view results, and conduct other functions. TreeVal supports pruning. After pruning, trees will grow clear wood from which select lumber and other high-value products are manufactured. Although TreeVal will accept data for up to three pruning lifts, the product recovery information currently in TreeVal is valid only for single-lift pruning.

Overview

This document provides information to silviculturists, foresters, and analysts on how to use TreeVal to analyze forest management regimes. The next section covers some cautions that all users should be aware of. The section "Using TreeVal to Analyze Forest Management Questions" explains how TreeVal uses silvicultural and economic data. It goes on to describe details of input files, results tables, and the organizational framework for input files and developing a forest management question. "A TreeVal Sample Project" gives two examples for setting up forest management questions in TreeVal and discusses other possible projects.

Cautions

Users should be aware of the sources of inaccuracies and software constraints in conducting analyses and making input assumptions. Knowledge of forestry and economics and general experience in problem solving through assumptions will help users mitigate these inaccuracies and constraints. Sources of inaccuracies come from input data and calculations; software constraints are the result of the incomplete state of current recovery work.

Sources of inaccuracies—Inaccuracies can come from the users' input data and from TreeVal calculations. The quality of the input data impacts the quality of TreeVal results. Users should understand how their stand data relate to the real stands that they are modeling. Stand data usually come from growth and yield models or directly from forest inventories. In either case, deviations from real forest growth and yield will occur. When users make assumptions in generalizing cost and price data, they should understand how those assumptions affect discounting in net present value, the allocation of logs to products, and the calculation of costs and values.

Users should be aware of some calculation methods in TreeVal. Log volumes are computed from Bruce's butt log formula for butt logs (Bruce 1982) and Smalian's formula for all other logs (USDA Forest Service 1991). TreeVal calculates results from recovery equations, which are statistical estimates of output from particular mill configurations. These configurations may differ significantly from those encountered by the user. TreeVal recovery equations are from a second-growth Douglas-fir recovery study (Fahey et al. 1991). TreeVal calculates costs by linearly interpolating cost tables with parameters such as diameter at breast height (DBH), small-end diameter, and average volume per tree. Also, TreeVal derives lumber prices from aggregate categories of lumber grades. Such derivations may not represent the grade volume distribution produced by actual mills in the local area. Finally, TreeVal calculates net present value and soil expectation value with one discount rate.

Software constraints—The current state of product recovery work constrains the breadth of the applicability of TreeVal by species, DBH, pruning, and juvenile wood. The recovery equations are designed for Douglas-fir trees up to 30 inches[2] DBH.

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[2] Program calculations and reports are in English units. A table of metric equivalents is provided at the end of the text.

Douglas-fir trees larger than 30 inches DBH are beyond the intended use of the recovery equations in TreeVal; however, these trees can be valued as logs. TreeVal accepts trees pruned up to three times, but it uses recovery information based on a single pruning lift. TreeVal assumes that calculating grade recovery of the knotty core is the same as calculating the recovery for the log at time of pruning. For a single-lift pruning, the knotty core forms a truncated cone. For two- and three-lift pruning, the knotty core approximates a cylinder. The volume of select lumber and other premium grades that require clearwood is based on the volume of clearwood. Further analysis is required to determine the bias involved when multiple-lift pruning is evaluated from the current recovery data.

The grade recovery equations depend on defining juvenile wood core diameter as 20 growth rings. Because juvenile wood changes gradually into mature wood and is difficult to observe under field conditions, the use of a consistent definition results in lower variation and error in the recovery equations. It would be a misapplication of the recovery equations to use juvenile wood measurements based on other definitions.

Using TreeVal to Analyze Forest Management Questions

Answers to forest management questions are found through comparison of forest management scenarios with their net present value, soil expectation value, product volume and values, and other information generated by scenario calculation. Users create a Stand Project and analyze scenarios in the Stand Project window. Users create silvicultural and market files by selecting input files in the Stand Project window. After calculating scenarios, they view results by selecting one or more scenarios in the Stand Project window and the type of result they want to see. Meaningful analysis of forest management questions depends on creating realistic input files and setting up multiple scenarios having recognizable differences.

In addition to examining forest management questions at the stand level, TreeVal also can be used to create a Log Project for valuing individual logs rather than stands of trees and the regimes that produce them. Input files and results are viewed in the Log Project window. The primary value of this feature is that it allows the user to verify and understand the workings of the software. Log Projects are not discussed here, but the TreeVal tutorial provides detailed instructions on creating a Log Project.

Using the Project Window to Set Up Analyses

The structure of the project window is designed to facilitate answering complex forest management questions. Users create scenarios in the project window by selecting input files for silvicultural and market regimes. In the project window, silvicultural regimes are represented by rows below the "SILVICULTURAL REGIME" title; e.g., in row 17 of the project window in figure 1, "con60.qua" (cell B17) represents the stand file for the silvicultural regime with the identification "none" (cell A17). Market regimes are represented by columns to the right of the "MARKET REGIME" title on the first row. For example, in column F of the same project window, market files are in the cells F7 to F15 and represent an array of economic data, including costs for manufacturing, harvesting, annual activities, treatment, sales and administration, and product prices and real rates of change for prices and costs.

The general steps in creating a project are as follows:

1. Set up a project

2. Set up one or more silvicultural regimes

3. Set up one or more market regimes

4. Calculate scenarios

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	A	B	C	D	E	F	G	H	I	J	K
1					MARKET REGIME						
2					Market ID	m1	m2	m3			
3					Market Title						
4					Market Desc	lum & ven	lum & ven	lum & ven			
5					Interest Rate	5.0	5.0	5.0			
6					Product List	1	1	1			
7					Market Files	hi93.lbr	midprice.lbr	max18.lbr			
8						veneer.vnr	veneer.vnr	min18.vnr			
9						demo.opr	demo.opr	demo.opr			
10						demo.maa	demo.maa	demo.maa			
11						demo.mat	demo.mat	demo.mat			
12						demo.hrv	demo.hrv	demo.hrv			
13											
14											
15	SILVICULTURAL REGIME										
16	Silv ID	Stand File	Silv Title	Harvest Ages	Desc	Scenario Results NPV [$/acre]					
17	none	con60.qua		60	30 GROWTH 60 EVEN-A	2,231	2,213	1,410			
18	thin	30_10060.qua		60, 30	30 THIN S 30 GROWTH 60 EVEN-A	2,734	2,665	1,915			
19	prun	pruntest.qua		54	14 GROWTH 19 PC THIN 19 LIFT1 19 GROWTH 54 EVEN-A	3,641	3,139	2,795			
20	read	mtest.std		40	40 EVEN-A	8,452	8,385	6,033			

Figure 1—Project window for DEMO.PRJ. DEMO.PRJ is a sample project displaying four silvicultural regimes and three market regimes producing results for 12 scenarios.

