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User's Guide to STUMP: A System of Timber Utilization and Mill Processing

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Abstract

STUMP is an integrated software package that allows estimation of end-product yield and value from hardwood-timber cruise data or from scaled log data. It consists of four modules and data-entry routines that use standard timber-cruise or log-scale entries plus the quality measures of tree or log grade to estimate yield value by log and lumber grade. The system uses existing tree- and log-quality models to predict expected lumber yields. Newly developed models are used to predict merchantable-log yields and potential veneer yields from tree-cruise data. STUMP is written in MS-FORTRAN and designed for MS-DOS machines with at least 384K RAM and two disk drives.

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Introduction

STUMP is an integrated set of microcomputer programs that assists the user in appraising timber, determining appropriate stumpage values, maintaining log-yard inventories by log size and grade, predicting primary end-product yields, and monitoring sawmill production. The programs are organized into four modules: 1) Woodland Inventory and Appraisal, (2) Tree to Log Conversion, (3) Mill Yard Inventory and Log Appraisal, and (4) Mill Processing and End-Product Recovery (Brisbin et al. 1988). Users can enter the system at various points depending on specific needs (Figure 1). STUMP should be a useful tool for landowners, consultants, timber buyers, and wood processors in evaluating product yields and values and in choosing processing alternatives.

Program Description

Module 1: Woodland Inventory and Appraisal

The Woodland Inventory and Appraisal module provides information on volume and end-product value for a tract of timber that is appraised for sale or inventoried for management purposes. Required input consists of the normal tree-cruise data of species. diameter at breast height (d.b.h.), and merchantable height plus tree grade (Hanks 1976). Optionally, an estimate of veneer section length in the butt of the trees can be recorded. Various sampling methods as well as a 100-percent cruise can be accommodated by the program. Output from Module 1 consists of a descriptive cover page, a one-page summary of the estimated product volume and value yield for the entire tract, and separate pages of estimates for each species. This output can be printed directly or saved to a disk file for editing. Summary statistics by species also are saved to a disk file for input to most commercial graphics programs. Models and algorithms used in Module 1 are presented in Hanks (1976) and Hanks and Brisbin (1978).

Module 2: Tree to Log Conversion

The second module provides information on the size, quality, and value of sawlogs and veneer logs that can be produced from the tract of timber. This is accomplished through a two-stage procedure. First, the expected board-foot volume and number of logs by log grade (Rast et al. 1973) are predicted from the tree-cruise data file that was used in Module 1. Second, a bucking simulator is used to produce estimated distributions of logs by scaling diameter, length, and log grade. The output can be both printed and stored in a disk file. The printed output contains a frequency table showing the estimated number of cut logs by species, log grade, scaling diameter, and length. Estimated stumpage or delivered log values based on user-supplied prices also are shown. The disk file that is created contains a description of each log that is produced from the tree data file by the bucking simulator. This file can be input into Module 3 or it can be further analyzed by commercial spreadsheet or graphics programs. Models and algorithms used in Module 2 are presented in Yaussy et al. (1988) and Yaussy and Brisbin (1988).

Module 3: Log Inventory and Appraisal

This module, primarily for use by the sawmill manager, provides a means for estimating the volume and value of lumber by lumber grade that can be produced from logs delivered to the sawmill. The user may directly enter the scaling data of logs that are delivered to the mill from independent sources or use output from Module 2 as input to this module. Log-scale information also is used to create and update a master log-yard inventory file that shows the current status of the log yard as to number of logs, volume, and value. This file will be updated by Module 4 as logs are withdrawn from inventory and converted to end products. Models and algorithms used in Module 3 are reported in Yaussy and Brisbin (1983), Howard and Yaussy (1986), and Yaussy (1986, 1987).

Module 4: Mill Processing

The fourth module tracks with the actual log-conversion process and the end products produced. Input consists of the identification numbers of logs that are withdrawn from the mill-yard inventory and processed through the sawmill. The actual lumber tally for the day's sawing also is entered. The effective use of this module will require that the identity of individual logs be maintained in the log-yard inventory by the use of stamped log numbers or a log-tagging procedure. The logs that are processed from inventory in a day's sawing can then be identified and the actual versus estimated lumber production can be compared to assist in the evaluation of mill efficiency. The daily sawing information is accumulated so that weekly, monthly, or year-to-date summaries can be produced. The sawing summaries are formatted for screen output. A hardcopy can be printed by using the Print Screen (Prt Sc) key. A less detailed screen-output summary of the log inventory also can be obtained in Module 4. A third output option in Module 4 allows the user to create ASCII files of a portion of the log inventory, lumber inventory, or sawing-summary files for further analysis by commercial software.

Data Input

Interactive data-entry programs are provided as a part of the overall system to create the tree, log, and lumber data files needed. The files are saved in ASCII format. As an alternative, these data files could be created through a text editor or programable, hand-held data recorder. The only restrictions are that the files be in ASCII format and that the variables be in the order expected by the computation routines (See Tables 1, 2, and 7 in the Appendix). The lumber-value file and the delivered-log or stumpage-value file supplied with the program are intended to be updated by the user. Prices entered can be current dollars per thousand board feet (Mbf) from a marketing bulletin, or local prices. A simple interactive data-entry routine is included to make these changes.

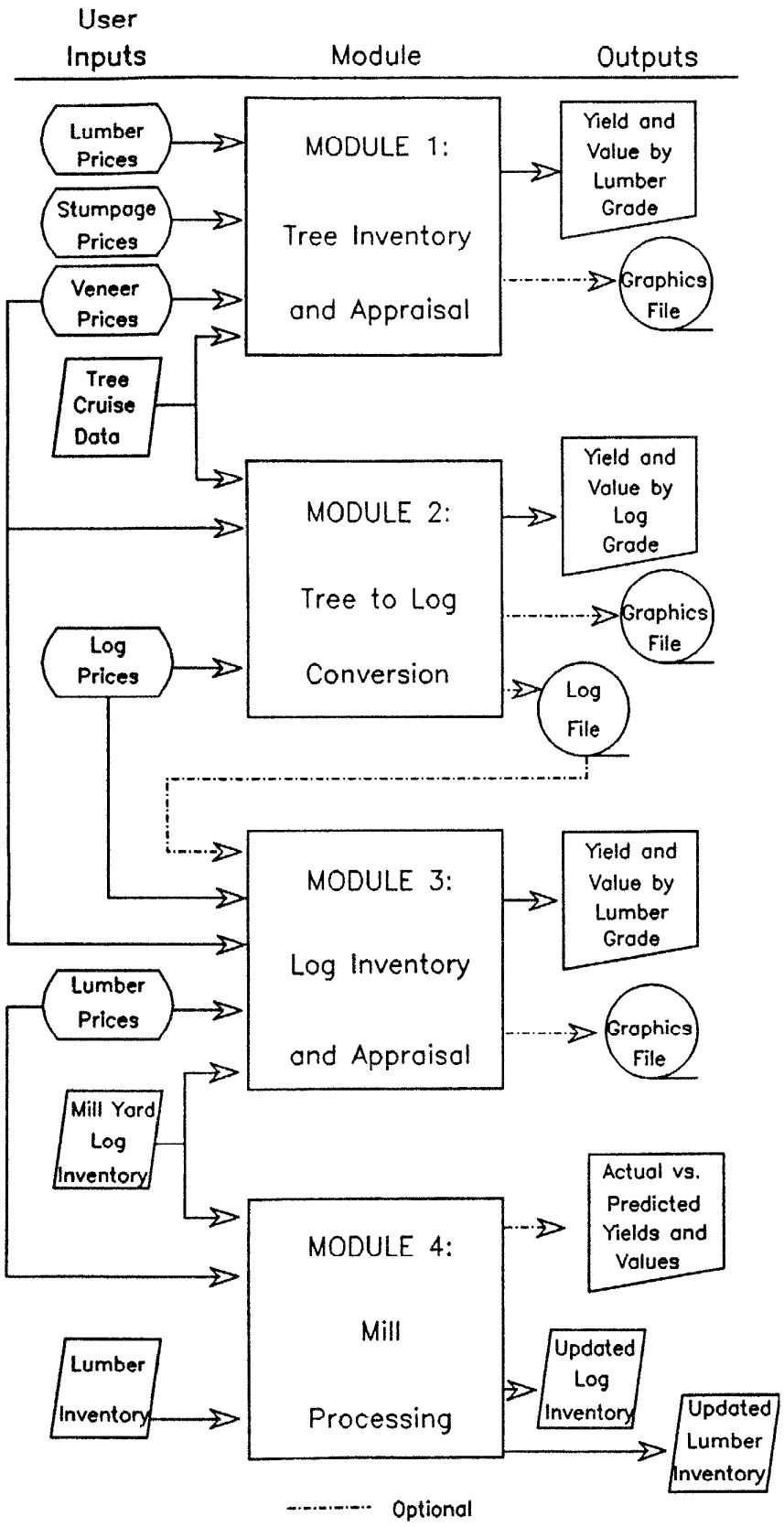

Figure 1.—Flowchart of the STUMP package.

Hardware Required

Modules 1, 2, and 3 are written in FORTRAN 77 and compiled by the Microsoft Optimizing Compiler, version 4.01. Module 4 and the interactive data-entry programs are implemented with the dBase III + programming language and compiled with Clipper. A menu system is used to select the appropriate modules. The individual modules will execute in 384K of RAM using MS-DOS, version 2.11 or greater. A minimum of two floppy drives or one floppy and one hard disk is required. However, a hard disk is almost mandatory to effectively manage the log-yard inventory file. An 80-column printer will accommodate all printed output.

