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Program Manual for Producing Weight-Scaling Conversion Tables

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Program Manual

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Weight-scaling--weighing truckloads of timber to determine volume--is much faster and cheaper than scaling individual pieces (7, 8, 11). Simple rules of thumb that convert weights into sawtimber or veneer volumes are usually insufficient over short periods, however, because they cannot account for the high variation common in individual loads or in small tracts. Long-log and tree-length logging increase the problems in applying rules of thumb because volumes of a variety of products must be estimated for individual truckloads.

Researchers have developed techniques for accurately estimating volumes of various products on individual loads when the weight and the number of trees on the load are known (2, 9, 10). These techniques have been tailored to long-log and tree-length logging (1, 3, 4, 6), and to the merchantability limits of individual firms.

This manual presents a computerized system that will yield weight-scaling estimates for individual firms. The system is flexible enough to accommodate normal logging techniques while producing scale estimates for any combination of three basic roundwood products: veneer logs, sawmill logs, and pulpwood. It is geared directly to inventory control and allocation of raw material to processing centers and includes a program which helps relate scaling data to prospective stumpage sales and harvesting operations. Details of the development of the statistical

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models have already been reported (3). Three programs are provided. Program WTVOL generates estimates of veneer volumes, sawmill volumes, and pulpwood volumes in any combination desired. Program CHECK uses regression coefficients developed by WTVOL plus weight-volume data from periodic check scales to calculate volume and percentage differences between estimated and observed volumes. Program VOLWT estimates average total and saw-log weights by form class, d.b.h., and number of usable 16-foot logs from volume per tree and average tree length. These tables can be related back to earlier stumpage sales and harvests.

Description of Linear Models

Earlier reports show that linear regression models can provide reliable estimates for this weight-scaling system. The general form of the equations for programs WTVOL and CHECK is:

$$Y_i = b_{0i} + b_{1i}NT + b_{2i}WT + b_{3i}(WT \times NT)^{\frac{1}{2}}$$

where

Y_i = either veneer volume, total saw-log volume, or total saw-log weight.

NT = number of trees, long logs or short logs per load (not mixed).

WT = total net weight of the load.

In program VOLWT the form is:

$$Y_i = b_{0i} + b_{1i}AV + b_{2i}AL$$

where

Y_i = either average total weight or average saw-log weight per tree.

and

AV = average volume per tree.

AL = average length per tree (number of usable 16-foot logs).

A number of models were tested but those indicated above were consistently better in estimating the dependent variables and were judged to be of higher practical value. Freese's manual (5) describes the stepwise regression procedures by which the models were developed.

Not all estimates produced by the programs described here are generated directly by regression. For instance, where estimates are

desired for sawtimber and pulpwood from tree-length material, sawtimber weights are generated by regression, but pulpwood weights are calculated by subtracting estimated sawtimber weight from total weight. Such estimates are simpler and more consistent. Similarly, where estimates are desired for veneer, sawmill, and pulpwood volumes, total sawtimber volume and veneer volume are estimated by regression, and sawmill volumes are estimated by the difference between the two regression estimates.

Data Handling and Management

Data required to produce conversion tables are:

1. Total board-foot volume (sawmill plus veneer volume).
2. Sawmill volume.
3. Veneer volume.
4. Total weight (all products).
5. Pulp weight.
6. Number of trees, long logs, or short logs (not mixed).

These data are collected for each load and recorded as indicated by exhibits 1 and 2. Other data are required by the three programs included here, but these special data requirements are noted in the discussions of the individual programs.

Keypunch formats for the data are shown in Appendix 4. None of the programs discussed here edit input data; therefore, considerable care must be taken in recording and keypunching.

Estimating Volumes from Weight

Program WTVOL is the cornerstone of this system; it provides estimates of product volumes. The program permits users to choose from five options depending on logging. technique and product raw materials. These options are:

1. Long or short logs
   a. Sawtimber only (option 1).
   b. Veneer only (option 2).
   c. Sawmill and veneer logs (option 3).
2. Tree-length logs
   a. Sawtimber and pulpwood (option 4).
   b. Veneer, sawmill, and pulpwood (option 5).

Exhibit 1. Weight ticket

WEIGHT TICKET NO. 26803

Date _____ F. NO. _____
Customers Name _____ Trk. NO. _____
Butts _____ Total Pcs. _____
☐ No Pulpwood _____ ☐ Pulpwood _____
Sec. _____ T . -R , County _____
Remarks: _____

Lbs. Gross Driver _____
Lbs. Tare Driver ☐ IOn Cl Off
Lbs. Net at: _____ Per Lb. Price _____

Footage -
Pulpwood-
Shipper _____
Weigher _____

/ / Scales Tare Weight Permit
Name _____ ☐ No Pulpwood
Butts _____
Total Pcs. _____
Ticket No. 26803

/ / Log Yard Scale Permit
Name _____ ☐ No Pulpwood
Butts _____
Total Pcs. _____
Ticket No. 26803

Exhibit 2. Data collection form

Name of Firm Date

Load Number	Total Scale	Small Log Scale	Veneer Log Scale	Net Load Weight	Pul pwood Weight	dumber of temsor Butt!

The input data decks for this program are:

1. Name header card--for firm name, dates, tract identification, or any other information needed to identify the tables.

2. Option card[1]

   a. Option code (1-5 as described previously).

   b. Pounds per cord of pulpwood conversion.

   C. Minimum number of trees for which a table is desired.

   d. Maximum number of trees for which a table is desired.

   e. Minimum net load weight to appear on each table.

   f. Maximum net load weight to appear on each table.

3. Truckload data cards

   a. Identification.

   b. Total volume (veneer and sawmill).

   c. Sawmill volume.

   d. Veneer volume.

   e. Total net load weight.

   f. Pulp weight.

   g. Number of trees, long logs, or short logs.

4. Trailer card--blank if other data sets follow; 9999 in columns 1-4 if no other data follow.

These decks make up one complete data set and WTVOL requires that these cards all be present and in the order noted. Since firms usually are receiving timber from several tracts whose average timber sizes may vary considerably, WTVOL is programed to produce multiple sets of tables in a single run. The maximum number of sets of tables that can be produced in one run is limited only by the specific requirements of the computer system developing the tables. In producing a set of tables, the program reads a set of header control cards then reads basic data cards until a trailer card is encountered. Next, regression analysis is performed and tables are generated. If the trailer card previously encountered is blank in the first four columns, the program reads the next set of header cards and basic data cards and produces a second set of tables. This sequence is followed until a trailer card is encountered with the value 9999 in columns 1 through 4, which indicates the last data set.

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[1]Items (b) through (f) of the option card may be left blank. Where (b) is left blank, pulpwood will be tabulated in pounds rather than cords. Where (c) through (f) are left blank, the program will produce tables based on the actual ranges of number of trees and net load weight observed in the sample data.

Once the name card and option card are read, the regression analysis is begun and sums of squares and products are developed as each truckload data card is read. After all cards are read, the regression equations are developed and the tables are generated by substituting values for number of trees and total net load weight. Table range is limited by the minimum and maximum values for number of trees and net load weight shown in the option card or as calculated from the sample data when minimum and maximum values are not shown in the option card. This sequence is followed for all sets of input data.

The form of the output from WTVOL depends upon the nature of the raw material and the consequent option chosen. Each set of volume tables is preceded by a summary sheet showing means and standard deviations, regression equations developed, and the coefficients of determination (R^2) and standard errors associated with each equation. An example of this summary page is shown in exhibit 3. Tables showing volumes by weight follow the summary page and are illustrated for all options in exhibits 4 through 8.

To use these tables, record net load weight and number of trees or logs for each truckload. Refer to the table corresponding with the number of trees or logs recorded, go down the left-hand column to find weight in thousands of pounds, and finally go across this row to locate the volume(s) shown under weight in hundreds of pounds. Note that weights are shown to the nearest even hundred pounds which should be sufficient for most applications. When further precision is required, users should interpolate or use net weight and number of trees (or logs) in the regression equations shown on the summary page to calculate volumes directly.

Appendix 3x indicates the deck setup for this program, a program listing is shown in Appendix 2a, all input data formats are shown in Appendix 4, and definitions of the variable names are given in Appendix 1. As indicated in Appendix 3a, program WTVOL also uses two supporting subroutines, MATINV and MULT, in developing the regression analysis. These subroutines are briefly discussed in a following section.