In TreeVal, input and result data are organized in a project. A project is set up by recording the project name and projectwide parameters. Once users have done this, they create scenarios by setting up silvicultural and market regimes, which are composed of data input files. Each silvicultural regime contains a stand file, and each market regime consists of up to nine types of market files. The intersection of a silvicultural regime, which takes up a row in the project window, and a market regime, which takes up a column, is a scenario cell. Once both regimes of a scenario are set up, TreeVal can calculate the scenario.

Project setup—TreeVal calculates all scenarios within a project with the same project-wide parameters. Users set these parameters in dialog boxes by using the **New** command (**File** menu). The parameters are stump height, nominal saw-log length, stand age for discounting, and diameter class limits. Users set stump height for all trees and the nominal saw-log length at 16 or 20 feet. Veneer log length is fixed at 17 feet (including trim). Users choose to discount the stand to either stand age zero (stand establishment) or the first stand age in the Stand file (ORGANON), which is usually when the stand was last inventoried or when a growth model started growing the stand. We call the age to which discounting is done the analysis age. Soil expectation values are calculated only if analysis age is zero. Finally, TreeVal shows results by diameter with the same diameter limits for all scenarios. Users can select these limits. For more information, see **Project Setup** dialog box and **Creating a Project** in TreeVal **Help**.

Setting up a silvicultural regime—The contents of the stand file determine the silvicultural component of the forest management question. A silvicultural regime consists of one stand file. Once users type in a four-character code in the Silv ID column, (which TreeVal uses to name results files and add titles to results tables), they can select a Stand file by right-clicking under the Stand File Column. The Stand file can be a Wood

Quality Output file produced by the ORGANON growth model (Hann et al. 1997). Information about ORGANON can be found at the ORGANON internet site: www.cof.orst.edu/cof/fr/research/organon/. Users also can manually enter stand data into a Stand file spreadsheet readable by TreeVal. See the TreeVal tutorial for more information. After the selection, TreeVal reads the stand history and lists the thinning and harvest ages in descending order, so that you can readily recognize the stand file by final harvest age and thinning ages. Existing silvicultural regimes can be cut, copied, pasted, and deleted.

Setting up a market regime—A market regime consists of up to nine market files and some additional information. The market files provide information on product prices, production costs, and their estimated real rates of change. Additional information required for a complete market regime includes the interest rate for discounting when calculating net present value and soil expectation value, and the list of products to manufacture from the stands. Once users type in a two-character code for the market identification, which TreeVal uses to name results files and add titles to results tables, they can select or create market files. Frequently-used market files can be kept in a file pool, which can be accessed from any project. Existing market regimes can be cut, copied, pasted, and deleted.

Calculation—Once silvicultural and market regimes are set up, calculation is done by activating the cell representing the intersection of the silvicultural regime (a row) and the market regime (a column).

Input Files

TreeVal has 10 types of input files: the stand input file and nine types of market input files—lumber, veneer, other products, other species, harvesting, treatment, annual cost, real changes in prices, and real changes in costs. Stand and Market files hold input data representing the parameters that define the forest management problem. Although this is a large number of files, the advantage is that many of them can be called up for successive analyses without modification. All files used for a scenario are retained with the associated results; but when a scenario is deleted, those files are automatically deleted as well (unless they have been used by more than one scenario). Files saved to the File Pool directory in TreeVal remain intact until deleted by the user.

Stand file—The Stand file contains data on forest inventory, tree whorls, pruning, and stand history. The stand history lists the treatments and stand age when treatments occurred. Every tree in the Stand file has a line of inventory data, including DBH, total height, and crown ratio, and one or more lines describing measurements at whorls: height of whorl, diameter of largest branch, diameter of juvenile wood, and diameter of bole. Also, for each time the tree was pruned, the Stand file has one line of pruning data. The ORGANON growth model can produce an output file that can be read into TreeVal. Users can manually enter data into a Stand file template.

Lumber, Veneer, and Other Products files—Lumber and Veneer files contain product prices, manufacturing costs, and the minimum and maximum small-end diameter log constraints. See figure 2 for an example of a Lumber file. Veneer files have a similar format. Users input lumber prices into six categories, which TreeVal converts to either visual or machine stress-rated (MSR) lumber prices. Current prices for these six categories are reported quarterly by the Pacific Northwest Research Station (Warren 2000). Price projections are available for the same grade groupings in Haynes and Fight (1992). These price categories represent weighted averages of multiple grades, which have variable production volumes from quarter to quarter. The TreeVal recovery equations recognize six lumber grade categories for both Visual and MSR lumber. However,

Figure 2—Lumber input file.

these aggregations differ from those used for input prices, so TreeVal adjusts the input prices (by applying volume weighting factors) to better approximate the grade assortment generated from the lumber recovery equations. To calculate the price for Select lumber, for example, TreeVal assumes production will be 50 percent C Select and 50 percent D Select and Shop.

The Other Products file pertains only to Douglas-fir and contains the net value (or mill yard value) of chip logs, the gross value of residue chips and other residues, and the minimum small-end diameter for chip logs. If given more than one allocation option, TreeVal will allocate logs to chip logs if the net value of a chip log is greater than the net value of the log if processed as lumber or veneer. Residue chips and other residues are byproducts of lumber and veneer manufacturing processes.