User's Guide

1.0 Creating and Editing Data Sets

STUMP uses three types of inventory data sets: tree, log, and lumber. This section describes how the tree and log-inventory data sets are created and modified. The lumber inventory is discussed in the section describing Module 4. In all of the modules and editing routines. repeated pressing of the F10 function key will return the user to the Main Menu.

1.1 Tree Cruise data (Modules 1 and 2).

This is the first option of the STUMP Main Menu. The program asks for the full pathname of the tree-cruise data set. Include the drive designation and subdirectory names if needed:

A:STUMP.TRE
C:\DATA\SOUTH40.TRE

A directory of files can be displayed by pressing the F9 function key and entering the drive designation. A pathname and wild cards can be included:

A:
A:*.TRE

Each data set has an associated header file with the same file name as the data set with the extension 'HE1'. This file contains tract information specific to the data set. If the data-set name entered does not exist, the user can choose to create a new file. An ASCII file with data columns separated by a space and in the order shown in Table 1 can be entered as the data set. The program will ask you to create a header file.

When a valid data set name has been entered, the introductory information contained in the header file will appear on the screen for editing. If this is a new file, or an ASCII file without a header file, the user will be asked to provide the necessary information. Figure 5 (Appendix) is an example of the screen containing the introductory information:

- Date the tract was measured
- Name of the person collecting the data
- Name of the tract
- Number of acres in the tract
- Sampling method used

The user would choose a (100-percent tally) if every tree on the tract was measured. More information is needed if any of the other sampling methods was used. To calculate intervals, the program needs the number of points, plots, or strips, and the student's t-value. The t-value for a 95-percent confidence interval is 1.96 if more than 120 trees are measured. If a point sample has been taken, the basal-area factor (BAF) of the prism or angle gauge is entered. Otherwise, the size of the plots or strips is entered in acres.

The next menu determines how the data set will be modified. The choices are:

1. Append
2. Edit
3. Delete

If this is a new data set, only Append is meaningful.

Each tree record appended to the data set contains the variables shown in Figure 6. Online explanations of these variables can be displayed by pressing the F9 function key. Plot numbers should be numbered consecutively from one to the number of plots entered in the header file. This assures proper execution in Module 1. Tree d.b.h. can be entered in inches and tenths. Merchantable height is in 16-foot logs and half logs. Cull is the percentage of the tree considered defective. Thirty-one species groups are available and their codes are listed in Table 3. The timber cruiser is required to take USDA Forest Service tree grades on each tree to obtain an accurate estimation of value for the tract. If tree grades are not taken, grade 2 can be used for all trees to obtain a rough estimate of the volume, though the values will not be valid. Finally, the length of a veneer bolt can be entered for each tree.

When the Edit option is chosen, function keys allow the user to move through the list of trees in the data set (Fig. 7). Entering a record number for editing brings up the same screen shown in Figure 6 with the values that were entered previously for that record. These values may now be corrected.

The third option allows the user to delete entire tree records from the data set. A tree list is displayed and function keys allow movement through the list much as in the Edit option. Entry of a record number toggles the '*' indicating whether or not the tree record will be deleted. The actual deletion does not occur until the delete routine is exited. The entire data set is sorted by plot number when the tree-inventory modification program is exited; therefore, any appended trees are automatically listed with the data from the same plot.

1.2 Log-inventory data (Modules 3 and 4).

The second option of the STUMP Main Menu allows the user to modify and create log-inventory data sets used in Modules 3 and 4. This program operates in much the same way as the tree cruise modification program. The user is

asked to enter the full pathname of the log-inventory data set. Include the drive designation and subdirectory names if needed:

A:STUMP.LOG
C:\DATA\NORTH40.LOG

A directory of files can be displayed by pressing the F9 function key and entering the drive designation. A pathname and wild cards can be included:

A:
A:*.LOG

The log file is an ASCII file in the format shown in Table 2. The data columns must be in the order shown with at least one space between columns. Any ASCII file in this format can be used as a log file and edited by this program.

As with the tree data, the log data can be modified in any of three ways:

1. Append
2. Edit
3. Delete.

If this is a new data set, only Append is meaningful. Each log record appended to the data set contains the variables shown in Figure 8. On-line explanations of the variables can be displayed by pressing the F9 function key. The first ID must be a unique identification for each log. It may consist of up to 10 letters and numbers in any arrangement. The second ID, also 10 characters, may be anything meaningful to the user such as an identification number for the hauler who delivered the log to the mill yard or the tract from which it came. Valid species codes are listed in Table 3.

Scaling diameter, log length, and cull percent are measurements normally taken for a log. USDA Forest Service log grades are required to accurately predict lumber grade yields from each log. If log grades are not taken. grade 2 can be used for all logs to obtain a rough estimate of the volume, though the values will not be valid. The date that the log record is entered into the computer is automatically displayed, but can be changed at the user's discretion.

Function keys allow movement through the list of logs in the Edit option (Fig. 9). Entering a record number for editing brings up the screen shown in Figure 8 with the values that were last entered for that log. These values may now be corrected.

The Delete option allows the user to remove entire log records from the data set. The log list is displayed and function keys allow movement through the list. Entering a record number toggles the '*' indicating whether or not the log record will be deleted. The actual deletion does not occur until the delete routine is exited.

1.3 Editing the price files.

The price files must be edited by the user to maintain up-to-date price information which will provide more accurate value estimations. Four price files are provided. The first file is the lumber prices used in Module 1. Next is a file containing stumpage prices based on tree grades. The third file comprises the log prices used in Modules 2, 3 and 4. A different lumber price file is used for Modules 3 and 4 than in Module 1 because different species substitutions occur. The option to print any of the price files is provided.

The first and fourth options work identically, so this description will apply to both. A screen containing the 31 species groups listed in Table 3 will be displayed. The user is asked to select the species group in which the prices will be changed. Only the prices applicable to the market area in which the user competes need to be updated. The next display contains all of the lumber grades and associated prices per Mbf for the selected species. These prices can now be updated as needed. When the user indicates that the prices are correct, the screen returns to the previous menu to allow for another species selection.

The second option asks the user if the stumpage price of the trees is to be calculated by the Doyle or International 1/4-inch log rule. This will determine which type of volume will be calculated for the trees. A screen containing the 31 species groups will then be displayed. The user is asked to select the species in which the prices will be modified. Only the prices applicable to the market area in which the user competes need to be updated. When a species number is selected, a table containing the price per Mbf is displayed for each of four tree grades. When the prices have been corrected, the program returns to the previous menu at which point the user may choose a different species.

After choosing the third option, the user is asked if the logs are to be scaled by the Doyle or International 1/4-inch log rule. This will determine which type of volume will be calculated for the logs. The user can then choose to edit the veneer- or log-grade product prices. The veneer-product prices are used in both Modules 1 and 2. A screen containing the 31 species groups will be displayed. The user is asked to select the species in which the prices will be modified. Only the prices applicable to the market area in which the user competes need to be updated. The choice of product prices to be edited can be changed by pressing the F8 function key. When a species number is selected, a table containing the price per Mbf is displayed for logs or veneer bolts. The veneer prices are split into four categories depending on scaling diameter. Likewise, the value placed on grade 1 logs can be different for smaller scaling diameters (13 to 15 inches). When the prices have been corrected, the program returns to the previous menu at which point the user may choose a different species or change product choice.

Any of the price files can be printed by selecting the fifth option. The user is queried as to which price file is desired.

2.0 Using the Modules

This section discusses the actual operations of the modules. Each module is a stand-alone program that is independent of other modules. However, the input of data and the output of estimates have been designed to flow smoothly from one module to another, yielding similar results. The data sets to be used with these modules should be edited by the routines described in Section 1. The price files should be kept up to date to ensure accurate estimates of value by the modules.

2.1 Module 1 operation.

The Woodland Inventory and Appraisal Module (option 4 of the Main Menu) uses tree-cruise data which must have been processed through the edit procedure offered by option 1. A short introduction to Module 1 can be viewed if desired, and pertinent price information (edited in option 3) and coefficients are read in at this time.

When asked for the TREE DATA file name, the full pathname should be entered, including the disk drive specification. If a nonexisting file is specified, you will be prompted to reenter the proper pathname of your file. Introductory information for the tract being analyzed is presented on the screen if the data file exists and has an associated header file (created by the edit procedure). Any of this information can be changed at this time for this single run of the data. Caution should be used in changing items which will affect the results of the analysis, such as inventory method, acreage, etc.

2.1.1 Output options. The next menu shown contains the output options. These can be modified to suit the user's needs and can be saved as defaults to be used in subsequent runs of Module 1. The species-breakdown option allows the user to choose the amount of output that will be created. Choosing the "STAND" option will produce a single-page printout (all species combined). Choosing the "SPECIES" option produces a single-page output for each species in the data file in addition to the stand summary sheet.

Three product-breakdown summaries can be reported:

1. *No. 1 common and better.* Combines the values for Firsts and Seconds (FAS), FAS One Face (F1F), Selects (SEL), and Number 1 Common (N1C) lumber grades into a single unit and reports this along with the other usual lumber grades.

2. *No. 1 face and better.* Combines the values for FAS and F1F lumber grades into a single unit and reports this along with the other usual lumber grades.

3. *All products available.* Reports all lumber grades.