Check-Scaling

Once WTVOL has been applied to initial sample data, this weight-scaling system may be regarded operative if the firm's limits of precision have been met. But constant checks are essential to determine continuing accuracy of the system and to demonstrate its integrity. For this purpose, truckload samples should be continually taken and program CHECK can then be applied.

CHECK compares actual measured volumes of truckload samples (check-scale samples) with tabular volumes generated by WTVOL from the base data. The CHECK program reproduces tabular values from the weight/volume tables by calculating the weights and volumes with the

Exhibit 3. Summary page of WTVOL output

WEIGHT SCALING OF TREES FOR VENEER, SAWMILL AND PULPWOOD VOLUME

NAME OF FIRM OR ORGANIZATION

NUMBER OF LOADS = 10 (NO.)

	MEAN		STANDARD DEVIATION	
NUMBER OF TREES =	34.9000	(NO.)	6.0223	(NO.1
PULPWOOD VOLUME =	2.7629	(CORDS)	1.2612	(CORDS)
PULPWOOD WEIGHT =	14.7813	(MLBS)	6.7473	(MLBS)
SAWMILL VOLUME =	0.9569	(MBF)	0.3045	(MBF)
VENEER VOLUME =	1.2246	(MBF)	0.5946	(MBF)
TOTAL WEIGHT =	55.7380	(MLBS)	9.1239	(MLBS)
SAWLOG WEIGHT =	40.9567	(MLBS)	5.1091	(MLBS)

THE REGRESSION EQUATION FOR ESTIMATING TOTAL SAWLOG VOLUME IS

TOTAL SAWLOG VOLUME = 1.1071 + 0.5614 (NO OF TREES) + 0.3932 (TOTAL WEIGHT) + -0.9250 (SQRT(TOTAL WEIGHT * NO OF TREES))

MULTIPLE R SQUARED = 0.8736
STANDARD ERROR = 0.1656

THE REGRESSION EQUATION FOR ESTIMATING TOTAL SAWLOG WEIGHT IS

TOTAL SAWLOG WEIGHT = 19.2999 + 5.2443 (NO OF TREES) + 3.9024 (TOTAL WEIGHT) + -8.6234 (SQRT(TOTAL WEIGHT * NO OF TREES))

MULTIPLE R SQUARED = 0.8584
STANDARD ERROR = 2.3546

THE REGRESSION EQUATION FOR ESTIMATING TOTAL VENEER VOLUME IS

VENEER VOLUME = 1.3769+ 0.5570 (NO OF TREES) + 0.4117 (TOTAL WEIGHT) + -0.9682 (SQRT(TOTAL WEIGHT • NO OF TREES))

MULTIPLE R SQUARED = 0.7958
STANDARD ERROR = 0.3292

same linear regression equations that were used in the table-generating program, WTVOL. The coefficients for these equations are printed on the summary page at the beginning of the WTVOL output.

Input for the CHECK program is:

1. Name header card--same as name card identification for WTVOL.

2. Option card--the program handles five options which are identified on this card, and are the same as those outlined for WTVOL. This card also contains the weight per cord of pulpwood being used for options 4 and 5.

3. Linear regression equation coefficients card--coefficients must be read in the order noted below.

   a. Option 1 requires only one card (the constant and regression coefficients for total saw-log volume).

   b. Option 2 requires only one card (the constant and regression coefficients for veneer-log volume).

   c. Option 3 requires two cards (the constant and regression coefficients for total saw-log volume and total veneer volume).

   d. Option 4 requires two cards (the constant and regression coefficients for total saw-log volume and total saw-log weight).

   e. Option 5 requires three cards (the constant and regression coefficients for total saw-log volume, total saw-log weight, and total veneer volume).

4.. Truckload data cards--same as truckload data cards for WTVOL.

5. Trailer,card--same as trailer card in WTVOL.

In CHECK, no calculations are made until the first truckload data card is read. At that time tabular values are developed using the constant and regression coefficients and the values for number of trees and total net weight read from the truckload data card. These values are subtracted from the measured check-scale volumes on the truckload data card. These differences are printed on the output, added into summary areas, and the next truckload data card is read. After all check-scale cards are read, percentage differences are computed and printed along with actual differences.

Exhibit 4. Example of table for sawmill-only option

NAME OF FIRM OR ORGANIZATION

30 LOGS

THOUS. OF POUNDS	HUNDREDS OF POUNDS 0 SAWTIMBER (MBF)	2 SAWTIMBER (MBF)	4 SAWTIMBER (MBF)	6 SAWTIMBER (MBF)	8 SAWTIMBER (MBF)
30	2.173	2.160	2.146	2.133	2.120
31	2.108	2.096	2.084	2.072	2.061
32	2.050	2.039	2.028	2.018	2.008
33	1.998	1.989	1.980	1.971	1.962
34	1.954	1.946	1.938	1,930	1.923
35	1.916	1.909	1.902	1.896	1.890
36	1.884	1.878	1.873	1.867	1.862
37	1.858	1.853	1.849	1.845	1.841
38	1.837	1.834	1.830	1.827	1.824
39	1.822	1.819	1.817	1.815	1.814
40	1.812	1.811	1.809	1.808	1.808
41	1.807	1.807	1.806	1.806	1.807
42	1.807	1.808	1.808	1.809	1.810
43	1.812	1.813	1.815	1.816	1.818
44	1.821	1.823	1.825	1.828	1.831
45	1.834	1.837	1.841	1.844	1.848
46	1.852	1.856	1.860	1.864	1.869
47	1.873	1.878	1.883	1.888	1.893
48	1.899	1.904	1.910	1.916	1.922
49	1.928	1.935	1.941	1.948	1.954
50	1.961	1.968	1.976	1.983	1.990
51	1.998	2.006	2.014	2.022	2.030
52	2.038	2.047	2.055	2.064	2.073
53	2.082	2.091	2.100	2.109	2.119
54	2.129	2.138	2.148	2.158	2.168
55	2.179	2.189	2.199	2.210	2.221
56	2.232	2.243	2.254	2.265	2.276
57	2.288	2.299	2.311	2.323	2.335
58	2.347	2.359	2.371	2.384	2.396
59	2.409	2,422	2.434	2.447	2.460
60	2.474	2.487	2.500	2.514	2.527
61	2.541	2.555	2.569	2.583	2.597
62	2.611	2.626	2.640	2.654	2.669
63	2.684	7.699	2.714	2.729	2.744
64	2.759	2.774	2.790	2.805	2.821
65	2.837	2.853	2.869	2.885	2.901
66	2.917	2.933	2.950	2.966	2.983

Exhibit 5. Example of table for veneer-only option

NAME OF FIRM OR ORGANIZATION

30 LOGS

THDUS. OF POUNDS	HUNDREDS OF POUNDS 0 VENEER (MBF)	2 VENEFR (MBF)	4 VENEER (MBF)	6 VENEFR (MBF)	a VENEER (MBF)
30	1.392	1.378	1.364	1.350	1.337
31	1.324	1.311	1.299	1.287	1.275
32	1.263	1.252	1.241	1.230	1.220
33	1.210	1.290	1.190	1.131	1.172
34	1.163	1.155	1.147	1.139	1.131
35	1.123	1.116	1.109	1.103	1.096
36	1.070	1.084	1.079	1.073	1.068
37	1.063	1.058	1.054	1.049	1.045
38	1.047	1.038	1.935	1.032	1.029
39	1.036	1.023	1.021	1.019	1.017
40	1.016	1.014	1.013	1.012	1.011
41	1.011	1.010	1.010	1.010	1.010
42	1.011	1.01 I	1.012	1.013	1.014
43	1.016	1.017	1.019	1.021	1.023
44	1.025	1.028	1.031	1.033	1.036
45	1.040	1.043	1.047	1.050	1.054
46	1.358	1.062	1.067	1.071	1.076
47	1.081	1.086	1.091	1.097	1.102
48	1.108	1.114	1.129	1.126	1.132
49	1.139	1.146	1.152	1.159	1.167
50	1.174	1.181	1.189	1.196	1.204
51	1.212	1.221	1.229	1.237	1.246
52	1.755	1.267	1.272	1.282	1.291
53	1.300	1.310	1.320	1.329	1.339
54	1.340	1.360	1.370	1.381	1.191
55	1.407	1.413	1.424	1.435	1.446
56	1.458	1.469	1.481	1.493	1.505
57	1.517	1.529	1.541	1.554	1.566
58	1.579	1.591	1.604	1.617	1.630
59	1.644	1.657	1.671	1.684	1.698
60	1.712	1.726	1.740	1.754	1.768
61	1.782	1.797	1.812	1.826	1.841
62	1.856	1.071	1.886	1.901	1.917
63	1.912	1.948	1.964	1.979	1.995
64	2.011	2.02 7	2.044	2.060	2.076
65	7.093	2.109	7.126	7.143	2.160
66	2.177	2.194	2.211	2.228	2.246