Treatment Cost file—The Treatment Cost file contains the cost of silvicultural treatments other than types of harvesting (fig. 3). These treatments are stand establishment (STAND EST), fertilization (FERTIL), pruning (LIFT1, LIFT2, LIFT3), and precommercial thinning (PC THIN). If the analysis age is at stand age zero, TreeVal will include the cost of stand establishment. TreeVal accepts different pruning costs for the first (LIFT1), second (LIFT2), and third (LIFT3) pruning. Users also can enter pruning costs in dollars per acre or per tree, or both. Users can assign the first thinning of a silvicultural regime as a precommercial thinning. There are no products for a precommercial thinning, and the cost specified in the Treatment Cost file for precommercial thinning is charged to the year it is incurred.

Harvest Cost file—The Harvest Cost file contains costs for three activities: harvesting (felling, bucking, movement to roadside or landing, and loading), hauling (transport to processing site), and sale administration (fig. 4). Harvest and sale costs each can be split into two categories: Harvest cost/acre and Harvest cost/thousand cubic feet (MCF), and Sale cost/acre and Sale cost/MCF, respectively. Users can enter harvest costs and sales and administration costs as either $/acre or $/MCF, or both. Harvest costs in $/MCF are entered in the table. The other three categories require only a single value. Any values entered in the above categories will be included in the total harvest cost (the harvest cost categories are additive). Alternatively, the users need to enter only one value, if it reflects all relevant costs. A unique set of harvest costs can

demo.mat · Treatment Costs

Activity	$/Acre
STAND EST	400
FERTIL	
LIFT1	150
LIFT2	
LIFT3	
PC THIN	100

Figure 3–Treatment Cost File.

demo.hrv

Harvest Type: EVEN-A

Harvest cost/acre: 160   Sale cost/acre:

Haul cost/MCF: 150   Sale cost/MCF: 50

Harvest Cost $/MCF

Avg DBH of cut trees	Harvested volume per acre					
	2	3	4	5	6	20
10	554	550	548	547	546	544
12	460	456	454	453	452	450
14	386	383	381	380	379	377
16	330	326	324	323	322	320
18	351	339	334	330	328	319
20	307	295	289	285	283	275
22	279	267	261	257	255	246
24	266	254	248	244	242	234

Figure 4—Harvest Cost file.

be assigned to each of four Harvest Type options (Even-aged Harvest, Uneven-aged Harvest, Overstory Removal, and Thinnings) displayed in the drop-down box at upper left. TreeVal will assume zero harvest cost for any Harvest Type for which the user has not entered a specific set of harvest costs. The $/MCF cost table differs with average DBH of cut trees and harvested volume per acre (MCF/acre). TreeVal calculates harvest cost in $/MCF by interpolating between the user-entered DBH and harvest volume values. The harvested volume per acre and average DBH parameters in the harvest cost table remain the same for all Harvest Types in a scenario.

Annual Management Cost file—The Annual Management Cost file lists the annual management costs that can be applied from stand analysis age to the end of the rotation (fig. 5). TreeVal assesses annual management costs and changes in real costs and real prices based on the number of years from the analysis age. Annual management costs can be adjusted for inflation by entering an adjustment multiplier in the sales and administration column of the Real Cost Change file.

Real Cost and Real Price Change files—The Real Cost Change file (fig. 6) lists real percentages of change in costs and prices, which can be applied from analysis age to the end of the rotation. To calculate real change, costs are grouped into four categories: manufacturing, harvesting and hauling, treatment, and sale administration. The sale administration multiplier also will be applied to annual costs. Real changes in costs and prices are zero beyond the first rotation.

The Real Price Change file adjusts prices similarly.

Figure 5—Annual Management Cost file.

Figure 6—Real Cost Change file.

Solutions and Reports

TreeVal displays volume and value results by product type, product grade, diameter class, and stand (per acre and per thousand cubic feet); displays costs and values of production steps from stump to finished product; and shows volume and value results for individual trees and logs. Scenarios generate five types of results tables: Summary, Log Allocation and Value, Product Recovery and Value, Stand Volume and Value, and Production Costs and Values. Users view these results by selecting up to six scenarios that share the same silvicultural or market regime and then clicking the result name under the **Table** menu or on a **Results** button on the toolbar. Scenarios that have the same silvicultural regime share the same row, and those that have the same market regime share the same column. The selected scenarios need not be contiguous in the column or row.

After users select a results table for viewing, they choose the reporting options (such as viewing volume or value results) and harvests they want. A scenario may include several commercial thinnings and other types of harvests. Users can compare any set of harvest results from multiple scenarios; TreeVal will display a table with the results for each scenario identified by the silvicultural and market labels given by the user in the Project window. While the **Results** table window is active, users also can view graphic representations for all results except the Production Costs and Values table. The five results tables are briefly described below.

Summary table—The Summary table shows net present value, soil expectation value, and total product volume in cubic feet. Users can compare the differences in silvicultural or market regimes of scenarios with net present value, soil expectation value, and gross product value. View the Summary table by choosing **Tables** from the menu bar or the **Summary** button on the toolbar.

Log Allocation and Value—Log Allocation and Value results summarize log volume and net value of logs at the mill. These results are listed by Douglas-fir product type: lumber (either visually graded or machine stress rated), veneer, and chip logs; and logs of species other than Douglas-fir.

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Product Recovery and Value—Product Recovery and Value results summarize gross value and volumes by the grade in each product type. Chip logs are a single product with no grades. These results show how different silvicultural regimes may effect the production of quality wood.

Stand Table, Volume, and Values—Stand Table, Volume, and Values command shows trees per acre, gross value, product volume, clearwood volume, juvenile wood volume, and largest limb diameter by DBH classes. These results show how silvicultural regimes affect the growth of different sized trees and their growth in clearwood and juvenile wood volume and limb diameter. Also, these results show which tree size contributes the most volume and value.

Production Costs and Values—Production Costs and Values results show values and costs from gross value to conversion return at the stump. These results show the relation between silvicultural treatment, manufacturing, harvesting, and hauling costs. Higher cost silvicultural treatments generally produce larger log sizes, which are associated with lower unit cost of harvest and manufacture.