Tree-scale volumes can be reported in the Doyle or International log scale. Caution must be used in changing the log rule since the tree and veneer values reported depend on the values per Mbf entered in the price files, which should reflect the log rule used.

One of three options can be chosen for the form of the output: saved to a disk file, sent to the printer, or both. The summary file is created with the same pathname as the tree data file used as input except that the three-letter extension is changed to 'SM1'. If this file should exist from a previous run, you will be asked if you want to overwrite it. If you choose not to overwrite it, you will be prompted for a new pathname. The resulting data file can be printed at a future date or from a different machine.

An optional graphics file can be produced that will have the same pathname as the data file with the extension 'GR1'. It contains summary information that can be imported into a spreadsheet or graphics package for further analysis. Each line in the file contains nine values (Table 4):

1. Species code as listed in Table 3.
2–5. Net board footage by the log scale being used for each tree grade.
6. Total of items 2 through 5.
7. Percentage of N1C and better lumber in the total lumber-scale volume.
8. Percentage of F1F and better lumber in the total lumber-scale volume.
9. Value of all the lumber in dollars per Mbf.

When you leave the output options menu, the program will begin processing the data file. If the data file contains records for chestnut oak, processing will stop and you will be asked whether worm holes in chestnut oak lumber should be treated as a defect in this analysis. When processing is completed, the screen displays predicted total board-foot lumber-scale volumes and volumes on a per-acre basis and for the entire tract for each species (Fig. 10). Although the output from Module 1 is fairly self-explanatory (Fig. 2), a few comments may need clarification. Average height of the trees is average merchantable height. Unless otherwise stated, all values listed are calculated on a lumber-scale basis. Only veneer value and stumpage value are calculated on a timber-scale basis. If any sampling method other than a 100-percent cruise is chosen, standard errors and confidence intervals are displayed. These statistics represent only deviations from the actual volumes due to sampling method used and do not account for any deviations introduced by the prediction equations that were used.

2.2 Module 2 operation.

The Tree to Log Conversion Module (option 5 of the main menu) uses tree-cruise data which must have been processed through the edit procedure offered by option 1. A short introduction to Module 2 can be viewed if desired, and pertinent price information (edited in option 3) and coefficients are read in at this time.

When asked for the TREE DATA file name, the full pathname should be entered, including the disk drive

specification. If a nonexisting file is specified, you will be prompted to reenter the proper pathname of your file. Introductory information for the tract being analyzed is presented on the screen if the data file exists and has an associated header file (created by the edit procedure). Any of this information can be changed at this time for this single run of the data. Caution should be used in changing items that will affect the results of the analysis, such as inventory method, acreage, etc.

2.2.1 Output options. The next menu shown contains the output options. These can be modified to suit user needs and can be saved as defaults to be used in subsequent runs of Module 2. The species breakdown option allows you to choose the amount of output that will be created. Choosing the 'STAND' option will produce a single-page printout (all species combined). Choosing the 'SPECIES' option produces a single-page output for each species in the data file in addition to the stand summary sheet.

One of three options can be chosen for the form of the output: saved to a disk file, sent to the printer, or both. The summary file is created with the same pathname as the tree data file used as input except that the three-letter extension is changed to 'SM2'. If this file should exist from a previous run, you will be asked if you want to overwrite it. If you choose not to overwrite it, you will be prompted for a new pathname. The resulting data file can be printed at a future date or from a different machine.

A data file can be produced that contains a record of each log predicted to be produced from the stand. This includes all the acreage in the stand, not only that which was sampled; therefore, ample disk space is needed to hold the new data set. The log file is created with the same pathname as the tree data file used as input except that the three-letter extension is changed to 'LOG'. If this file should exist from a previous run, you will be asked if you want to overwrite it. If you choose not to overwrite it, you will be prompted for a new pathname. The log data set will have the same format as those used in Modules 3 and 4 (Table 2).

An optional graphics file can be produced that will have the same pathname as the data file with the extension 'GR2'. It contains summary information that can be imported into a spreadsheet or graphics package for further analysis. Each line in the file contains seven values (Table 5):

1. Species code as listed in Table 3.
2–5. Net board footage by the log scale being used for each log grade.
6. Total of items 2 through 5.
7. Value of all the logs in dollars per Mbf of lumber.

When you leave the output options menu, the program will begin processing the data file. When processing is completed, the screen displays predicted numbers of logs, gross and net board-foot log-scale volumes and the value of the logs on a per-acre basis and for the entire tract for each log grade (Fig. 11). The output from Module 2 is fairly self-explanatory (Fig. 3). If any sampling method other than a 100-percent cruise is chosen, standard errors and confidence intervals are displayed. These statistics represent only deviations from the actual volumes due to sampling method used and do not account for any deviations introduced by the prediction equations.

2.3 Module 3 operation.

The Log Inventory and Appraisal Module (option 6 of the main menu) uses log-yard inventory data which must have been processed through the edit procedure offered by option 2. A short introduction to Module 3 can be viewed if desired, and pertinent price information (edited in option 3) and coefficients are read in at this time.

When asked for the LOG DATA file name, the full pathname should be entered, including the disk drive specification. If a nonexisting file is specified, you will be prompted to reenter the proper pathname of your file.

2.3.1 Output options. The next menu shown contains the output options. These can be modified to suit user needs and can be saved as defaults to be used in subsequent runs of Module 3. The species-breakdown option allows you to choose the amount of output that will be created. Choosing the 'STAND' option will produce a single-page printout (all species combined). Choosing the 'SPECIES' option produces a single-page output for each species in the data file in addition to the stand summary sheet.

As with Module 1, three product-breakdown summaries can be reported:

1. *No. 1 common and better.* Combines the values for Firsts and Seconds (FAS), FAS One Face (F1F). Selects (SEL), and Number 1 Common (N1C) lumber grades into a single unit and reports this along with the other usual lumber grades.

2. *No. 1 face and better.* Combines the values for FAS and F1F lumber grades into a single unit and reports this along with the other usual lumber grades.

3. *All products available.* Reports all lumber grades.

The log-scale volumes can be reported in the Doyle or International log scale. Caution must be used in changing the log rule since the log and veneer values reported depend on the values per Mbf entered in the price files, which should reflect the log rule used.

One of three options can be chosen for the form of the output: saved to a disk file, sent to the printer, or both. The summary file is created with the same pathname as the log data file used as input except that the three-letter extension is changed to 'SM3'. If this file should exist from a previous run, you will be asked if you want to overwrite it. If you choose not to overwrite it, you will be prompted for a new pathname. The resulting data file can be printed at a future date or from a different machine.

An optional graphics file can be produced that will have the same pathname as the data file with the extension 'GR3'. It contains summary information that can be imported into a spreadsheet or graphics package for further analysis. Each line in the file contains 13 values (Table 6):

1. Species code as listed in Table 3.
2–11. Numbers of logs and net board footage by the log scale being used for each log grade.
12–13. Totals of items 2 through 11.

When you leave the output options menu, the program will begin processing the data file. When processing is completed the screen displays predicted total board-foot lumber-scale values and volumes (Fig. 12). The output from Module 3 is presented in Figure 4.

2.4 Module 4 operation

Option 7 of the main menu accesses Module 4, which also uses log-yard inventory data. In addition, a user-supplied daily sawing record is maintained that itemizes the logs that have been sawed and the amount and grade of the lumber actually produced. Module 4 is more dependent on the order in which operations are processed than any of the other modules or data-entering routines; therefore, care must be taken to enter information in the manner presented in this guide.

The first screen that appears displays a short introduction, if desired, or the Main Menu can be displayed. At this time you should specify the date of the information that is to be entered by pressing the F6 function key. This date is necessary for the proper processing of the sawing records and this is your only opportunity to change it.

2.4.1 Edit log inventory. Option 1 of the Module 4 Main Menu allows the user to edit and update the log-yard inventory. It is similar to the log-data entry routine (option 2, STUMP Main Menu) and should be done before editing the lumber inventory file, option 2. The user is asked to enter the full pathname of the log-inventory data set. Include the drive designation and subdirectory names if needed:

A:STUMP.LOG
C:\DATA\NORTH40.LOG

A directory of files can be displayed by pressing the F9 function key and entering the drive designation. A pathname and wild cards can be included:

A:
A:*.LOG

The log file is an ASCII file in the format shown in Table 2. The data columns must be in the order shown with at least one space between columns. Any ASCII file in this format can be used as a log file and edited by this program.

The log data may be modified in any of three ways:

1. Append
2. Edit
3. Delete.

If this is a new data set, only Append is meaningful. This option is used to add logs to the inventory as they are delivered to the mill. Each log record appended to the data set contains the variables shown in Figure 8. On-line explanations of the variables can be displayed by pressing the F9 function key. The first ID must be a unique identification for each log. It may consist of up to 10 letters and numbers in any arrangement. The second ID, also 10 characters, may be anything meaningful to the user, such as an identification number for the hauler who delivered the log to the mill yard or the tract from which it came. Valid species codes are listed in Table 3.

Scaling diameter, log length, and cull percent are measurements normally taken for a log. USDA Forest Service log grades are required to accurately predict lumber grade yields from each log. If log grades are not taken, grade 2 can be used for all logs to obtain a rough estimate of the volume. The date that the log record is entered into the computer is displayed automatically and may not be changed (see 2.4.).

Function keys allow movement through the list of logs in the Edit option (Fig. 9). Entering a record number for editing brings up the screen shown in Figure 8 with the values that were last entered for that log. These values may now be corrected.