Exhibit 6. Example of table for veneer and sawmill option

NAME OF FIRM OR ORGANIZATION

30 LOGS

HUNDREDS OF POUNDS

THOUS. OF POUNDS	0 VENEER (MBF)	0 SAWMILL (MBF)	2 VENEER (MBF)	2 SAWMILL (MBF)	4 Vi-VEER (MBF)	4 SAWMILL (MBF)	6 VENEER (MBF)	6 SAWMILL (MBF)	8 VENEER (MBF)	8 SAWMILL (MBF)
30	1.392	0.781	1.379	0.702	1.364	0.782	1.350	0.703	1.337	0.783
31	1.324	0.704	1.311	0.784	1.299	0.795	1.287	0.786	1.275	0.786
32	1.263	0.787	1.252	0.787	1.241	0.707	1.230	0.788	1.220	0.788
33	1.210	0.709	1.200	0.789	1.190	0.790	1.181	0.790	1.172	0.790
34	1.163	0.791	1.155	0.791	1.147	0.791	1.139	0.792	1.131	0.792
35	1.177	0.792	1.116	0.793	1.109	0.793	1.103	0.793	1.096	0.793
36	1.090	0.794	1.084	0.794	1,079	0.794	1.073	0.794	1.068	0.794
37	1.063	0.795	1.053	0.795	1.054	0.795	1.049	0.795	1.045	0.795
3R	1.042	0.795	1.038	0.796	1.035	0.796	1.032	0.796	1.029	0.796
39	1.026	0.796	1.023	0.796	1.021	0.796	1.019	0.796	1.017	0.796
40	1.016	0.796	1.014	0.796	1.013	0,796	1.012	0.796	1.011	0.796
41	1.011	0.796	1.010	0.796	1.010	0.796	1.010	0.796	1.010	0.796
42	1.011	0.796	1.011	0.796	1.012	0.796	1.013	0.796	1.014	0.796
43	1.016	0.796	1.017	0. 796	1.019	0,796	1.021	0.795	1.023	0.795
44	1.025	0.795	1.028	0.795	1.031	0.795	1.033	0.795	1.036	0.795
45	1.040	0.794	1.043	0.794	1.047	0.794	1.050	0.794	1.054	0.794
46	1.059	0.793	1.062	0.791	1.067	0.793	1.071	0.793	1.076	0.792
47	1.081	0.792	1.086	0.797	1.091	0.792	1.097	0.791	1.102	0.791
48	1.108	0.791	1.114	0.791	1.120	0.790	1.126	0.790	1.132	0.790
49	1.137	0.789	1.146	0.709	1.152	0.709	1.159	0.788	1.167	0.788
50	1.174	0.788	1.181	0.787	1.189	0.787	1.196	0.786	1.204	0.786
51	1.212	0.786	1.721	0.785	1.229	0.785	1.237	0.784	1.246	0.784
52	1.255	0.784	1.263	0.703	1.272	0.703	1.282	0.702	1.291	0.782
53	1.300	0.781	1.310	0.781	1.320	0.780	1.329	0.780	1.339	0.780
54	1.349	0.779	1.360	0.779	1.370	0.77%	1.381	0.778	1.391	0.777
55	1.402	0.777	1.413	0.776	1.474	0.776	1.435	0.775	1.446	0.774
56	1.458	0.774	1.469	0.773	1.481	0.773	1.493	C.772	1.505	0.772
57	1.517	0.771	1.529	0.771	1.541	0.770	1.554	0.769	1.566	0.769
58	1.579	0.768	1.591	0.768	1.604	0.167	1.617	0.766	1.630	0.766
59	1.644	0.765	1.657	0.764	1.671	0.764	1.684	0.763	1.698	0.763
60	1.712	0.762	1.726	0.761	1.740	0.761	1.754	0.760	1.768	0.759
61	1.782	d.759	1.797	0.758	1.812	0.757	1.826	0.757	1.841	0.756
62	1.856	0.755	1.871	0.754	1.886	0.754	1.901	0.753	1.917	0.752
63	1.932	0.752	1.948	0.751	1.964	0.750	1.979	0.749	1.995	0.749
64	2.011	0.748	2.077	0.747	7.044	0.746	2.060	0.746	2.076	0.745
65	7.093	0.744	2.109	0.743	2.126	0.743	2.143	0.742	2.160	0.741
66	2.177	0.740	2.194	0.739	7.211	0.739	2.228	0.738	2.246	0.737

Exhibit 7. Example of table for sawmill and pulpwood option

NAME OF FIRM OR ORGANIZATION

30 TREES

HUNDREDS OF POUNDS

THOUS. OF POUNDS	0 SAWTIMBER (MBF)	PULP (CORDS)	2 SAWTIMBER (MBF)	PULP (CORDS)	4 SAWTIMBER (MBF)	PULP (CORDS)	6 SAWTIMBER (MBF)	PULP (CORDS)	8 SAWTIMBER (MBF)	PULP (CORDS)
30	2.173	3.0	7.140	0.0	2.146	0.0	2.133	0.0	2.120	0.0
31	2.108	0.0	2.096	0.0	2.084	0.0	2.072	0.0	2.061	0.0
32	2.050	0.0	2.033	0.3	2.029	0.0	2.018	0.0	2.008	0.0
33	1.998	0.0	1.989	0.0	1.980	0.0	1.971	0.0	1.962	0.0
34	1.954	0.01s	1.946	0.061	1.938	0.104	1.930	0.145	1.923	0.187
35	1.916	0.728	1.909	0.268	1.902	0.308	1.896	0.348	1.890	0.387
34	1.884	0.426	1.878	0.464	1.073	0.502	1.867	0.540	1.862	0.577
37	1.858	0.614	1.853	0.651	1.849	0.687	1.845	0.722	1.841	0.758
38	1.837	0.793	1.834	0.927	1.830	0.861	1.827	0.895	1.824	0.928
39	1.822	0.961	1.819	0.394	1.817	1.026	1.815	1.058	1.814	1.090
40	1.812	1.171	1.811	1.152	1.809	1.183	1.808	1.213	1.808	1.243
41	1.807	1.272	1.807	1.302	1.806	1.331	1.806	1.359	1.807	1.387
42	1. eo7	1.415	1.803	1.443	1.808	1.470	1.809	1.497	1.810	1.524
43	1.812	1.550	1.813	1.576	1.815	1.601	1.816	1.627	1.818	1.652
44	1.821	1.677	1.923	1.701	1.825	1.725	1.828	1.749	1.831	1.773
45	1.834	1.796	I. 837	1.819	1.841	1.841	1.844	1.864	1.848	1.886
46	1.852	1.308	1.856	1.929	1.860	1.951	1.864	1.972	1.869	1.992
47	1.877	2.013	1.878	2.333	1.883	2.053	1.888	2.072	1.893	2.092
48	1.899	2.111	1.934	7.129	1.910	2.148	1.916	2.166	1.922	2.184
49	1.928	2.702	1.335	1.219	1.941	2.237	1.948	2.254	1.954	2.270
50	1.461	2.287	1.968	7.333	1.974	2.319	1.983	2.335	1.990	2.350
51	1.998	2.366	2.006	7.381	2.014	2.395	2.022	2.410	2.030	2.424
52	2.038	2.438	2.047	2.452	2.055	2.466	2.064	2.479	2.073	2.492
53	2.082	2.505	2.091	2.518	2.100	7.530	2.109	2.542	2.119	2.554
54	2.129	2.566	2.138	2.577	7.148	2.589	2.158	2.600	2.168	2.611
55	2.179	2.621	2.193	2.632	2.199	2.641	2.210	2.652	2.221	2.662
56	2.732	2.671	2.243	2.681	2.254	2.690	2.265	2.699	2.276	2.708
57	2.288	2.716	2.299	2.724	2.311	2.733	2.323	2.741	2.335	2.748
53	2.347	2.755	2.359	2.763	3.371	2.770	2.384	2.777	2.396	2.784
59	7.409	2.793	2.422	2.797	2.434	2.803	2.447	2.809	2.460	2.815
60	2.414	2.820	2.497	2.826	2.500	2.831	7.514	2.816	2.527	2.841
61	7.541	2.845	2.555	2.850	2.569	2.854	7.583	2.858	2.597	2.862
62	2.611	2.866	2.625	2.949	2.640	2.872	2.654	2.876	2.669	2.879
63	2.604	2.881	2.699	2. ea4	2.714	2.887	2.729	2.889	2.744	2.891
64	2.759	2.993	2.774	2.995	2.790	2.896	2. A05	2.898	2.821	2.899
65	2.837	2.900	7.853	2.901	2.869	2.702	2.895	2.902	2.901	2.903
66	2.917	2.903	2.933	1.903	2.950	2.903	2.966	2.903	2.983	2.902