Other Results—TreeVal allows users to view value and volume information of individual trees from multiple scenarios. It also is possible to analyze log output at the log level instead of the stand level. This is accomplished by accessing the Tree List file and associated Detail files. When a scenario is calculated, TreeVal generates six data files (Tree List file, Log Allocation Detail, Product Volume Detail, Product Value Detail, Stand Detail, and Production Cost and Value Detail) that can be viewed by clicking on the right mouse button and double clicking on the highlighted selection. A Tree List file (with a ".tre" extension) is generated for each calculated scenario and can be several hundred kilobytes in size. Each of the five detail files contains data for all scenarios in a project. The files are described briefly below. Definitions of all labels used in reporting are listed in appendix 3.

Tree List—Displays product, volume, and value information for every log of each harvested tree in the Stand file for the selected scenario. Unless otherwise indicated, designations refer to tree-specific data and results pertaining to trees included in the Stand file.

Log Allocation Detail—Reports all calculated scenarios. Displays allocation of harvest by log type, volume, and net value for every harvest activity and the total of all harvests. Total harvest data are given first, then each harvest activity, beginning with the final harvest. All reporting is at the stand level.

Product Volume Detail—Reports all calculated scenarios. Displays product volume allocation by type and grade for every harvest activity and the total of all harvests. Total harvest data are given first, then each harvest activity, beginning with the final harvest All reporting is at the stand level.

Product Value Detail—Reports all calculated scenarios. Displays product value allocation by product type and grade for every harvest activity and the total of all harvests. Total harvest data are given first, then each harvest activity, beginning with the final harvest. All reporting is at the stand level.

Stand Detail—Reports all calculated scenarios. Displays aggregate volume and value data for pruned and unpruned trees by diameter class. All reporting is at the stand level.

Production Cost and Value Detail—Reports all calculated scenarios. Displays Douglas-fir log revenue and harvest and manufacturing costs per acre and per cubic foot for every harvest activity and the total of all harvests. Total harvest data are given first, then each harvest activity, beginning with the final harvest. All reporting is at the stand level.

Analyzing a Project

Users can analyze a set of scenarios when the scenarios have relevant differences among them. These differences arise from the files and information composing the regimes: stand files, market files, interest rates, and product allocations. Scenarios with the same market regime, but different silvicultural regimes, can illustrate the effectiveness of silvicultural treatments and management actions. Using a computer model, users may want to grow a stand or a set of stands with a different number of thinnings, under different thinning intensities, or compare fertilized with not fertilized, or pruned with not pruned. Scenarios with the same silvicultural regimes, but different market regimes, can illustrate the influence of different harvesting systems, manufacturing systems, product allocations or other market components.

A TreeVal Sample Project

TreeVal includes a sample project, called DEMO.PRJ, displaying four silvicultural regimes and three market regimes producing results for 12 scenarios. Three of the silvicultural regimes (with Silv IDs "none," "thin," and "prun") arise from the same set of initial stand conditions, a stand in western Washington with 304 trees per acre and King's site index (King 1966) of 125. Additional stand information can be found in Barbour et al. (1997). The silvicultural regimes for this project analysis are as follows:

Grow/harvest (Silv. ID="none"), no treatments, even-aged harvest age 60.

Grow/commercial thin/harvest (Silv. ID="thin"), commercial thin age 30 to 100 trees per acre, even-aged harvest at age 60.

Grow/precommercial thin/prune/harvest (Silv. ID="prun"), precommercial thin at age 19 to 100 trees per acre, prune all remaining stems at age 19, even-aged harvest at age 54.

The final silvicultural regime (Silv. ID="read") contains stand data read in from an Excel file created with the STIMPORT.XLS template, has no treatments and an even-aged harvest age 40. This regime is intended only to demonstrate how stand data in spreadsheet format can be read into TreeVal; it is not meant to be comparable with the regimes described above. The results of the various market regimes on a given silvicultural regime can be compared directly, however.

The three market regimes are as follows:

Produce veneer and visual grade lumber with high (1993) lumber prices (Market ID = m1). TreeVal will allocate logs to the product option offering the highest returns.

Produce veneer and visual grade lumber (Market ID = m2). Lumber price equals 75 percent of m1.

Produce veneer and visual grade lumber with high (1993) lumber prices, but impose log allocation restrictions such that all logs with a small-end log diameter (SED) greater than 18 inches must be allocated to veneer production (Market ID = m3). This forces big logs to veneer even if returns are less than those obtained from lumber production. The project window for DEMO.PRJ is shown in figure 1.

	A	B	C	D	E
	Log Allocation Volume: m1				
1	Log Allocation Volume: m1				
2					
3	Silv/Mrkt Id	none_m1	thin_m1	prun_m1	read_m1
4	Harvest	All	All	All	All
5	Title/ID	none	thin	prun	read
6	Df Lumber (cf)	719	829	3935	1051
7	Df Veneer (cf)	14896	12693	12147	17895
8	Df Chip Logs (cf)	132	180	49	141
9	Other Species (cf)	0	0	0	0
10	Total (cf)	15746	13702	16131	19087

Figure 7—Log Allocation table.

Reviewing DEMO.PRJ

TreeVal is configured to analyze a single silvicultural regime across multiple market regimes, or a single market regime across multiple silvicultural regimes. First, we view results tables (see description under Solutions and Reports) for one market regime (M1) across the four silvicultural regimes described above. To display the results side by side for all four regimes, drag the cursor across all four scenario cells under the m1 market column to highlight them. Then click on the desired results button from the TreeVal tool bar. The Summary table is not illustrated here because much of what it contains is already displayed in the Project window. Figure 7 shows the Log Allocation table, which reports harvest log volume (the default setting for the table) for the entire rotation. The thinning regime (Title/ID = "thin") produced the lowest volume, 13,702 cubic feet, and the pruning regime had the highest volume, even though it was harvested 6 years earlier. The volume for the "read" silvicultural regime is actually higher than the pruning regime, but this is a hypothetical stand, very different from the other three silvicultural regimes.