The Delete option allows you to remove entire log records from the data set. You would use this option if logs were removed from your inventory but were not processed by your mill (reselling veneer logs, or processing below grade logs as firewood). The log list is displayed and function keys allow movement through the list. Entering a record number toggles the '*' indicating whether or not the log record will be deleted. The actual deletion does not occur until the delete routine is exited.

The fourth option allows you to remove logs from the inventory file as they enter the mill for processing. The log list is displayed and function keys allow movement through the list. Entering a record number toggles the '*' indicating whether or not the log record will be processed. The actual calculations do not occur until the routine is exited.

2.4.2 Edit lumber inventory. The green-lumber inventory can be edited and updated using option 2 of the Module 4 Main Menu. This should only be done after option 1 has been completed for the date being processed. The user is asked to enter the full pathname of the lumber-inventory data set. Include the drive designation and subdirectory names if needed:

A:STUMP.LUM
C:\DATA\HARDWOOD.LUM

A directory of files can be displayed by pressing the F9

function key and entering the drive designation. A pathname and wild cards can be included:

A:
A:*.LUM

The lumber file is an ASCII file in the format shown Table 7. The data columns must be in the order shown with at least one space between columns. Any ASCII file in this format can be used as a lumber file and edited by this program.

The lumber data may be modified in any of three ways:

1. Append
2. Edit
3. Delete.

If this is a new data set, only Append is meaningful. This option is used to add lumber to the inventory as it is processed by the mill. Each lumber record appended to the data set contains the variables shown in Figure 13. On-line explanations of the variables can be displayed by pressing the F9 function key. The first ID must be a unique identification for each log. It may consist of up to 10 letters and numbers in any arrangement.

The date of sawing is displayed automatically and may not be changed at this time (see section 2.4). The species codes are those listed Table 3. One of the numbers appearing in the lower half of the screen is used to represent the lumber grade accepted by the program. Not all lumber grades need to be separated. If your mill only grades N1C and better, then all lumber of that grade would be entered as N1C. The Special grade: entry line can be used to note non-NHLA lumber grades such as TIMBERS or PALLET.

Lumber thickness is reported in quarter inches (i.e., 4 represents four quarter lumber, 8 represents eight quarter, etc.). Surface measure is reported in square feet. If surface measure is recorded, lumber width and length are not. If surface measure is entered as a 0, you are requested to enter lumber width in inches and lumber length in feet.

Function keys allow movement through the list of lumber in the Edit option (Fig. 14). Entering a record number for editing brings up the screen shown in Figure 13 with the values that were last entered for that lumber grade. These values may now be corrected.

The Delete option allows you to remove lumber records from the data set. You would use this option as lumber was sold or otherwise removed from your inventory. The lumber list is displayed and function keys allow movement through the list. Entering a record number toggles the '*' indicating whether or not the lumber record will be deleted. The actual deletion does not occur until the delete routine is exited.

When you leave the lumber inventory editing routine, the program checks each record against the file containing the logs sawed for the same date. If a matching species of log is not found, you are given five options:

F6 Create a new log record in the daily file
F7 Input another date to check
F8 View the daily log data file
F9 View the daily lumber data file
F10 Exit the process with no further action

If you choose to exit the process, reports that would include the lumber entry in question will not be accurate until the lumber file or the log file is edited to correct the disparity.

2.4.3 Log and lumber reports. The last option on the Module 4 Main Menu allows you to summarize the data in the log and lumber inventories. This option can be run at any time: however, the log end lumber inventories should be updated to the same point in time. You can change the date listed on the report by using the F6 function key.

The first option of the Reports menu summarizes a log-inventory file and displays gross and net log-scale volumes to the screen. (A more complete and faster summary can be obtained by using Module 3.) The user is asked to enter the full pathname of the log-inventory data set. Include the drive designation and subdirectory names if needed:

A:STUMP.LOG
C:\DATA\1989.LOG

A directory of files can be displayed by pressing the F9 function key and entering the drive designation. A pathname and wild cards can be included:

A:
A:*.LOG.

When a valid log file is entered, a menu containing the output options is displayed. The user may choose to have the output sent to the screen, the printer, or to an ASCII disk file which may be uploaded to other software packages. The summaries are presented on screen two species at a time (Fig. 15) when screen output is selected. If the disk file is chosen, the user is asked for a file name for the report. Gross and net log-scale volumes are shown by log grade and totaled over log grade.

Option 2 of the Reports menu allows you to compare the lumber volumes actually produced with those predicted for the logs that have been processed. This report can be summarized over any period of dates listed in the lumber file. This allows weekly, monthly, or yearly reports by species to be displayed to the screen (Fig. 16), the printer, or to an ASCII disk file. The top of the report offers a summary of gross and net log-scale volumes for the logs that were sawed during the period specified. These volumes reflect the scaling rule (Doyle or International) chosen when the log file was updated. The lower portion of the screen is a comparison of the volume of lumber by grade actually produced by the mill during the specified period and the volumes which the equations in STUMP predicted for the logs sawed.

With the reports section of Module 4, you may save special reports to disk to be analyzed by other software such as spreadsheets or graphics packages (option 3). These files may contain information about either the daily log- and lumber-production file or the log-inventory file.

The daily production file report may contain any of the following items:

- Species
- Date the logs were sawed
- Number of logs sawed
- Gross volume by log grade
- Net volume by log grade
- Predicted value of the lumber sawed from those logs
- Predicted lumber-grade volumes
- Actual lumber-grade volumes

If Species and/or Date is chosen, you will be asked if you want to include specific species/dates in the report or every species/date.

The user is asked to enter the full pathname of the report file being produced. Include the drive designation and subdirectory names if needed:

A:STUMP.REP
C:\DATA\QUERCUS.REP

A directory of files can be displayed by pressing the F9 function key and entering the drive designation. A pathname and wild cards can be included:

A:
A:*.REP

When a valid data file name is entered, the report file is created. There is one record for each combination of species and date found in the daily file that matches the specific parameters requested. The individual variables within each record are reported in the order shown in Table 8. Only the variables that you request will be in the report: the others are skipped.

The log-inventory report is obtained in much the same way as the daily-production file report. The user is asked to enter the full pathname of the log-inventory data set. Include the drive designation and subdirectory names if needed:

A:STUMP.LOG
C:\DATA\1988.LOG

A directory of files can be displayed by pressing the F9 function key and entering the drive designation. A pathname and wild cards can be included:

A:
A:*.LOG

The log inventory report may contain any of the following items:

- First identification number
- Second identification number
- Species
- Log diameter
- Log length
- Percentage of the log considered cull Log grade
- Date

If Species and/or Date is chosen. you will be asked if you want to include specific species/dates in the report or every species/date.

The user is asked to enter the full pathname of the report file being produced.

Include the drive designation and subdirectory names if needed:

A:STUMP.REP
C:\DATA\QUERCUS.REP

A directory of files can be displayed by pressing the F9 function key and entering the drive designation. A pathname and wild cards can be included:

A:
A:*.REP

When a valid data file name is entered, the report file is created. There is one record for each one in the log-inventory file which matches the specific species and dates requested. Only the variables that you request will be in the report; the others are skipped.

Literature Cited

Brisbin, Robert L.; Yaussy, Daniel A.; Fuller, Leslie G. 1988. **A progress report on STUMP: a system of timber utilization and mill processing.** The Compiler. 5(5): 9-13.

Hanks, Leland F. 1976. **Hardwood tree grades for factory lumber.** Res. Pap.: NE-333. Upper Darby, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 80 p.

Hanks, Leland F.; Brisbin, Robert L. 1978. **Lumber grade yields for graded aspen logs and trees.** Res. Pap. NE-423. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 13 p.

Howard, Andrew F.; Yaussy, Daniel A. 1986. **Multivariate regression model for predicting yields of grade lumber from yellow birch sawlogs.** Forest Products Journal. 36(11/12): 56-60.

Rast, Everette D.; Sonderman, David L.; Gammon, Glenn L. 1973. **A guide to hardwood log grading.** Gen. Tech. Rep. NE-1. Upper Darby, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 31 p.

Yaussy, Daniel A. 1986. **Green lumber grade yields from factory grade logs of three oak species.** Forest Products Journal. 36(5): 53-56.

Yaussy, Daniel A. 1987. **Green lumber grade yields from sugar maple and basswood factory grade logs.** Northern Journal of Applied Forestry. 4: 154-157

Yaussy, Daniel A.; Brisbin, Robert L. 1983. **Multivariate regression model for predicting lumber grade volumes of northern red oak sawlogs.** Res. Pap. NE-536. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 11 p.

Yaussy, Daniel A.; Brisbin, Robert L. 1988. **Predicting individual dimensions and grade from hardwood cruise data.** In: The 1988 symposium on systems analysis in forest resources. Kent B., ed. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 75-80.

Yaussy, Daniel A.; Brisbin, Robert L.; Humphreys, Mary J. 1988. **Predicting volumes and numbers of logs by grade from hardwood cruise data.** Res. Pap. NE-613. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 15 p.

This computer program is available on request with the understanding that the U.S. Department of Agriculture cannot assure its accuracy, completeness, reliability, or suitability for any other purpose than that reported. The recipient may not assert any proprietary rights thereto nor represent it to anyone as other than a Government-produced computer program. For cost information, please write:

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Acknowledgment

The Main Menu for STUMP was prepared from the AUTOMENU package by Marshall W. Magee, Magee Enterprises. 6577 Peachtree Industrial Blvd.. Norcross, GA 30092-3769. Magee Enterprises has granted permission for distribution of the AUTOMENU application for STUMP. AUTOMENU has a copy notice which requests that users send the developer $50.00. The AUTOMENU application contained on the Menu disk is convenient for operating STUMP but is not essential. The various programs comprising STUMP can be executed directly from DOS by simply typing their name.