Exhibit 8. Example of table for veneer, sawmill, and pulpwood option

NAME OF FIRM OR ORGANIZATION

30 TREES

HUNDREDS OF POUNDS

THOUS. OF POUNDS	0 VENEER (MBF)	0 SAWMILL (MBF)	0 PULP (CORDS)	2 VENEER (MBF)	2 SAWMILL (MBF)	2 PULP (CORDS)	4 VENEER (MBF)	4 SAWMILL (MBF)	4 PULP (CORDS)	6 VENEER (MBF)	6 SAWMILL (MBF)	6 PULP (CORDS)	8 VENEER (MBF)	8 SAWMILL (MBF)	8 PULP (CORDS)
30	1.397	0.751	0.3	1.378	0.782	0.0	1.364	0.782	0.0	1.350	0.787	0.0	1.337	0.783	0.0
31	1.324	0.784	0.0	1.311	0.704	0.0	1.299	0.785	0.0	1.287	0.786	0.0	1.275	0.786	0.0
32	1.263	0.797	0.0	1.252	0.787	0.0	1.241	0.187	0.0	1.230	0.788	0.0	1.220	0.780	0.0
33	1.210	0.789	0.0	1.200	0.709	0.0	1.190	0.790	0.0	1.181	0.790	0.0	1.172	0.790	0.0
34	1.163	0.791	0.019	1.155	0.791	0.061	1.147	0.791	0.104	1.139	0.792	0.145	1.131	0.792	0.107
35	1.123	0.792	0.228	1.116	0.793	3.268	1.109	0.793	0.338	1.103	0.793	0.348	1.096	0.793	0.387
36	1.090	0.794	3.426	1.084	0.794	0.464	1.079	0.794	0.502	1.073	0.794	0.540	1.068	0.194	0.577
37	1.063	0.795	0.614	1.058	0.795	0.651	1.054	0.795	0.687	1.049	0.795	0.722	1.045	0.795	0.758
38	1.042	0.795	0.793	1.039	0.796	0.827	1.035	0.796	0.861	1.032	0.796	0.095	1.029	0.796	0.928
39	1.026	0.796	0.961	1.023	0.796	0.994	1.021	0.796	1.026	1.019	0.796	1.050	1.017	0.796	1.090
40	1.016	0.796	1.121	1.014	0.796	1.152	1.013	0.796	1.183	1.012	0.796	1.213	1.011	0.796	1.243
41	1.011	0.796	1.272	1.010	0.796	1.307	1.010	0.796	1.331	1.010	0.796	1.359	1.010	0.796	1.387
42	1.011	0.796	1.41s	1.011	0.796	1.443	1.312	0.796	1.470	1.013	0.796	1.497	1.014	0.796	1.524
43	1.016	0.796	1.550	1.017	0.796	1.576	1.019	0.796	1.601	1.021	0.795	1.627	1.023	0.795	1.652
44	1.025	0.795	1.677	1.028	0.795	1.701	1.331	0.795	1.725	1.033	0,795	1.749	1.036	0.795	1.773
45	1.040	0.774	1.796	1.043	0.794	1.819	1.047	0.794	1.841	1.050	0.794	1.864	1.054	0.794	1.886
46	1.058	0.793	1.909	1.062	0.793	1.929	1.067	0.793	1.951	1.071	0.793	1.972	1.076	0.792	1.992
47	1.081	0.792	2.013	1.085	0.797	2.033	1.091	0.792	2.053	1.097	0.791	2.072	1.102	0.791	2.092
48	1.108	0.791	2.111	1.114	0.791	2.129	1.120	0.790	2.148	1.126	0.790	2.166	1.132	0.790	2.184
49	1.139	0.789	2.202	1.144	0.789	2.219	1.152	0.789	2.237	1.159	0.788	2.254	1.167	0.788	2.270
50	1.174	0.789	2.287	1.181	3.787	3.303	1.189	0.787	2.319	1.196	0.706	2.335	1.204	0.786	2.350
51	1.212	0.786	2.366	1.221	0.705	2.381	1.229	0.785	2.395	1.237	0.784	2.410	1.246	0,784	2.424
52	1.355	0.784	2.435	1.263	0.783	2.452	1.272	0.783	2.466	1.282	0.782	2.479	1.291	0.782	2.492
53	1.300	0.781	2.505	1.310	0.781	2.518	1.320	0.780	2.530	1.329	0.780	2.542	1.339	0.780	2.554
54	1.149	0.779	2.564	1.360	0.779	2.577	1.370	0.718	2.589	1.381	0.778	2.600	1.391	0.777	2.611
55	1.402	5.777	2.621	1.413	0.776	2.637	1.424	0.776	2.642	1.435	0.775	2.652	1.446	0.774	2.662
56	1.458	0.774	7.671	1.469	0.773	2.681	1.481	0,773	2.690	1.493	0.772	2.699	1.505	0.772	2.708
57	1.517	0.771	2.716	1.529	0.771	2.774	1.541	0.770	2.733	1.554	0.769	2.741	1.566	0.769	2.748
58	1.579	0.768	2.756	1.591	0.768	7.163	1.604	0.767	7.770	1.617	0.766	2.777	1.630	0.766	2.784
59	1.644	0.765	2.793	1.657	0.764	7.197	1.671	0.764	2.803	1.684	0.763	2.009	1.698	0.763	2.815
60	1.712	0.762	2.320	1.726	0.761	2.826	1.740	0.761	2.831	1.754	0.760	2.036	1.768	0.759	2.841
61	1.782	0.759	2.845	1.797	0.758	2.850	1.817	0.757	2.854	1.826	0.157	2.858	1.841	0.756	2.862
62	1.856	0.755	2.066	1.871	0.754	2.869	1.886	0.754	2.872	1.901	0.753	2.876	1.917	0.752	2.879
63	1.912	0.752	7.181	1.948	0.751	2.884	1.964	0.750	2.887	1.979	0.749	2.889	1.995	0.749	2.891
64	2.011	0.740	7.093	7.027	0.747	2.895	2.044	0.746	2.896	2.060	0.746	2.898	2.076	0.745	2.899
65	2.093	0.744	2.900	2.109	0.743	2.401	2.176	0.741	2.902	2.143	0.742	2.902	2.160	0.741	2.903
46	2.177	0.743	2.903	7.194	0.739	2.903	2.211	0.739	2.903	2.220	0.738	2.903	2.246	0.737	2.902

Output from this program consists of a table (exhibit 9) giving the ID number of each individual check-scale load and the difference between its actual measured product volumes and those calculated by using regression equations developed in generating the previous weight-volume tables. These differences for each product are summed and printed on the table as the "Total Difference." The program also sums the actual volumes of each product contained in the check-scale sample and the total percentage difference is calculated as a percentage of the actual total volume. This percentage gives an indication of the error in the tabular values being checked.