View the table again, this time selecting net value instead of volume for the "show" option. The same relation holds, with the pruning regime generating the highest return at the mill ($66,251). The net value for the "read" silvicultural regime is again the "highest," but remember, this is a hypothetical stand.

Figure 8 shows product recovery information. The default setting is for volume, but again, this information also is available in value terms. The thinning regime produced the lowest lumber volume and highest chip log volumes, as one would expect. Only the pruned regime generated any of the highest value lumber grade category, D selects and better. The lumber and veneer product units are expressed in board feet and square feet, respectively, and chip logs and byproducts are listed in terms of cubic-foot log volume.

The Stand table (fig. 9) reveals the diameter distribution of harvested trees. The thinning regime has a bimodal distribution, reflecting the cutting of 8- to 12-inch trees for commercial thinning and then a final harvest. The regime with no treatments ("none") has a bell-shaped diameter curve owing to the higher stocking late in the rotation resulting in tree suppression. The pruning regime harvested only 82 trees because a precommercial thinning was applied. Recall that the previous table reported a high volume of lumber produced by the pruned regime.

Product Recovery Volume: m1

	A	B	C	D	E
1	Product Recovery Volume: m1				
2					
3	Silv/Mrkt Id	none_m1	thin_m1	prun_m1	read_m1
4	Harvest	All	All	All	All
5	Title/ID	none	thin	prun	read
6	**Df Lumber (bf)**	**3898**	**4339**	**36326**	**5694**
7	D selects & better	0	0	23263	0
8	Structural	42	129	257	2
10	No.1	332	608	1894	135
12	No.2	2156	2341	7386	2904
14	Utility	965	890	2535	1787
15	Economy	403	371	990	865
16	**Df Veneer (sf 3/8)**	**281500**	**240056**	**233778**	**346302**
17	A and B	11501	6976	2307	14388
18	C	166720	122289	66153	190329
19	D	103279	110791	165318	141585
20	Chip Logs (cf)	132	180	49	141
21	Residue Chips (cf)	5338	4686	5176	6240
22	Residue Sawdust (cf)	1237	1065	1309	1530

Figure 8—Product Recovery table.

TPA for All DF: m1

	A	B	C	D	E
1	TPA for All DF: m1				
2	Inches	TPA	TPA	TPA	TPA
3	Silv/Mrkt Id	none_m1	thin_m1	prun_m1	read_m1
4	Harvest	All	All	All	All
5	Name	none	thin	prun	read
6	4 - 5.9	0	0	0	0
7	6 - 7.9	0	0	0	0
8	8 - 9.9	3	76	0	0
9	10 - 11.9	26	100	0	0
10	12 - 13.9	31	0	0	0
11	14 - 15.9	32	0	0	0
12	16 - 17.9	32	0	0	0
13	18 - 19.9	26	25	0	100
14	20 - 21.9	27	22	8	50
15	22 - 23.9	19	18	21	50
16	24 - 25.9	5	23	17	50
17	26 - 27.9	0	0	18	0
18	28 - 29.9	0	0	19	0
19	> 30	0	0	0	0
20	Total	201	265	82	250

Figure 9—Stand table.

The Production Costs and Values table (fig. 10) provides a breakdown of costs across all activities to determine the conversion return to stumpage in either $/cubic feet log volume or $/acre.

Now view the Log Allocation table results for only the "none" silvicultural regime across all three market regimes (fig. 11). In this example, the harvest log volume is the same for market regimes m1 and m2 (15,746 cubic feet), but slightly higher for m3 (15,752 cubic feet), even though the silvicultural treatments are identical in the three scenarios.

Production Costs and Values per unit volume: m1

	A	B	C	D	E
1	Production Costs and Values per unit volume: m1				
2		$/cf	$/cf	$/cf	$/cf
3	Silv/Mrkt Id	none_m1	thin_m1	prun_m1	read_m1
4	Harvest	All	All	All	All
5	Name	none	thin	prun	read
6	Gross Product Value for Df	4.21	3.99	4.67	4.20
7	Manuf. Costs for Df	0.45	0.42	0.57	0.44
8	Conversion Return, all logs	3.77	3.58	4.11	3.77
9	Hauling Costs, all logs	0.15	0.15	0.15	0.15
10	Harvesting Costs, all logs	0.33	0.34	0.25	0.27
11	Sale Costs, all logs	0.05	0.04	0.05	0.05
12	Conversion Return for Stumpage, all	3.23	3.05	3.66	3.30

Figure 10—Production Cost and Value table.

Log Allocation Volume: none

	A	B	C	D
1	Log Allocation Volume: none			
2				
3	Silv/Mrkt Id	none_m1	none_m2	none_m3
4	Harvest	All	All	All
5	Title/ID	m1	m2	m3
6	Df Lumber (cf)	719	719	14556
7	Df Veneer (cf)	14896	14896	1063
8	Df Chip Logs (cf)	132	132	133
9	Other Species (cf)	0	0	0
10	Total (cf)	15746	15746	15752

Figure 11—Log Allocation table, volume comparison by market regime.

This arises from a shift in volume between products with different log lengths. Veneer logs are bucked to 17-foot lengths vs. 16.5 feet for saw logs. Because of log length assigned to each product, a tree allocated to veneer will have a top log length different from the top log of the same tree allocated to lumber. Depending on log geometry, trees with veneer logs may yield slightly more or less volume than the same stem bucked to saw-log lengths. In market regimes m1 and m2, veneer is more profitable than lumber for logs greater than 18 inches SED, so the volume allocation did not change. In fact, over 90 percent of log volume is sent to veneer. However, in m3, the lumber and veneer input files are configured to allocate all logs less than 18 inches SED to lumber. The SED restrictions always take precedence over optimizing financial returns, so all logs less than 18 inches SED allocated to veneer in m1 and m2 are forced into lumber in m3. The result is a redirection of over 90 percent of the veneer logs in m1 and m2 to lumber in m3. Thus product allocation can be dictated by prices or diameter limits.