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Appendix

Quick Guide to STUMP

I. Installation
   A. See your DOS manual to set up a CONFIG.SYS file on your boot disk. It should contain these parameters (the values for FILES end BUFFERS are minimum values).
      1. DEVICE = ANSI.SYS
      2. FILES = 20
      3. BUFFERS = 15
   B. Your boot disk also should contain the ANSI.SYS file included with the original system disk.
   C. Restart your computer
   D. Dual Floppy System
      1. Make backup copies of all disks.
         a. Make sure you are at the A: prompt. Enter A:.
         b. Insert Menu Disk in drive B:.
         c. Insert a blank formatted disk in drive A:.
         d. Enter COPY B:*.*.
         e. Repeat steps a-d for each program disk and the data file disk.
      2. Enter B: to move to the B: drive.
      3. Place Menu Disk in the B: drive.
      4. Enter STUMP.
   B. Hard Disk System
      1. Move to the hard drive on which STUMP will reside. Enter C:, D:, or whatever the drive designation is.
      2. Insert Menu Disk in drive A:.

3. Enter A:INST__HD.
4. Follow the screen prompts.
5. This program will create a subdirectory called STUMP on the specified drive, copy all files to this subdirectory, and set up the menu program to access these files from there.
6. Enter STUMP.

II. Creating and Editing Data Sets
A. Tree-cruise data (Modules 1 and 2).
1. Creating a new data set
a. Choose 1 from the main STUMP menu.
b. Follow prompts.
c. When asked for data set name, enter the full pathname including the drive designation and subdirectory names if needed.
2. Using an existing ASCII file
a. Data columns must be in the order shown in Table 1.
b. There must be at least one space between data columns.
c. Choose 1 from the main STUMP menu.
d. Follow prompts.
e. When asked for data set name, enter the full pathname including the drive designation and subdirectory names if needed.
f. Create a header record.
3. Editing a data set
a. Data columns must be in the order shown in Table 1.
b. Choose 1 from the main STUMP menu.
c. Follow prompts.
d. When asked for data set name, enter the full pathname including the drive designation and subdirectory names if needed.
B. Log-inventory data (Modules 3 and 4).
1. Creating a new data set
a. Choose 2 from the main STUMP menu.
b. Follow prompts.
c. When asked for data set name, enter the full pathname including the drive designation and subdirectory names if needed.
2. Using an existing ASCII file
a. Data columns must be in the order shown Table 2.
b. There must be at least one space between data columns.
c. Choose 2 from the main STUMP menu.
d. Follow prompts.
e. When asked for data set name, enter the full pathname including the drive designation and subdirectory names if needed.
3. Editing a data set
a. Data columns must be in the order shown Table 2.
b. Choose 2 from the main STUMP menu.
c. Follow prompts.
d. When asked for data set name, enter the full pathname including the drive designation and subdirectory names if needed.

III. Editing Prices
A. Choose 3 from the main STUMP menu.
B. Follow prompts.
1. Module 1 prices
a. Choose a species.
b. Modify appropriate lumber grade prices as needed.
c. Repeat steps a and b for each species to be modified.
2. Module 2 prices
a. Choose International or Doyle scale for the log prices.
b. Select a category of prices to edit.
i. Veneer bolts.
ii. Grade 1. 2, or 3 logs.
c. Choose a species.
d. Modify appropriate log grade or veneer prices as needed.
e. Repeat steps a through d for each species to be modified.
3. Module 3 and 4 prices
a. Choose a species.
b. Modify appropriate lumber grade prices as needed.
c. Repeat steps a and b for each species to be modified.

IV. Running Module 1 (Tree Appraisal).
A. Choose 4 from the main STUMP menu.
B. Follow the prompts.
C. When asked for data set name, enter the full pathname including the drive designation and subdirectory names if needed.
D. Modify any of the tract information if needed.
E. Modify the output options to meet your needs.
1. The species breakdown has the option of a single-page output for the stand or a page of output for each species on the tract.
2. The product breakdown allows the user to choose lumber grade groupings such as No. 1 Common and better.
3. International 1/4 inch or Doyle scale volumes can be selected for calculating tree volumes.
4. Results can be output to a data file for later printing, to the printer, or to both.
a. The ASCII output data file will automatically be named with the pathname of the tree-cruise data set with the extension '.SM1'.
b. The printer is assumed to be the primary printer attached to the parallel port.
5. An optional graphics file can be chosen.
a. The graphics data file will automatically be named with the pathname of the tree-cruise data set with the extension '.GR1'.
b. This ASCII file contains tree grade summary information which can be loaded into the user's graphics package to produce bar graphs.
6. Any changes made to this menu can be saved as defaults to be used the next time Module 1 is used.

F. Batch processing of the tree-cruise data will proceed.
G. If chestnut oak is detected in the data set, the user will be asked to choose whether worm holes are considered a defect in their market.
H. Output from Module 1
   1. An example of the output from Module 1 is shown in Figure 2.
   2. The amount and type of output are dependent on the choices made in the output-options menu.
   3. All values listed are determined by the lumber-grade prices entered in the Module 1 price file edited previously.
   4. All confidence intervals are reflections of the sampling scheme and do not include model inaccuracies. If a 100-percent inventory was performed, no confidence intervals are output.

V. Running Module 2 (Tree to Log Conversion)
   A. Choose 5 from the main STUMP menu.
   B. Follow the prompts.
   C. When asked for data set name, enter the full pathname including the drive designation and subdirectory names if needed.
   D. Modify any of the tract information if needed.
   E. Modify the output options to meet your needs.
      1. The species breakdown has the option of a single-page output for the stand or a page of output for each species on the tract.
      2. Results can be output to a data file for later printing, to the printer, or to both.
         a. The ASCII output data file will automatically be named with the pathname of the tree-cruise data set with the extension '.SM2'.
         b. The printer is assumed to be the primary printer attached to the parallel port.
      3. An optional log-data file can be created that can be used in Module 3.
         a. This ASCII data file will automatically be named with the pathname of the tree-cruise data set with the extension '.LOG'.
         b. The number of logs will represent the total number of logs produced by the tract.
         c. Defect percentages for each log estimated for a tree will be the same as the defect given to the tree.
      4. An optional graphics file can be chosen.
         a. The graphics data file will automatically be named with the pathname of the tree-cruise data set with the extension '.GR2'.
         b. This ASCII file contains log-grade summary information which can be loaded into the user's graphics package to produce bar graphs.
      6. Any changes made to this menu can be saved as defaults to be used the next time Module 2 is used.
   F. Batch processing of the tree cruise data will proceed.
   G. Output from Module 2
      1. An example of the output from Module 2 is shown in Figure 3.
      2. The amount and type of output are dependent on the choices made in the output options menu:
      3. All values listed are determined by the log- and veneer-grade prices entered in the Module 2 price file edited previously.
      4. All confidence intervals are reflections of the sampling scheme and do not include model inaccuracies. If a 100-percent inventory was performed, no confidence intervals are output.

VI. Running Module 3 (Log Appraisal)
   A. Choose 6 from the STUMP Main Menu.
   B. Follow the prompts.
   C. When asked for data set name, enter the full pathname including the drive designation and subdirectory names if needed.
   D. Modify the output options to meet your needs.
      1. The species breakdown has the option of a single-page output for the stand or a page of output for each species on the tract.
      2. The product breakdown allows the user to choose lumber grade groupings such as No. 1 Common and better.
      3. International or Doyle scale volumes can be selected for calculated tree volumes.
      4. Results can be output to a data file for later printing, to the printer, or to both.
         a. The ASCII output data file will automatically be named with the pathname of the log inventory data set with the extension '.SM3'.
         b. The printer is assumed to be the primary printer attached to the parallel port.
      5. An optional graphics file can be chosen.
         a. The graphics data file will automatically be named with the pathname of the log-inventory data set with the extension '.GR3'.
         b. This ASCII file contains log-grade summary information which can be loaded into the user's graphics package to produce bar graphs.
      6. Any changes made to this menu can be saved as defaults to be used the next time Module 1 is used.
   E. Batch processing of the tree-cruise data will proceed.
   F. Output from Module 3
      1. An example of the output from Module 3 is shown in Figure 4.
      2. The amount and type of output are dependent on the choices made in the output-options menu.
      3. All values listed are determined by the lumber-grade prices entered in the Module 3 price file edited previously.

VII. Running Module 4 (Mill Processing)
- A. Choose 7 from the Main Menu.
- B. Follow prompts.
- C. Maintaining the Log Inventory File.
  1. Choose 1 from the Module 4 Main Menu.
  2. Enter the log-inventory data set name.
     - a. Existing.
     - b. New—it will be created.
     - c. Ask for a disk directory.
  3. First three options allow editing of the log inventory without affecting the daily production calculations.
     - a. Append.
     - b. Edit.
     - c. Delete.
  4. Remove logs that have been sawed. This allows a report to be generated to predict the value and volume of lumber produced from a day's sawing.
- D. Maintaining the Lumber Inventory File.
  1. Use F6 to change the date to the one on which the lumber was sawn.
  2. Choose 2 from the Module 4 Main Menu.
  3. Enter the lumber inventory data set name.
     - a. Existing.
     - b. New—it will be created.
     - c. Ask for a disk directory.
  4. Append. Add daily totals by species, lumber grade, and dimensions to the database. Enter entire date's records before exiting to the Module 4 Main Menu.
  5. Edit the lumber database records.
  6. Delete lumber database records.
  7. The program will check the daily log file for logs of the same species that have been sawed.
- E. Reports.
  1. Choose 3 from the Module 4 Main Menu.
  2. Choose type of report to be processed.
     - a. 1 summarizes the logs left in the log inventory. This is a less detailed summary than would be produced by Module 3.
     - b. 2 summarizes the sawed log and lumber information for specific dates and compares actual with predicted lumber volumes.
     - c. 3 creates specialized data files in ASCII format that can be uploaded into other software to create graphs or reports.