In options 3 and 5 which check both veneer and sawmill volumes, the total veneer difference and the total sawmill difference are added to get a "Total Saw-Log Difference." The total sawmill and veneer volumes of the sample are also combined to get the "Total Saw-Log Volume," and the total saw-log difference is calculated as a percentage of the total volume.

Exhibit 9. Example of CHECK output for pulpwood, veneer, and sawmill option

NAME OF FIRM OR ORGANIZATION
CHECK SCALES

DIFFERENCES IN ACTUAL AND CALCULATED DATA

(ACTUAL-CALCULATED)

ID	QULQ CORDS (NO)	VENEER (MBF)	SAWMILL (MBF)
435	0.265	-0.744	0.273
436	0.187	-0.117	0.104
437	-0,465	-0.107	0.029
438	-0.533	0.580	0.013
439	-0.584	0.324	0.017
440	0.301	-0.214	0.090
441	-0.600	-0.033	0.070
TOTAL DIFF.	-1.430	-0.312	0.597
PERCENT OF ACTUAL	-11.9	-1.4	14.6

TOT AL SAWLOG DIFF. (V.VOL.DIFF.+S.VOL.DIFF.) 0.285

TOTAL SAWLOG DIFF. AS PERCENT OF ACTUAL SAWLOG VOL. 1.1

Similar to WTVOL, CHECK is set up to handle any number of data sets at one time. A blank trailer card must follow each data set if more data sets are to follow. If no more sets follow, the trailer card should contain 9999 in columns 1 through 4. A new name header card, option card, and regression equation coefficients card must head each data set in the program.

Appendix 1 shows definitions of variable names, Appendix 2b includes the program listing for CHECK, Appendix 3b illustrates the deck setup, and Appendix 4 describes input data formats. No subroutines are used in CHECK.

Estimating Weights from Volumes

This program is designed to produce, through regression analysis, tables showing average weight per tree by diameter class and number of usable 16-foot logs. The program is flexible enough to handle any number of form classes, ranging from 65 to 90, any type of log rule (i.e., Scribner, International a-inch, or Doyle), any volume table giving cubic-foot or board-foot volumes, and any range of diameters for different species.

Five types of data cards are required as input to the program:

1. Name card--same as for WTVOL and CHECK.

2. Option card--includes number of form classes for which tables are desired and the minimum and maximum diameters for which weights are to be estimated in each table.

3. -Truckload data cards--same as for WTVOL and CHECK with an additional variable--total saw-log length in linear feet per load.

4. Trailer card--same as for WTVOL and CHECK.

5. Volume cards--volume data by form class, diameter, and number of 16-foot logs (simply volume tables punched into cards).

After the truckload data cards are read, the regression coefficients for determining average total weight per tree and average saw-log weight per tree are determined. They are then applied to the volume data by d.b.h. and number of usable 16-foot logs to produce weight tables by diameter and length for each desired form class and species. In addition to the tabular weights, average total weight per tree, average saw-log weight per tree, average total volume per tree, average number of usable 16-foot logs per tree, percentage variation explained by the regression equations, and their standard errors are computed and are footnoted on each table as illustrated in exhibits 10 and 11.

Exhibit 10. Example of VOLWT average total weight per tree table for form class 78

NAME OF FIRM OR ORGANIZATION

FORM CLASS 78

AVERAGE TOTAL WEIGHT PER TREE*
WEIGHT tM.LRS.1 BY NUMBER OF USABLE 16-FOOT LOGS

TREE DIAMETER (INCHES)	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5
10	0.639	0.915	1.191	1.452	1.712	-----	A----	----
11	0,702	0.993	1.285	1.561	1.837	------	------	------
12	0.756	1.063	1.371	1.662	1.954	2.214	2.482	-----
13	0.827	1.157	1.495	1.803	2.110	2.386	2.669	--I-
14	0.904	1.266	1.620	1.943	2.266	2.557	2.849	--e---
15	0.998	1.391	1.784	2.130	2.484	2.791	3.106	------
16	1.092	1.516	1.940	2.317	2.702	3.041	3.371	----
17	1.201	1.664	2.127	2.543	2.959	3.321	3.675	mm--
18	1.310	1.812	2.314	2.769	3.217	3.602	3.979	---
19	1.450	1.999	2.548	3.042	3.536	3.945	4.361	------
20	1.583	2.186	2.790	3.323	3.856	4.303	4.743	5.136
21	1.731	2.397	3.062	3.642	4.222	4.709	5.195	5.635
22	1.887	2.607	3.335	3.970	4.597	5.122	5.647	6.134
23	2.050	2.841	3.624	4.313	5.002	5.559	6.115	6.648
24	2.214	3.067	3.920	4,664	5.407	5.995	6.583	7.171
25	2.409	3.340	4.263	5.077	5.891	6.541	7.191	7.826
26	2.604	3.605	4.614	5.490	6.366	7.079	7.791	8.480
27	2.807	3.886	4.972	5.919	6.873	7.632	8.392	9.135
28	3.002	4.166	5.331	6.355	7.388	8.186	8.984	9.790
29	3.228	4.486	5.744	6.854	7.964	8.825	9.686	10.570
30	3.462	4.813	6.165	7.353	8.541	9.464	10.380	11.342
31	3.711	5.164	6.625	7.915	9.204	10.213	11.214	12.223
32	3.968	5.523	7.085	8.476	9,867	10.961	12.048	13.103
33	4.226	5.881	7.545	9.037	10.521	11.678	12.843	13.969
34	4.475	6.240	8.005	9.583	11.169	12.403	13.638	14.834
35	4.771	6.66 1	8.551	10.246	11.940	13.269	14.597	15.887

THE ABOVE TABLE FOR ESTIMATING AVERAGE TOTAL WEIGHT PER TREE WAS DERIVED BY SOLVING THE FOLLOWING---

*AVERAGE TOTAL WEIGHT PER TREE = 0.02511 + 7.79592 (AVER. VOL./TREE) + 0.50516 (NO. OF USABLE 16-FOOT LOGS)

MEAN AVERAGE TOTAL WEIGHT PER TREE = 3.509 (M.LBS.)
STANDARD DEVIATION OF AVERAGE TOTAL WEIGHT PER TREE = 0.950 (M.LBS.)
MEAN TOTAL VOLUME PER TREE = 0.257 (M.B.F.)
STANDARD DEVIATION OF AVERAGE VOLUME PER TREE = 0.091 (M.B.F.)
VARIATION EXPLAINED BY REGRESSION EQUATION = 88.57 PERCENT
STANDARD ERROR OF REGRESSION EQUATION = 0.325 (M.LBS.)
MEAN NO. OF USABLE 16-FOOT LOGS = 2.931 (16-FOOT LOGS)
STANDARD DEVIATION OF NO. OF USABLE 16-FOOT LOGS = 0.528 (16-FOOT LOGS)

*NOTE: AVERAGE VOLUME PER TREE WAS BASED ON OOYLF LOG RULE VOLUMES--
MESAVAGE AND GIRARD

Exhibit 11. Example of VOLWT average saw-log weight per tree table for form class 78