Metric Equivalents

When you know:	Multiple by:	To find:
Inches	2.54	Centimeters
Feet	0.305	Meters

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Appendix 1

System Requirements

TreeVal requires an IBM-compatible computer, 8 mb of RAM, and a Windows 95, Windows 98, Windows 2000, or Windows NT operating system. A Pentium microprocessor, additional RAM, and a large hard drive (1 GB or more) are desirable. RAM requirements differ with problem size. Stands with many trees and activities will need more RAM to do calculations.

Appendix 2

Tips and Troubleshooting

Suggestions and strategies—Focus on comparing scenarios that share the same silvicultural regime or market regime. Make sure that these scenarios have specific differences so that valid deductions can be made. For example, one scenario may be pruned and the other not or one scenario may have a heavy thinning at stand age 30, another a light thinning at age 30, and a third no thinning.

In the Project window, the cells containing descriptions can be expanded and files can be viewed by double-clicking the cell. When using a Stand Input file (*.STD), specify a branch index (BIX) for the butt log. If you do not, TreeVal will estimate the branch index at the base of the crown and extend that number to the butt log. Because the branch index at the base of the crown tends to be larger than anywhere else along the bole, not specifying a BIX for the butt log will cause TreeVal to overestimate the BIX for the butt log. This overestimate results in predicting poorer quality forest products and a lower valued butt log.

TreeVal produces files that are in Excel 4.0 format. Some of these files are used to generate results tables; these files have the extensions TA1, TB2, TC1, TC2, TD1, and TE1. To view these files, select one scenario cell, then select one of the detail file commands from the right-click menu. Calculating TreeVal scenarios also produces additional files not required to run a project; these files have the extensions: ERR and TRE. Because TRE files are generally quite large, you may want to erase these files to free hard disk space.

TreeVal operates efficiently when the number of trees in a scenario is 255 or less. TreeVal will run with stands of more than 255 trees (provided the amount of whorl data is small; see next section, "Troubles") but the maximum number of trees that can be displayed in the tree list file is 255. TreeVal accepts, at most, eight harvests of any type (thinning, even-aged harvest, uneven-aged harvest, and overstory removal). If TreeVal encounters more than eight harvests, it will ignore the first harvest(s).

TreeVal may use up available RAM on some computers. Save frequently and exit Windows when the calculations seem to be slowing down. If the stands you use have many trees and you have several scenarios, you may have to calculate each scenario individually rather than use the **Calculate All** menu choice.

Troubles: memory problems and freezing up—TreeVal's ability to solve scenarios is influenced by many factors, such as rotation length and the number of activities conducted. The two primary limitations are available RAM on the computer and the amount of data comprising each tree entry in the stand input file. For ORGANON output files, tree data will consist primarily of lines of whorl data (one line for every 5 years of tree growth). Thus the number of trees that TreeVal can handle in a stand input file is inversely correlated with the amount of whorl data per tree. If TreeVal fails to solve a scenario with an ORGANON type input file, the user has three options. The first is to add RAM to the computer. The second is to reduce the number of trees in the input file by combining the information from several similar trees into one "typical" tree and adjusting its expansion factor. In stands where tree population is sufficiently diverse, this may not be appropriate. The third option is to reduce the number of lines of whorl data

for each tree down to four lines: the first whorl, the whorl having the greatest limb size in the first 17 feet of the tree, the whorl having the greatest limb size in the rest of the tree, and the whorl closest to a 4-inch top. TreeVal interpolates the remaining whorl values. By reducing the number of whorls per tree from several dozen to just four, many more trees can be included in the input file. The amount of information for each tree is reduced, but the integrity of the stand data is enhanced by the inclusion of additional trees.

Appendix 3

Definitions

Tree List File—

TreeNum—Number of each tree in the stand input file

Spp—Species

DBH—Diameter at breast height

ht—Height of tree

tpa—Trees per acre; the expansion factor applied to a given tree number

age—Age of the tree

cr—Crown ratio; the ratio of live crown to total tree height

grossCubicVolume—Gross merchantable wood volume of a tree (in cubic feet)

totalValue—Total value of all wood products from tree for a selected market regime

grossClrWdVolume—Gross merchantable clearwood volume (in cubic feet)

grossJuvWdVolume—Gross merchantable juvenile wood volume (in cubic feet)

treeBIX—Branch index

pruned—Indicates if tree was pruned; 1=pruned, 0=unpruned

logCount—Number of logs of merchantable timber

mfgCost—Cost to manufacture lumber and veneer from a tree

product_1—Product type for log 1; 3=saw log, 5=veneer log, 6=chip log

logLength_1—Length of log 1

sed_1—Small-end diameter of log 1

led_1—Large-end diameter of log 1

logBIX_1—Branch index; average of largest limb in each quadrant of log 1

juvWoodCoreDiam_1—Diameter of juvenile wood core

logVol_1—Wood volume of log 1 (in cubic feet)

logVolume_g1_1 through logVolume_g6_1—Log 1 volume by product type and grade (lumber in MBF, veneer in thousand square feet [MSF]). For visual lumber grade: g1=D Selects and Btr; g2=Select Structural; g3=No.1; g4=No. 2; g5=No. 3; g6=Economy. For MSR lumber grades: g1=D Selects & Btr.; g2=2100; g3=1650F; g4=1450; g5=No. 3; g6=Economy. For veneer: g1=AB; g2=C; g3=D.

chipVolume_1—Wood chip volume of log 1 (in cubic feet) if designated as a chip log

residueChipsVolume_1—Volume of wood chips (in cubic feet solid wood equivalent, generated by processing log 1 into lumber or veneer

residueVolume_1—Sawdust, etc., volume (in cubic feet solid wood equivalent, generated by processing log 1 into lumber or veneer

logValue_g1_1 through logValue_g6_1—Gross value of log 1 by product type and grade ($). For visual lumber grade: g1=D Selects & Btr; g2=Select Structural; g3=No.1; g4=No. 2; g5=No. 3; g6=Economy. For MSR lumber grades: g1=D Selects & Btr.; g2=2100; g3=1650F; g4=1450; g5=No. 3; g6=Economy. For veneer: g1=AB; g2=C; g3=D.