VIII. Test Data Sets Another disk has been included that contains data sets which are set up in the formats needed to run STUMP programs.
- A. STUMP.TRE is a tree cruise-data set that can be used in Modules 1 and 2.
- B. STUMP.HE1 is a header file that contains information about STUMP.TRE and is used when STUMP.TRE is called.
- C. STUMP.LOG is a log inventory file that can be used in Module 3.
- D. STUMP.LUM is a file of lumber cut from the logs removed from STUMP.LOG.

Table 1.—Tree-cruise data file

PLOT	DBH	MERCH HT*	DEFECT	SPECIES	TREE GRADE	VENEER
1	14	1.5	0	'WHO'	2	0
1	10	.5	10	'BLO'	4	0
1	15	1.5	5	'WHO'	4	0
1	14	1.5	0	'WHO'	3	0
1	14	2.5	2	'NRO'	2	0
1	15	1.5	7	'WHO'	2	0
2	11	1.5	4	'NRO'	3	0
2	10	.5	5	'BLO'	3	0
2	16	2.0	0	'WHO'	3	0
2	10	.5	12	'NRO'	3	0
2	12	1.5	6	'BLO'	3	0
2	19	2.5	0	'WHO'	1	0
2	20	2.5	3	'WHO'	2	0
2	10	.5	2	'BLO'	3	0
3	12	1.5	6	'WHO'	3	0
3	14	1.0	8	'WHO'	2	0
3	18	2.0	2	'WHO'	1	16
3	19	3.0	0	'WHO'	2	0
3	17	2.5	0	'WHO'	1	0
3	19	2.5	27	'WHO'	4	0
3	21	2.5	3	'WHO'	1	12
3	18	3.0	0	'WHO'	1	0
4	14	2.0	0	'BLO'	3	0
4	17	1.5	0	'WHO'	1	0
4	10	.5	7	'SCO'	3	0
4	11	1.0	4	'NRO'	3	0
4	11	1.0	16	'NRO'	3	0
4	14	1.5	2	'WHO'	3	0
4	10	.5	0	'SCO'	3	0
5	20	1.0	0	'WHO'	1	0
5	14	1.5	4	'WHO'	2	0
5	23	3.0	0	'WHO'	1	0
5	18	2.0	5	'WHO'	2	0
5	14	2.0	0	'HIC'	2	0
5	11	1.0	6	'BLO'	3	0

*Merchantable sawlog height is defined as the height in 16-foot logs and half logs to the small end of the highest bole section which will produce a grade 3 log.

Table 2.—Log-inventory data file

PRIMARY ID	SECONDARY ID	SPECIES	SCALING DIAM	SCALING LENGTH	DEFECT	LOG GRADE	DATE
'01'	'STUMP'	'WHO'	12.0	8.0	00	'2'	'05/19/88'
'02'	'STUMP'	'WHO'	11.0	8.0	00	'3'	'05/19/88'
'03'	'STUMP'	'WHO'	12.0	12.0	11	'3'	'05/19/88'
'04'	'STUMP'	'NRO'	12.0	8.0	00	'2'	'05/19/88'
'05'	'STUMP'	'NRO'	11.0	8.0	04	'2'	'05/19/88'
'06'	'STUMP'	'NRO'	11.0	8.0	00	'2'	'05/19/88'
'07'	'STUMP'	'NRO'	11.0	8.0	00	'2'	'05/19/88'
'08'	'STUMP'	'WHO'	13.0	10.0	00	'2'	'05/19/88'
'09'	'STUMP'	'WHO'	12.0	8.0	00	'3'	'05/19/88'
'10'	'STUMP'	'NRO'	11.0	8.0	06	'2'	'05/19/88'
'11'	'STUMP'	'NRO'	11.0	8.0	00	'2'	'05/19/88'
'12'	'STUMP'	'WHO'	13.0	12.0	00	'3'	'05/19/88'
'13'	'STUMP'	'WHO'	12.0	8.0	00	'3'	'05/19/88'
'14'	'STUMP'	'NRO'	13.0	10.0	05	'1'	'05/19/88'
'15'	'STUMP'	'NRO'	11.0	10.0	00	'2'	'05/19/88'
'16'	'STUMP'	'NRO'	11.0	8.0	00	'2'	'05/19/88'
'17'	'STUMP'	'NRO'	11.0	8.0	02	'2'	'05/19/88'
'18'	'STUMP'	'NRO'	11.0	8.0	00	'2'	'05/19/88'
'19'	'STUMP'	'BLO'	10.0	14.0	00	'3'	'05/19/88'
'20'	'STUMP'	'BLO'	8.0	10.0	15	'3'	'05/19/88'
'21'	'STUMP'	'WHO'	15.0	16.0	00	'1'	'05/19/88'
'22'	'STUMP'	'WHO'	13.0	16.0	00	'2'	'05/19/88'
'23'	'STUMP'	'WHO'	11.0	16.0	00	'3'	'05/19/88'
'24'	'STUMP'	'WHO'	16.0	16.0	24	'2'	'05/19/88'
'25'	'STUMP'	'WHO'	14.0	16.0	00	'3'	'05/19/88'
'26'	'STUMP'	'BLO'	13.0	10.0	00	'1'	'05/19/88'
'27'	'STUMP'	'BLO'	13.0	10.0	03	'1'	'05/19/88'
'28'	'STUMP'	'BLO'	12.0	8.0	00	'2'	'05/19/88'
'29'	'STUMP'	'WHO'	13.0	10.0	00	'1'	'05/19/88'
'30'	'STUMP'	'WHO'	12.0	8.0	04	'3'	'05/19/88'
'31'	'STUMP'	'WHO'	15.0	16.0	07	'1'	'05/19/88'
'32'	'STUMP'	'WHO'	13.0	12.0	00	'2'	'05/19/88'
'33'	'STUMP'	'WHO'	11.0	12.0	00	'3'	'05/19/88'
'34'	'STUMP'	'WHO'	15.0	16.0	00	'2'	'05/19/88'
'35'	'STUMP'	'WHO'	13.0	14.0	00	'3'	'05/19/88'

Table 3.—List of species groups and codes

Species group	Code
Ash	ASH
Aspen	ASP
Basswood	BAS
Beech	BEE
Black cherry	BLC
Black oak	BLO
Black walnut	BLW
Cherrybark oak	ZCO
Chestnut oak	CHO
Cottonwood	COT
Cucumber	CUC
Elm	ELM
Hickory	HIC
Magnolia	MAG
Misc. hard hardwoods	MHH
Misc. red oaks	MRO
Misc. soft hardwoods	MSH
Misc. white oaks	MWO
Northern red oak	NRO
Paper birch	PAB
Pecan	PEC
Red maple	REM
River birch	RIB
Scarlet oak	SCO
Silver maple	SIM
Southern red oak	SRO
Sugar maple	SUM
Sweet birch	ZSB
White oak	WHO
Yellow birch	YEB
Yellow-poplar	YEP

Table 4.—Variables contained in '.GR1' files and their order

Order	Variable
1	Species code
2	Tree-grade 1 scale volume
3	Tree-grade 2 scale volume
4	Tree-grade 3 scale volume
5	Below-grade scale volume
6	Total scale volume
7	Percentage of lumber graded No. 1 Common and better
8	Percentage of lumber graded First and Seconds, one face, and better
9	Value of the lumber based on lumber-scale volume

Table 5.—Variables contained in '.GR2' files and their order

Order	Variable
1	Species code
2	Veneer-scale volume
3	Log-grade 1 scale volume
4	Log-grade 2 scale volume
5	Log-grade 3 scale volume
6	Total scale volume
7	Values in dollars per mbf

Table 6.—Variables contained in '.GR3' files and their order

Order	Variable
1	Species code
2	Number of grade 1 logs
3	Log-grade 1 scale volume
4	Number of grade 2 logs
5	Log-grade 2 scale volume
6	Number of grade 3 logs
7	Log-grade 3 scale volume
8	Number of below-grade logs
9	Below-grade scale volume
10	Number of veneer logs
11	Veneer-scale volume
12	Total number of logs
13	Total scale volume

Table 7.—Lumber data file used in Module 4

ID NUMBER	DATE	SPECIES	THICKNESS	WIDTH	LENGTH	SURFACE AREA	LUMBER GRADE	SPECIAL GRADE
'1'	'05/20/88'	'WHO'	4	0	0	50	'FAS'	' '
'2'	'05/20/88'	'WHO'	6	0	0	25	'FAS'	' '
'3'	'05/20/88'	'WHO'	8	0	0	30	'FAS'	' '
'4'	'05/20/88'	'WHO'	4	0	0	375	'NO1C'	' '
'5'	'05/20/88'	'WHO'	6	0	0	80	'NO1C'	' '
'6'	'05/20/88'	'WHO'	8	0	0	205	'NO1C'	' '
'7'	'05/20/88'	'WHO'	4	0	0	530	'NO2C'	' '
'8'	'05/20/88'	'WHO'	6	0	0	250	'NO2C'	' '
'9'	'05/20/88'	'WHO'	8	0	0	200	'NO2C'	' '
'10'	'05/20/88'	'WHO'	4	0	0	400	'NO3C'	' '
'11'	'05/20/88'	'WHO'	6	0	0	200	'NO3C'	'PALLET'
'12'	'05/20/88'	'WHO'	8	0	0	175	'NO3C'	'PALLET'