NAME OF FIRM OR ORGANIZATION

FORM CLASS 78

AVERAGE SAWLOG WEIGHT PER TREE*
WEIGHT (M.LBS.) BY NUMBER OF USABLE 16-FOOT LOGS

TREE DIAMETER (INCHES)	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5
10	0.530	0.783	1.036	1.274	1.511	------	------	d e ---
11	0.591	0.859	1.127	1.380	1.633	---a--	------	- - - -
12	0.644	0.928	1.211	1.480	1.748	1.986	2.231	------
13	0.713	1.019	1.334	1.617	1.901	2.154	2.414	- - - -
14	0.789	1.126	1.456	1,754	2.053	2.321	2.590	------
15	0.881	1.248	1.616	1.938	2.267	2.551	2.842	m - m -
16	0.973	1.371	1.769	2.121	2.481	2.795	3.101	- - e - -
17	1.079	1.516	1.952	2.342	2.733	3.070	3.399	------
18	1.186	1.661	2.135	2.564	2,985	3.344	3.697	------
19	1.324	1.844	2.364	2.831	3.298	3.680	4.071	------
20	1.453	2.027	2.601	3.106	3.611	4.031	4.445	4.812
21	1.599	2.233	2.868	3.419	3.969	4.428	4.887	5.301
22	1.751	2.439	3.135	3.739	4.336	4.833	5.330	5.789
23	1.911	2.668	3.417	4.075	4.733	5.260	5.788	6.293
24	2.072	2.890	3.708	4.419	5.130	5.688	6.246	6.805
25	2.263	3.157	4.043	4.823	5.603	6.222	6.842	7.446
26	2.453	3.416	4.387	5.278	6.069	6.749	7.430	8.087
27	2.652	3.691	4.738	5.648	6.565	7.291	8.017	8,728
28	2.843	3.966	5.089	6.075	7.069	7.833	8.597	9.370
29	3.064	4.279	5.494	6.564	7.633'	8.459	9.285	10.133
30	3.293	4.600	5.906	7.052	8.198	9.085	9.964	10.889
31	3.537	4.943	6.356	7.602	8.847	9.818	10.781	11.751
32	3.789	5.294	6.807	8.151	9.496	10.551	11.598	12.614
33	4.041	5.645	7.257	8.701	10.137	11.253	12.376	13.461
34	4.286	5.997	7.708	9.235	10.771	11.963	13.155	14.309
35	4.576	6.409	8.242	9.884	11.527	12.810	14.094	15.339

THE ABOVE TABLE FOR ESTIMATING AVERAGE SAWLOG WEIGHT PER TREE WAS DERIVED BY SOLVING THE FOLLOWING---

*AVERAGE SAWLOG WEIGHT PER TREE = -0.03726 + 7.63369 (AVER. VOL./TREE) + 0.46018 (NO. OF USABLE 16-FOOT LOCSJ

MEAN AVERAGE SAWLOG WEIGHT PER TREE = 3.274 (M.LBS.)

STANDARD DEVIATION OF AVERAGE SAWLOG WEIGHT PER TRFE = 0.906 (M.LBS.)

MEAN TOTAL VOLUME PER TREE = 0.257 (M.B.F.)

STANDARD DEVIATION OF AVERAGE VOLUME PER TRFE = 0.091 (M.B.F.)

VARIATION EXPLAINED BY REGRESSION EQUATION = 90.53 PERCENT

STANDARD ERROR OF REGRESSION EQUATION = 0.282 (M.LBS.)

MEAN NO. OF' USABLE 16-FOOT LOGS = 2.931 (16-FOOT LOGS)

STANDARD DEVIATION OF NO. OF USABLE 16-FOOT LOGS = 0.528 (16-FOOT LOGS)

*NOTE: AVERAGE VOLUME PER TREE WAS BASED ON DOYLE LOG RULE VOLUMES--
HESAVAGF AND GIRARD

VOLWT is as flexible as other programs described here and, in producing multiple sets of tables in a single run, is controlled by the trailer cards similar to those for the other programs. Here, though, the trailer card is used to indicate an end of truckload data and the beginning of volume data in addition to informing the program of an end of data sets. The trailer card should be placed after the truckload data deck as before and should be blank in columns 1 through 4 when additional data sets follow and should contain 9999 in columns 1 through 4 when the data set being read is the last one. When multiple data sets are being read, volume data must follow each data set.

The deck setup for VOLWT is shown in Appendix 3c, input data formats are shown in Appendix 4, and definitions of variable names are shown in Appendix 1. VOLWT also uses subroutines MATINV and MULT as part of its regression analysis.

Subroutines

Subroutines MATINV and MULT are required in both programs WTVOL and VOLWT to perform the regression analysis. MATINV inverts the matrix consisting of sums of squares and sums of products of the independent regression variables. This matrix is given to MATINV by the main programs and MATINV replaces this matrix by its inverse. The inverse matrix and the matrix containing the sums of the dependent variables and the sums of products of the dependent variables times the independent variables are input to MULT. MULT multiplies these two matrices to develop a matrix of regression coefficients which are returned to the main program.

These two subroutines are not hardware dependent and should require no alterationor programer action regardless of the program in which they are used or which option is chosen. No definitions of variable names used in them are included here, but listings for both can be found in Appendices 2d and 2e.

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Appendix 1

Definitions of Program Variable Names

AMEAN	Array of averages for number of trees per load, total weight per load, board-foot volume per load (sawmill plus veneer volume), saw-log weight per load, board-foot veneer volume per load.
AMNPUL	Mean pulp volume.
AMNPWT	Mean pulp weight.
AMNSML	Mean sawmill volume.
AMSE	Array of mean square errors for the regression equations.
ANLOGS	Number of usable 16-foot logs.
APV	Pulp volume (or weight) per truckload.
ATPV	Total pulp volume (or weight) in all sample truckloads.
ATSLV	Total saw-log volume in all sample truckloads.
ATSV	Total sawmill volume in all sample truckloads.
ATVV	Total veneer volume in all sample truckloads.
B	Array of regression constants and coefficients.
CPV	Calculated pulp volume (or weight).
CSMV	Calculated sawmill volume.
DET	Determinant of the matrix continuing sums, sums of squares and products of the independent variables.
ICOUNT	Line count controlling printer.
ID	Truckload identification number.
IFC	Form class.
IFRAC	Fraction of load weight not in even thousands of pounds.
IO	Code used to select program option which varies according to product raw material.

ITREES	Identifies the number of trees per load to which each table applies. Appears in heading of each table.
ITWT	Truckload weight, in even thousands of pounds, appearing in left-most column of each table.
IW	TWTMIN rounded back to nearest lowest thousands of pounds.
IWTM	Total net load weight.
IX	Do-loop index.
JJ	Diameter class varying from 10-40 inches.
K	Counter used in determining when the number of form classes for which weights have been computed equals NK.
KARRAY	Array of volumes by form class, length, and diameter.
LOGRL	Log rule.
MAXD	Maximum diameter appearing in weight table.
MIND	Minimum diameter appearing in weight table.
NAME	Name of firm or organization.
NCASE	Number of form classes for which tables are to be produced.
NOLDS	Total number of loads.
PPD	Percentage difference in actual pulp volume (or weight) and calculated pulp volume (or weight).
PSLVD	Percentage difference in actual saw-log volume and calculated saw-log volume.
PSVD	Percentage difference in actual sawmill volume and calculated sawmill volume.
PULPWT	Pulpwood weight read from truckload data cards.
PVD	Difference in actual pulp volume (or weight) and calculated pulp volume (or weight) by load.
PVVD	Percentage difference in actual veneer volume and calculated veneer volume.

PWFCTR	Weight per cord factor used in converting pulpwood from pounds to cords.
PWT	Array of pulpwood weights (or volumes) calculated and printed in tables.
REGSS	Regression sum of squares.
RHS	Right-hand side of normal equations.
RSQR	Coefficient of multiple determination.
SAWWT	Array of average saw-log weights.
SCALE	Total truckload volume.
SLVD	Saw-log volume difference per load.
SMLVOL	Sawmill volume.
SOLRHS	Array containing product of B times RHS. Used in calculating sums of squares due to error.
SPWTSQ	Sum of squares of pulp weight.
SPX	Sums, sums of squares and products of the independent variables.
SPYX	Sums, sums of squares and products of independent and dependent variables.
SSE	Sums of squares due to error.
SSMLSQ	Sum of squares of sawmill volume.
SSY	Sum of squares of the dependent variable corrected for the mean.
STD	Standard deviation of variables whose means are defined in AMEAN.
STDPUL	Standard deviation of pulp volume.
STDPWT	Standard deviation of pulp weight.
SUMSML	Sum of sawmill volume.
SVD	Sawmill volume difference per load.
SVOL	Calculated tabular values of sawmill volume.