chipValue_1—Value of wood chips from log 1 if designated as a chip log

residueChipsValue_1—Value of wood chips generated by processing log 1 into lumber or veneer

residueValue_1—Sawdust, etc., value generated by processing log 1 into lumber or veneer

Definitions, Log Allocation Detail—

SilvId—Four-letter reporting code assigned to silvicultural regime

MarketId—Two-letter reporting code assigned to market regime

harvestAge_1—Age_1 represents the sum of all harvests occurring in the scenario

unprDFLumVol_1—Volume of unpruned Douglas-fir logs (in cubic feet) allocated for lumber production from all harvests in the scenario

prDFLumVol_1—Volume of pruned Douglas-fir logs (in cubic feet) allocated for lumber production from all harvests in the scenario

unprDFVenVol_1—Volume of unpruned Douglas-fir logs (in cubic feet) allocated for veneer production from all harvests in the scenario

prDFVenVol_1—Volume of pruned Douglas-fir logs (in cubic feet) allocated for veneer production from all harvests in the scenario

chipLogVolume_1—Volume of chip logs (Douglas-fir and other species) from all harvests in the scenario (in cubic feet)

otherVolume_1—Volume of other species logs (in cubic feet) produced from all harvests in the scenario

unprDFLumValue_1—Total value of unpruned Douglas-fir logs allocated for lumber production from all harvests in the scenario

prDFLumValue_1—Total value of pruned Douglas-fir logs allocated for lumber production from all harvests in the scenario

unprDFVenValue_1—Total value of unpruned Douglas-fir logs allocated for veneer production from all harvests in the scenario

prDFVenValue_1—Total value of pruned Douglas-fir logs allocated for veneer production from all harvests in the scenario

chipLogValue_1—Total value of chip logs (Douglas-fir and other species) from all harvests in the scenario

otherValue_1—Total value of other species logs (in cubic feet) produced from all harvests in the scenario. Subsequent column headings in the file change only with respect to time of harvest. For instance, for the heading "HarvestAge_2," Age_2 represents the final harvest in the scenario. Additional iterations (e.g., Age_3, Vol_3, and Val_3) refer to age, volume, and value of a commercial thinning occurring earlier in the scenario. It is the third harvest report (after total harvest and final harvest) in the file, hence the _3 designation.

Definitions, Product Volume Detail—

SilvId—Four-letter reporting code assigned to silvicultural regime

MarketId—Two-letter reporting code assigned to market regime

age_1—age_1 represents the sum of all harvests occurring in the scenario

prodTypeOfLumber_1—Indicates whether lumber is produced under visual or MSR grading

volumeLumber_1_1 through volumeLumber_1_6—Total volume of Douglas-fir lumber produced from unpruned logs from all harvests in the scenario, reported by grades 1-6. For visual lumber grades: 1=D Selects and Btr; 2=Select Structural; 3=No.1; 4=No. 2; 5=No. 3; 6=Economy. For MSR lumber grades: 1=D Selects & Btr; 2=2100; 3=1650; 4=1450; 5=No. 3; 6=Economy.

volumeAB_1 through volumeD_1—Volume of Douglas-fir veneer by grade (grades AB, C, D) from unpruned logs from all harvests in the scenario

volumeChipLogs_1—Total wood chip volume (in cubic feet) of chip logs from all harvests in the scenario

volumeChipResidue_1—Total volume of wood chips (in cubic feet solid wood equivalent, generated by processing unpruned logs from all harvests in the scenario

volumeResidue_1—Volume of sawdust, etc. (in cubic feet solid wood equivalent, generated by processing unpruned logs from all harvests

volPrLumber_1_1 through volPrLumber_1_6—Total value of Douglas-fir lumber produced from pruned logs from all harvests in the scenario, reported by grades 1-6. For visual lumber grades: 1=D Selects & Btr; 2=Select Structural; 3=No.1; 4=No. 2; 5=No. 3; 6=Economy. For MSR lumber grades: 1=D Selects & Btr; 2=2100; 3=1650; 4=1450; 5=No. 3; 6=Economy.

volPrAB_1 through volPRD_1—Total volume of Douglas-fir veneer by grade (grades AB, C, D) produced from pruned logs from all harvests in the scenario

volPrChipLogs_1—Total wood chip volume (in cubic feet) of chip logs from all harvests in the scenario

volPrChipResidue_1—Total volume of wood chips (in cubic feet solid wood equivalent, generated by processing pruned logs from all harvests in the scenario

volPrResidue_1—Total volume of sawdust, etc. (in cubic feet solid wood equivalent), generated by processing pruned logs from all harvests in the scenario. Subsequent column headings in the file change only with respect to time of harvest. For instance, for the heading "Age_2," Age_2 represents the final harvest in the scenario. Additional iterations (e.g., Age_3, volumeLumber_3_1) refer to the age when the third harvest

activity takes place (a commercial thinning occurring earlier in the scenario, because _2 indicates final harvest), and volume of lumber of grade 1 produced from unpruned logs of that harvest. It is the third harvest report (after total harvest (_1), and final harvest (_2) in the file), hence the _3 designation.