Table 8.—Variables contained in daily report file in order

Order	Variable
1	Species code
2	Date lumber was produced
3	Number of logs
4	Gross log-grade 1 scale volume
5	Gross log-grade 2 scale volume
6	Gross log-grade 3 scale volume
7	Gross below-grade scale volume
8	Net log-grade 1 scale volume
9	Net log-grade 2 scale volume
10	Net log-grade 3 scale volume
11	Net below-grade scale volume
12	Predicted value of lumber
13	Predicted first and seconds (FAS) volume
14	Predicted FAS one face volume
15	Predicted selects volume
16	Predicted saps volume
17	Predicted No. 1 common volume
18	Predicted No. 2A common volume
19	Predicted No. 2B common volume
20	Predicted No. 2C common volume
21	Predicted sound wormy volume
22	Predicted No. 3A common volume
23	Predicted No. 3B common volume
24	Predicted No. 3C common volume
25	Actual FAS volume
26	Actual FAS one face volume
27	Actual selects volume
28	Actual saps volume
29	Actual No. 1 common volume
30	Actual No. 2A common volume
31	Actual No. 2B common volume
32	Actual No. 2C common volume
33	Actual sound wormy volume
34	Actual No. 3A common volume
35	Actual No. 3B common volume
36	Actual No. 3C common volume

WHITE_OAK
PRODUCT YIELD INFORMATION

LUMBER GRADE	VALUE $/ACRE	VOLUME B.F./ACRE	TOTVAL ($)	TOTVOL (B.F.)
FAS	110.52	147.4	15141.38	20188.5
FAS1F	112.09	151.5	15356.73	20752.3
SELECTS	22.38	40.7	3065.67	5574.0
NO.1C	255.74	550.0	35036.96	75348.3
NO.2C	153.15	651.7	20981.24	89281.9
SW	37.11	176.7	5083.46	24206.9
NO.3A	85.08	472.6	11655.54	64753.0
NO.3B	65.95	439.7	9035.75	60238.3

PRODUCT SUMMARY	VALUE ($/ACRE)	VOLUME (B.F./ACRE)	STANDARD ERROR	CONFIDENCE INTERVAL
LUMBER SCALE	842.02	2630.2	257.4	2125.8 - 3134.7
VENEER DOYLE	.00	.0	.0	.0 - .0

TIMBER INFORMATION

AVERAGE DBH OF SAMPLE TREES (IN.)------	16.5
AVERAGE HEIGHT OF SAMPLE TREES (FEET)--	28
THE TOTAL NUMBER OF TREES PER ACRE-----	19
NUMBER OF GRADE 1 TREES PER ACRE-------	5
NUMBER OF GRADE 2 TREES PER ACRE-------	3
NUMBER OF GRADE 3 TREES PER ACRE-------	7
NUMBER OF BELOW GRADE TREES PER ACRE---	4

TIMBER SCALE SUMMARY	VALUE ($/ACRE) STUMPAGE	VALUE ($/ACRE) LUMBER	VOLUME (BF/ACRE) STUMPAGE	STANDARD ERROR	CONFIDENCE INTERVAL
GRADE 1 GROSS			944.5	190.2	571.7 - 1317.4
NET	315.11	428.51	921.4	186.2	556.4 - 1286.3
GRADE 2 GROSS			400.4	88.8	226.4 - 574.4
NET	68.33	165.00	390.5	87.5	219.0 - 561.9
GRADE 3 GROSS			647.9	103.9	444.3 - 851.5
NET	58.89	248.51	619.9	99.6	424.6 - 815.2
BELOW GRADE GROSS			485.8	106.4	277.2 - 694.5
NET	19.34	.00	386.9	83.4	223.4 - 550.4

Figure 2.—Module 1 printer output.

ASH

VENEER BOLTS	TOTAL	PER ACRE	STD. ERR.	CONFIDENCE_INTERVAL	
NUMBER OF LOGS	6	2	.093	1	2
GROSS INT. BF VOL.	1117	279	16.382	247	311
NET INT. BF VOL.	1092	273	16.016	241	304
DELIVERED PRICE($)	997	249	15.184	219	279

GRADE 1 LOGS	TOTAL	PER ACRE	STD. ERR.	CONFIDENCE_INTERVAL	
NUMBER OF LOGS	78	20	.530	18	21
GROSS INT. BF VOL.	12489	3122	74.977	2975	3270
NET INT. BF VOL.	12427	3107	74.541	2960	3253
DELIVERED PRICE($)	2538	634	18.007	599	670

GRADE 2 LOGS	TOTAL	PER ACRE	STD. ERR.	CONFIDENCE_INTERVAL	
NUMBER OF LOGS	221	55	1.384	53	58
GROSS INT. BF VOL.	22027	5507	125.043	5261	5752
NET INT. BF VOL.	21672	5418	122.945	5176	5660
DELIVERED PRICE($)	2571	643	14.629	614	672

GRADE 3 LOGS	TOTAL	PER ACRE	STD. ERR.	CONFIDENCE_INTERVAL	
NUMBER OF LOGS	296	74	2.081	70	78
GROSS INT. BF VOL.	17112	4278	107.237	4067	4489
NET INT. BF VOL.	16805	4201	105.160	3995	4408
DELIVERED PRICE($)	1425	356	8.860	339	374

	LENGTH	VENEER <=8	VENEER 10	VENEER 12	VENEER 14	VENEER 16>=	GRADE 1 10	GRADE 1 12	GRADE 1 14	GRADE 1 16	GRADE 2 8	GRADE 2 10	GRADE 2 12	GRADE 2 14	GRADE 2 16	GRADE 3 8	GRADE 3 10	GRADE 3 12	GRADE 3 14	GRADE 3 16
	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	35	0	0	0
	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	23	4	18
	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	18	0	9	11
	11	0	0	0	0	0	0	0	0	0	5	16	16	0	18	0	18	0	4	9
S	12	0	0	0	0	0	6	0	0	0	20	7	4	3	8	10	0	9	12	4
C	13	0	0	0	0	0	15	7	0	0	6	2	8	3	7	3	6	2	0	4
A	14	0	0	3	0	0	4	0	3	6	3	12	0	3	8	5	2	0	0	2
L	15	0	0	0	0	0	0	0	0	3	3	4	3	4	3	2	4	5	0	2
I	16	0	0	0	0	0	0	2	0	0	0	5	0	2	4	2	0	2	0	0
N	17	0	0	0	0	0	0	2	2	2	2	0	0	3	6	2	1	0	0	0
G	18	0	0	0	0	0	0	2	0	2	2	0	0	2	0	9	0	1	1	0
	19	0	0	0	0	0	1	0	0	6	5	2	2	1	0	2	2	2	0	0
D	20	0	0	0	0	0	1	0	0	2	5	4	0	0	1	1	0	0	0	0
I	21	0	0	0	0	1	0	2	0	0	3	0	0	0	0	0	0	0	0	0
A	22	0	0	0	0	0	1	2	0	0	1	0	0	2	0	1	1	0	0	0
M	23	0	0	0	0	0	0	0	2	0	1	0	0	0	0	1	0	0	0	0
E	24	0	1	0	0	0	0	0	0	3	1	0	0	0	1	0	0	0	0	0
T	25	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
E	26	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
R	27	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	32+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 3.—Module 2 printer output.

Date: 12/12/88

REC.#	PLOT	DBH	LOGS	CULL	SPECIES	GRADE	VENEER
1	1	14.0	1.5	5	'WHO'	2	0
2	1	10.0	0.5	2	'BLO'	4	0
3	1	15.0	1.5	40	'WHO'	4	0
4	1	14.0	1.5	10	'WHO'	3	0
5	1	14.0	2.5	0	'NRO'	2	0
6	1	15.0	1.5	3	'WHO'	2	0
7	10	14.0	1.5	0	'WHO'	2	0
8	10	17.0	2.0	5	'WHO'	2	0
9	10	18.0	2.5	19	'BLO'	4	0
10	10	19.0	2.5	5	'WHO'	3	0
11	10	13.0	1.0	0	'HIC'	3	0
12	10	14.0	1.5	3	'WHO'	3	0
13	11	16.0	1.5	8	'WHO'	1	0
14	11	15.0	2.0	0	'BLO'	2	0
15	11	18.0	2.0	3	'BLO'	2	0

If you wish to edit a log please enter the record # (REC #).

RETURN - View next 15 logs F8 - View previous page
F7 - View bottom of file F10 - Exit

Figure 7.—Tree data edit screen.