SWT	Calculated saw-log weight.
TITLE	Name of firm or organization.
TMAX	Maximum number of trees per load observed among sample loads.
TMIN	Minimum number of trees per load observed among sample loads.
TOSAWL	Total saw-log length per truckload.
TOTWT	Total weight per tree.
TPVD	Total pulpwood volume (or weight) difference in the sample.
TREES	Synonymous with ITREES but is in real mode used to calculate tabular values.
TREMAX	Maximum number of trees per load. Used as a delimiter in producing tables.
TREMIN	Minimum number of trees per load. Used as a delimiter in producing tables.
TSLVD	Total saw-log volume difference in the sample.
TSML	Total sawmill volume for all loads.
TSVD	Total sawmill volume difference in the sample.
TVVD	Total veneer volume difference in the sample.
TWT	Net load weight, in even hundreds of pounds, used in calculating tabular values.
TWTI	Synonymous with ITWT but in real mode.
TWTMAX	Maximum net load weight per truckload. Used as a delimiter in producing tables.
TWTMIN	Minimum net load weight per truckload. Used as a delimiter in producing tables.
VAR(1)	The number, one.
VAR(2)	Number of trees per load in WTVOL. Average volume per tree per truckload in VOLWT.
VAR(3)	Total net weight per load in WTVOL. Average saw-log length per tree per truckload in 16-foot logs in VOLWT.

VAR(4)	Square root of total net weight times number of trees per load in WTVOL. Average total weight per tree per truckload in VOLWT.
VAR(5)	Total board-foot volume (sawmill plus veneer) in WTVOL. In VOLWT, the average saw-log weight per tree per truckload.
VAR(6)	Total saw-log weight.
VAR(7)	Total veneer volume.
VVD	Veneer volume difference per load.
VVOL	Calculated tabular veneer volume.
WMAX	Maximum number of trees per load observed among sample loads.
WMIN	Minimum number of trees per load observed among sample loads.
XIFRAC	Synonymous with IFRAC but in real mode.
XIWT	Net load weight rounded to the nearest 200 pounds.
XIWTM	Synonymous with IWTM but in real mode.
XNO	Number of trees or logs per load.
Y	Dependent variables.