Definitions, Product Value Detail—

SilvId—Four-letter reporting code assigned to silvicultural regime

MarketId—Two-letter reporting code assigned to market regime

age_1—age_1 represents the sum of all harvests occurring in the scenario

prodTypeOfLumber_1—Indicates whether lumber is produced under visual or MSR grading

valueLumber_1_1 through valueLumber_1_6—Total value of Douglas-fir lumber produced from unpruned logs from all harvests in the scenario, reported by grade 1-6. For visual lumber grades: 1=D Selects & Btr; 2=Select Structural; 3=No.1; 4=No. 2; 5=No. 3; 6=Economy. For MSR lumber grades: 1=D Selects & Btr; 2=2100; 3=1650; 4=1450; 5=No. 3; 6=Economy.

valueAB_1 through valued_1—Value of Douglas-fir veneer by grade (grades AB, C, D) from unpruned logs from all harvests in the scenario

valueChipLogs_1—Total wood chip value (in cubic feet) of chip logs from all harvests in the scenario

valueChipResidue_1—Total value of wood chips generated by processing unpruned logs from all harvests in the scenario

valueResidue_1—Value of sawdust, etc., generated by processing unpruned logs from all harvests

valuePrLumber_1_1 through valuePrLumber_1_6—Total value of Douglas-fir lumber produced from pruned logs from all harvests in the scenario, reported by grade 1-6. For visual lumber grades: 1=D Selects & Btr; 2=Select Structural; 3=No.1; 4=No. 2; 5=No. 3; 6=Economy. For MSR lumber grades: 1=D Selects & Btr; 2=2100; 3=1650; 4=1450; 5=No. 3; 6=Economy.

valuePrAB_1 through valuePrD—Total value of Douglas-fir veneer by grade (grades AB, C, D) produced from pruned logs from all harvests in the scenario.

valuePrChipLogs_1—Total wood chip value of chip logs from all harvests in the scenario

valuePrChipResidue_1—Total value of wood chips generated by processing pruned logs from all harvests in the scenario

valuePrResidue_1—Total value of sawdust, etc., generated by processing pruned logs from all harvests in the scenario

Subsequent column headings in the file change only with respect to time of harvest. For instance, for the heading "Age_2," Age_2 represents the final harvest in the scenario. Additional interactions (e.g., Age_3, valueLumber_3_1) refer to the age when the third harvest activity takes place (a commercial thinning occurring earlier in the scenario, because _2 indicates final harvest), and value of lumber of grade 1 produced from unpruned logs of that harvest. It is the third harvest report (after total harvest (_1), and final harvest (_2)) in the file, hence the _3 designation.

Definitions, Stand Detail—

SilvId—Four-letter reporting code assigned to silvicultural regime

MarketId—Two-letter reporting code assigned to market regime

harvestAge—Age a harvest activity takes place; for a scenario, each activity is reported separately, as well as the sum of all harvests in the scenario.

dcSeq_01—Diameter class counter; tallies the number of diameter class increments present

Dcls_01—The diameter range of diameter class 1; subsequent classes will all have the same range (range and starting diameter selected in the Project Setup process)

tpaPruned_01—Number of pruned trees in the stand in diameter class 1

tpaUnpruned_01—Number of unpruned trees in the stand in diameter class 1

tpaOther_01—Number of other species trees in the stand in diameter class 1

grossValuePruned_01—Gross value of all pruned logs harvested in diameter class 1

grossValueUnpruned_01—Gross value of all unpruned logs harvested in diameter class 1

grossValueOther_01—Gross value of all other species logs harvested in diameter class 1

prodVolumePruned_01—Volume (in cubic feet) of all pruned logs harvested in diameter class 1

prodVolumeUnpruned_01—Volume (in cubic feet) of all unpruned logs harvested in diameter class 1

prodVolumeOther_01—Volume (in cubic feet) of all other species logs harvested in diameter class 1

clearVolumePruned_01—Volume (in cubic feet) of clearwood of all pruned logs harvested in diameter class 1

juvWoodPruned_01—Volume (in cubic feet) of juvenile wood in all pruned logs harvested in diameter class 1

juvWoodUnpruned_01—Volume (in cubic feet) of juvenile wood in all unpruned logs harvested in diameter class 1

LLADPruned_01—Diameter of largest limb in pruned logs harvested in diameter class 1

LLADUnpruned_01—Diameter of largest limb in unpruned logs harvested in diameter class 1. Subsequent column headings in the file change only with respect to diameter class. For instance, in the heading "dcSeq_02," _02 represents the second diameter class, _03 the third, etc.

Definitions, Production Cost and Value Detail—

SilvId—Four-letter reporting code assigned to silvicultural regime

MarketId—Two-letter reporting code assigned to market regime

harvestAge_1—Age_1 represents the sum of all harvests occurring in the scenario

productValueDFAc_1—Value of Douglas-fir products from all harvests (in dollars/acre)

mfgCostDFAc_1—Cost of manufacturing Douglas-fir products from all harvests (in dollars/acre)

convReturnAllLogsAc_1—Conversion return of all logs at the mill (in dollars/acre)

harvCostAllLogsAc_1—Cost of harvesting all logs for all harvests in a scenario (in dollars/acre)

haulCostAllLogsAc_1—Haul cost for all logs for all harvests in a scenario (in dollars/acre)

saleCostAllLogsAc_1—Sale cost for all logs for all harvests in a scenario (in dollars/acre)

convReturnStumpageAllLogsAc_1—Conversion return of all logs at the stump (in dollars/acre)

productValueDFFt_1—Value of Douglas-fir products from all harvests (in dollars/cubic feet)

mfgCostDFFt_1—Cost of manufacturing Douglas-fir products from all harvests in a scenario (in dollars/cubic feet)

convReturnAllLogsFt_1—Conversion return of all logs at the mill (in dollars/cubic foot)

harvCostAllLogsFt_1—Cost of harvesting all logs for all harvests in a scenario (in dollars/cubic feet)

haulCostAllLogsFt_1—Hauling cost for all logs for all harvests in a scenario (in dollars/cubic feet)

saleCostAllLogsFt_1—Sale cost for all logs for all harvests in a scenario (in dollars/cubic feet)

convReturnStumpageAllLogsFt_1—Conversion return of all logs at the stump (in dollars/cubic foot). Subsequent column headings in the file change only with respect to time of harvest. For instance, in the heading "harvestAge_2," Age_2 represents the final harvest in the scenario. Additional iterations (e.g., harvestAge_3, harvCost-AllLogsAc_3) refer to the age when the third harvest activity takes place (a commercial thinning occurring earlier in the scenario, because _2 indicates final harvest), and the harvest cost per acre for all logs removed in that harvest. It is the third harvest report (after total harvest (_1), and final harvest (_2)) in the file, hence the _3 designation.

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