Date: 12/12/88

Please complete all information

Id number: 583
Id number 2: STUMP
Species code: NRO
Diameter: 18.0
Length: 14.0
Cull: 5
Log grade: 1
Date: 12/12/88

Press RETURN to add another record.
F9 - Help F10 - Exit

Record # 582

Figure 8.—log data input screen.

```
Date:  12/12/88
Rec.#      ID#          ID#2          DIB    LENGTH   SPECIES   CULL   GRADE      DATE
   31   '00000031'    'STUMP_TR'     8.0     10.0     'HIC'     0      '3'  '11/28/88'
   32   '00000032'    'STUMP_TR'    15.0      8.0     'WHO'     8      '2'  '11/28/88'
   33   '00000033'    'STUMP_TR'    14.0      8.0     'WHO'     8      '3'  '11/28/88'
   34   '00000034'    'STUMP_TR'    14.0      8.0     'MSH'     0      '2'  '11/28/88'
   35   '00000035'    'STUMP_TR'    12.0     12.0     'MSH'     0      '3'  '11/28/88'
   36   '00000036'    'STUMP_TR'    10.0     10.0     'MSH'     0      '3'  '11/28/88'
   37   '00000037'    'STUMP_TR'    14.0     10.0     'BLO'     0      'V'  '11/28/88'
   38   '00000038'    'STUMP_TR'    12.0      8.0     'BLO'     0      '2'  '11/28/88'
   39   '00000039'    'STUMP_TR'    10.0     16.0     'BLO'     0      '3'  '11/28/88'
   40   '00000040'    'STUMP_TR'    13.0     10.0     'WHO'     0      '1'  '11/28/88'
   41   '00000041'    'STUMP_TR'    15.0     12.0     'WHO'     2      '1'  '11/28/88'
   42   '00000042'    'STUMP_TR'    13.0     10.0     'WHO'     2      '2'  '11/28/88'
   43   '00000043'    'STUMP_TR'    12.0      8.0     'WHO'     2      '3'  '11/28/88'
   44   '00000044'    'STUMP_TR'     9.0     16.0     'BLO'    10      '3'  '11/28/88'
   45   '00000045'    'STUMP_TR'    13.0     14.0     'BLO'     0      '1'  '11/28/88'
If you wish to edit a log please enter the RECORD #.

RETURN - View next 15 logs                    F8 - View previous page
F7     - View bottom of file                  F10 - Exit
```

Figure 9.—Log data edit screen.

```
TRACT    STUMP_TRACT

SPECIES                VOLUME          VALUE          TOTVOL          TOTVAL
                       B.F./ACRE       $/ACRE         B.F.            $
-------------------------------------------------------------------------------
HICKORY                  284.3           72.40        38945.1         9918.80
ASH                       14.0            5.55         1918.2          760.64
BLACK_CHERRY               7.0            3.19          964.5          437.30
MISC._SOFT_HRDWD         111.9           27.36        15330.2         3748.67
ASPEN                      4.2             .92          571.2          126.22
RED_MAPLE                 71.7           16.98         9827.1         2326.43
BASSWOOD                  22.4            5.48         3074.4          751.17
BLACK_OAK                557.6          175.29        76392.5        24014.38
NORTHERN_RED_OAK         274.3           85.85        37581.9        11761.96
SCARLET_OAK              251.2           77.07        34416.1        10559.09
WHITE_OAK               2438.9          698.74       334132.0        95727.55
CHESTNUT_OAK              38.4            9.04         5255.5         1238.66
-------------------------------------------------------------------------------
TOTAL                   4076.0          1177.89       558408.8       161370.90

Press RETURN to continue...
```

Figure 10.—Module 1 screen output.

		ALL_SPECIES			
VENEER BOLTS	TOTAL	PER ACRE	STD. ERR.	CONFIDENCE_INTERVAL	
NUMBER OF LOGS	208	2	.094	1	2
GROSS INT. BF VOL.	26813	196	12.470	171	220
NET INT. BF VOL.	26617	194	12.380	170	219
DELIVERED PRICE ($)	25562	187	12.535	162	211
GRADE 1 LOGS	TOTAL	PER ACRE	STD. ERR.	CONFIDENCE_INTERVAL	
NUMBER OF LOGS	1424	10	.288	10	11
GROSS INT. BF VOL.	143937	1051	31.235	989	1112
NET INT. BF VOL.	141142	1030	30.557	970	1090
DELIVERED PRICE ($)	46830	342	9.813	323	361
GRADE 2 LOGS	TOTAL	PER ACRE	STD. ERR.	CONFIDENCE_INTERVAL	
NUMBER OF LOGS	3360	25	.508	24	26
GROSS INT. BF VOL.	234127	1709	36.188	1638	1780
NET INT. BF VOL.	230329	1681	35.540	1612	1751
DELIVERED PRICE ($)	34558	252	5.448	242	263
GRADE 3 LOGS	TOTAL	PER ACRE	STD. ERR.	CONFIDENCE_INTERVAL	
NUMBER OF LOGS	4304	31	.573	30	33
GROSS INT. BF VOL.	262720	1918	39.320	1841	1995
NET INT. BF VOL.	256201	1870	38.039	1796	1945
DELIVERED PRICE ($)	22491	164	3.351	158	171

Press RETURN to continue or F10 to exit...

Figure 11.—Module 2 screen output.

PRODUCT YIELD INFORMATION

LUMBER GRADE	LUMBER TALLY (B.F.)	VALUE ($)
FAS	2627.7	1681.96
FAS1F	2416.7	1546.59
SELECTS	689.2	393.58
NO. 1C	8084.4	3271.82
NO. 2A	1367.0	273.39
NO. 2B	1437.5	258.76
NO. 2C	11854.2	2866.21
NO. 3A	6656.4	1333.91
NO. 3B	4444.3	664.55
NO. 3C	20.7	2.07
TOTALS	39598.0	12292.82

Press [RETURN] to continue.

Figure 12.—Module 3 screen output.

```
Date:   12/12/88                                   LUMBER INFORMATION

                        Please complete all information
                        Id number:              55
                        Date of sawing:         12/12/88
                        Species code:           CHO
                        Lumber grade:           12
                        Special grade:          TIMBERS
                        Lumber thickness:       16
                        Surface measure:            0
                        Lumber width:            4
                        Lumber length:          16

LUMBER GRADES:     1.  FAS              5. SAPS              9.  SW
                   2.  FAS1F            6. NO.2A            10.  NO.3A
                   3.  SELECTS          7. NO.2B            11.  NO.3B
                   4.  NO.1C            8. NO.2C            12.  NO.3C

                                Record #     13

              Press RETURN to add another record          F9 - Help
              F10 - Exit
```

Figure 13.—Lumber data input screen.

```
Date:   12/12/88                                        LUMBER INFORMATION
REC.#        ID #      DATE    SPECIES  THK WIDTH LENGTH SURFACE  LUMGR
    1      '1'       '05/20/88' 'WHO'    4     0      0      50   'FAS'
    2      '2'       '05/20/88' 'WHO'    6     0      0      25   'FAS'
    3      '3'       '05/20/88' 'WHO'    8     0      0      30   'FAS'
    4      '4'       '05/20/88' 'WHO'    4     0      0     375   'NO1C'
    5      '5'       '05/20/88' 'WHO'    6     0      0      80   'NO1C'
    6      '6'       '05/20/88' 'WHO'    8     0      0     205   'NO1C'
    7      '7'       '05/20/88' 'WHO'    4     0      0     530   'NO2C'
    8      '8'       '05/20/88' 'WHO'    6     0      0     250   'NO2C'
    9      '9'       '05/20/88' 'WHO'    8     0      0     200   'NO2C'
   10     '10'       '05/20/88' 'WHO'    4     0      0     400   'NO3C'
   11     '11'       '05/20/88' 'WHO'    6     0      0     200   'NO3C'
   12     '12'       '05/20/88' 'WHO'    8     0      0     175   'NO3C'


   If you wish to edit a log please enter the REC #.
   RETURN - View next 15 logs
   F7     - View bottom of file
   F8     - View previous page                    F10 - Exit
```

Figure 14.—Lumber data edit screen.

Report of Log Volumes in Inventory

International Date:11/21/89

SPECIES: WHITE_OAK

	GROSS	NET	VALUE $
GRADE 1	5396.90	5240.90	2537.20
2	8232.70	8011.80	1851.40
3	9985.50	9638.50	1136.50
BELOW GRADE	1312.30	1300.80	2614.70
TOTAL	24927.40	24192.00	8139.80

SPECIES: NORTHERN_RED_OAK

	GROSS	NET	VALUE $
GRADE 1	785.80	785.80	368.80
2	2496.70	2496.70	664.70
3	217.40	217.40	27.30
BELOW GRADE	0.00	0.00	0.00
TOTAL	3499.90	3499.90	1060.80

Press RETURN to continue.

Figure 15.—Module 4 log-inventory summary (screen display).

SAWING SUMMARY From: 05/20/88 TO: 11/16/88 FOR: HICKORY

Net Log Scale Volume	GROSS	NET
GRADE 1	0.00	0.00
GRADE 2	36.00	36.00
GRADE 3	57.50	57.50
BELOW GRADE	0.00	0.00
TOTAL	93.50	93.50

Lumber grades	PREDICTED	ACTUAL
FAS	4.10	0.00
FAS1F	5.70	0.00
SELECTS	3.80	0.00
NO. 1C	10.60	106.00
SAPS	0.00	0.00
NO. 2A	28.10	0.00
NO. 2B	42.30	0.00
NO. 2C	0.00	200.00
SW	0.00	0.00
NO. 3A	6.10	0.00
NO. 3B	3.00	0.00
NO. 3C	0.00	320.00
TOTAL	103.70	626.00

Press RETURN to continue.

Figure 16.—Module 4 lumber-tally summary (screen display).