Appendix 2a. Listing for WTVOL

```
000 1          DIMENSION NAME(20),VAR(7),SPXY(7,7),SPX(4,4),AMEAN(7),RHS(4,3),REG
              1SS(3),SSE(3),AMSE(3),RSQR(3),PWT(5),SVOL(5),B(4,3),VVOL(5)
0002           DIMENSION SSY(3),SOLRHS(3),STD(7)
0003           DOUBLE PRECISION VAR,SPXY,SPX,RHS,VOL,WTS,AMEAN,TREMIN,TREMAX,TWTM
              1IN,TWTMAX,DET,AMNPWT,SSE,AMSE,RSQR,REGSS,PULPWT,PWT,SVOL,TREES,TWT
              2I,SWT,B,SOLRHS,VVOL
0004           DOUBLE PRECISION SSY,TWT,PWFCTR,STD,STDPWT,SUMPWT,SPWTSQ,STDPVL,SU
              1MSML,SSMLSQ,STDSML,TMIN,TMAX,WMIN,WMAX
0005         1 0 0  2 I=1,7
0006           0 0  2 J=1,7
000 7        2 SPXY(I,J)=0.
0008           TSML=0
0009           SUMPWT=0.
0010           SPWTSQ=0.
0011           SUMSML=0.
0012           SSHL SQ=0.
0013           READ(5,3) (NAME(I),I=1,20)
0014           READ(5,4)IO,PWFCTR,TREMIN,TREMAX,TWTMIN,TWTMAX
0015         3 FORMAT(20A4)
0016         4 FORMAT(I1,F4.3,4F3.0)
        C
        C      VAR(1) IS ONE.
        C      VAR(2) IS THE NUMBER OF TREES PER LOAD.
        C      VAR(3) IS TOTAL NET WEIGHT PER LOAD.
        C      VAR(4) IS THE SQUARE ROOT OF TOTAL NET WEIGHT X NUMBER OF TREES PER LOAD.
        C      VAR(5) IS TOTAL BOARD FOOT VOLUME (SAWMILL + VENEER VOLUME).
        C      VAR(6) IS TOTAL SAWLOG WEIGHT.
        C      VAR(7) IS TOTAL VENEER VOLUME.
        C
0017         5 READ(5,6)ID,VAR(5),SMLVOL,VAR(7),VAR(3),PULPWT,VAR(2)
0018         6 FORMAT(I4,3F4.3,2F5.3,F3.0)
        C
        C    WHERE JO IS EQUAL TO 0 OR 9999, AN END OF SAMPLE DATA HAS BEEN EN-
        C    COUNTERED.   WHERE IO IS 0, OTHER DATA SETS WILL FOLLOW.   WHEREI D
        C    IS 9999, ALL DATA SETS HAVE BEEN READ.
        C
0019           IF( ID.EQ.0.OR. ID.EQ.9999)GO TO 12
        C
        C    IF OPTION 1,2, OR 4 IS DESIRED, BOARD-FOOT VOLUMES MAY BE PUNCHEO IN
        C    THE TOTAL VOLUME FIELD OR IN THE SPECIFIC VOLUME FIELD OR BOTH.   THE
        C    FOLLOWING STATEMENTS PLACE VALUES IN FIELOS LEFT BLANK FOR THESE
        C    OPTIONS WHEN SPECIFIC AN0 TOTAL VOLUME FIELDS ARE NOT PUNCHED.
        C
0020           IF(IO.EQ.3.OR.IO.EQ.5)GO TO 7
002 1          IF(VAR(5).EQ.0.)VAR(5)=SMLVOL
0022           IF(SMLVOL.EQ.0.)SMLVOL=VAR(5)
0023           IF(VAR(7).EQ.0.)VAR(7)=VAR(5)
        C
        C    THE FOLLOWING STATEMENTS DETERMINE MINIMUM & MAXIMUM NUMBER OF
        C    TREES PER LOAD FROM THE SAMPLE DATA WHEN THESE VALUES ARE NOT
        C    SPECIFIED IN THE OPTIONS CARD.
        C
0024         7 IF(TREMIN.NE.0.OR.TREMAX.NE.0)GO T O 8
0025           IF(SPXY(1,1).EQ.0)TMIN=900.
002 6          IF(SPXY(1,1).EQ.0)TMAX=0.
0027           IF(VAR(2).LT.TMIN)TMIN=VAR(2)
0020           IF(VAR(2).GT.TMAX)TMAX=VAR(2)
        C
        C    THE FOLLOWING STATEMENTS DETERMINE MINIMUM & MAXIMUM LOAD WEIGHTS
        C    FROM THE SAMPLE DATA WHEN THESE VALUES ARE NOT SPECIFIED IN THE
        C    OPTIONS CARD.
        C
0029         8 IF(TWTMIN.NE.0.OR.TWTMAX.NE.0)GO T O 9
0030           IF(SPXY(1,1).EQ.0)WMIN=900000.
003 1          IF(SPXY(1,1).EQ.0)WMAX=0.
0032           IF(VAR(3).LT.WMIN)WMIN=VAR(3)
0033           IF(VAR(3).GT.WMAX)WMAX=VAR(3)
        C
        C    VARIABLES USED IN REGRESSION ANALYSIS WHICH ARE NOT READ DIRECTLY
        C    ARE DETERMINE0 BELOW, SUMS AND SUMS OF SQUARES & PROOUCTS ARE ALSO
        C    CALCULATED.
        C
0034         9 VAR( 1)=1.0
0035           VAR(4)=(DSQRT(VAR(3)*VAR(2)))
0036           VAR(6)=VAR(3)-PULPWT
0037           TSML =TSML + SMLVOL
```

```
0038          IF(IO.EQ.4.OR.IO.EQ.5)GO TO 10
0039          IF(PULPWT.EQ.0)PULPWT=1
0040       1 0  SUMPWT=SUMPWT+PULPWT
0041          SPWTSQ=SPWTSQ+PULPWT**2
0042          SUMSML=SUMSML+SMLVOL
0043          SSMLSQ=SSMLSQ+SMLVOL**2
0044          DO 11 I=1,7
0045          DO 11 J=1,7
0046       11 SPXY(I,J)=SPXY(I,J)+VAR(I)*VAR(J)
0047          GO TO 5
        C
        C   SPXY IS SEPARATED INTO SPX (SUMS,SUMS OF SQUARES & PRODUCTS FOR
        C   THE INDEPENDENT VARIABLES) AND RHS (THE RIGHT-HAND SIDE OF THE
        C   NORYAC EQUATIONS ).
        C
0048       12 l-lo 14 I=1,4
0049          DO 13 J=1,4
0050       13 SPX(I,J)=SPXY(I,J)
0051          RHS(I,1)=SPXY(I,5)
0052          RHS(I,2)=SPXY(I,6)
0053       14 RHS(I,3)=SPXY(I,7)
        C
        C   SUBROUTINE MATINV IS CALLED TO INVERT THE MATRIX SPX.  SUBROUTINE
        C   MULTYULTIPLIES THE INVERSE OF SPX AND PHS TO DETERMINE B, THE
        C   REGRESSION COEFFICIENTS.
        C
0054          CALL MATINV(SPX,4,DET)
0055          CALL MULT(SPX,RHS,4,3,4,B)
        C
        C   STANDARD DEVIATIONS, MEANS, ERROR SUMS OF SQUARES, REGRESSION SUMS OF
        C   SQUARES,  MEAN SQUARE ERRORS, AND COEFFICIENTS OF VARIATION ARE CALCULATED.
        C
0056          DO 15 I=2,7
0057          STD(I)=(SPXY(I,I)-((SPXY(1,I)**2)/SPXY(1,1)))/(SPXY(1,1)-1.0)
0058          STD(I)=DSQRT(STD(I))
0059       15 AMEAN(I)=SPXY(1,I)/SPXY(1,1)
0060          AMNPWT=SUMPWT/SPXY(1,1J
0061          AMNSML = TSML/SPXY(1,1)
0062          IF(PWFCTR.LE.0.)PWFCTR=1.
0063          AMNPVL=AMNPWT/PWFCTR
0064          STDPWT=DSQRT((SPWTSQ-((SUMPWT**2)/SPXY(1,1)))/(SPXY(1,1)-1.0))
0065          STDPVL=STDPWT/PWFCTR
0066          STDSML=DSQRT((SSMLSQ-((SUMSML**2)/SPXY(1,1)))/(SPXY(1,1)-1.0))
0067          DO1 9  J=1,3
0068          SOLRHS(J)=0.
0069          DO 17 I=1,4
0070       17 SOLRHS(J)=SOLRHS(J)+B(I,J)*RHS(I,J)
0071          SSE(J)=SPXY(J+4,J+4)-SOLRHS(J)
0072          SSY(J)=SPXY(J+4,J+4)-(RHS(1,J)**2/SPXY(1,1))
0073          REGSS(J)=SSY(J)-SSE(J)
0074          AMSE(J)=SSE(J)/(SPXY(1,1)-4.0)
0075          AMSE(J)= (DSQRT (AMSE(J)))
0076       19 RSQR(J)=REGSS(J)/SSY(J)
0077          NOLDS=SPXY(1,1)
0078          IF(TREMIN.EQ.0.)TREMIN=TMIN
0079          IF(TREMAX.EQ.0.)TREMAX=TMAX
0080          IF(TWTMIN.EQ.0.)TWTMIN=WMIN
0081          IF(TWTMAX.EQ.0.)TWTMAX=WMAX
0082          IW=TWTMIN
0083          TWTMIN=IW
0084          GO TO (20,30,40,50,60),IO
        C
        C   SUMMARY PAGE FOR OPTION 1 IS PRINTED
        C
0085       2 0  WRITE(6,200)
0086          WRITE(6,100)(NAME(I),I=1,20)
0087          WRITE(6,202)NOLDS,AMEAN(2),STD(2),AMNSML,STDSML,AMEAN(6),STD(6)
0088          WRITE(6,204)(B(I,1),I=1,4)
0089          WRITE(6,102)RSQR(1),AMSE(1)
        C
        C   DELIMITERS ARE SET FOR PRODUCING THE TABLES.
        C
0090       21 TREES=TREMIN-1.
0091       2 2 TWT=TWTMIN
0092          TWTI=TWTMIN
0093          TREES=TREES+1.
0094          IF(TREES.GT.TREMAX)GOTO 80
0095          ITREES=TREES
```

```
0096          IF(IO.LE.3)WRITE(6,104)(NAME(I),I=1,20),ITREES
0097          IF(IO.GT.3)WRITE(6,106)(NAME(I),I=1,20),ITREES
0098          GO TO (23,33,43,53,63),IO
        C
        C   TABLE HEADING FOR OPTION 1 IS PRINTEO THEN TABULAR VALUES ARE
        C   CALCULATED & PRINTED FOR EACH LINE IN THE TABLES.
        C
0099       23 WRITE(6,206)
0100       24 DO2 6 I=1,5
0101          SVOL(I)=B(1,1)+B(2,1)*TREES+B(3,1)*TWT+B(4,1)*DSQRT(TWT*TREES)
0102          IF(SVOL(I).LE.0.)SVOL(I)=0.
0103       26 TWT=TWT+.2
0104          ITWT=TWTI
0105          WRITE(6,208)ITWT,(SVOL(I),I=1,5)
0106          TWTI=TWTI+1.
0107          If (TWT.GT.TWTMAX)GO TO 22
0108          GO TO 24
        C
        C   SUMMARY PAGE FOR OPTION 2 IS PRINTED
        C
0109       30 WRITE(6,300)
0110          WRITE(6,100) (NAME(I),I=1,20)
0111          WRITE(6,302) NOLDS,AMEAN(2),STD(2),AMEAN(7),STD(7),AMEAN(6),STD(6)
0112          WRITE(6,304) (B(I,3),I=1,4)
0113          WRITE(6,102) RSQR(3),AMSE(3)
0114          GO TO 21
        C
        C   TABLE HEADING FOR OPTION 2 IS PRINTED THEN TABULAR VALUES ARF
        C   CALCULATFO & PRINTED FOR EACH LINE IN THE TABLES.
        C
0115       33 WRITE(6,306)
0116       34 DO 36 I=1,5
0117          VVOL(I)=B(1,3)+B(2,3)*TREES+B(3,3)*TWT+B(4,3)*DSQRT(TWT*TREES)
0110          IF(VVOL(I).LE.0.) VVOL(I)=0.
0119       36 TWT=TWT+.2
0120          ITWT=TWTI
3111          WRITE(6,208)ITWT,(VVOL(I),I=1,5)
0127          TWTI=TWTI+1.
3123          IF(TWT.GT.TWTMAX)GO TO 22
0124          GO TO 34
        C
        C   SUMMARY PAGE FOR OPTION 3 IS PRINTED
        C
0125       40 WRITE(6,400)
0126          WRITE(6,100)(NAME(I),I=1,20)
0127          WRITE(6,402)NOLDS,AMEAN(2),STD(2),AMNSML,STDSML,AMEAN(7),STD(7),AM
            1EAN(6),STD(6)
0129          WRITE(6,204)(B(I,1),I=1,4)
0129          WRITE(6,102)RSQR(1),AMSE(1)
0130          WRITE(6,404)(B(I,2),I=1,4)
0131          WRITE(6,102)RSQR(2),AMSE(2)
0132          WRITE(6,304)(B(I,3),I=1,4)
0133          WRITE(6,102)RSQR(3),AMSE(3)
0134          GO TO 21
        C
        C   TABLE HEADING FOR OPTION 3 IS PRINTED THEN TABULAR VALUFS ARE
        C   CALCULATE0 & PRINTED FOR EACH LINE IN THE TABLES.
        C
0135       43 WRITE(6,408)
0136       44 00 46 I=1,5
0137          SVOL(I)=B(1,1)+B(2,1)*TREES+B(3,1)*TWT+B(4,1)*DSQRT(TWT*TREES)
0138          VVOL(I)=B(1,3)+B(2,3)*TREES+B(3,3)*TWT+B(4,3)*DSQRT(TWT*TREES)
0139          IF(VVOL(I).LE.0.)VVOL(I)=0.
3140          IF(SVOL(I).LE.0.)SVOL(I)=0.
0141          IF(VVOL(I).LT.SVOL(I))GO TO 45
0142          VVOL(I)=SVOL(I)
0143          SVOL(I)=0.
0144          G0 TO46
0145       45 SVOL(I)=SVOL(I)-VVOL(I)
0146       46 TWT=TWT+.2
0147          ITWT=TWTI
0148          WRITE(6,142)ITWT,VVOL(1),SVOL(1),VVOL(2),SVOL(2),VVOL(3),SVOL(3),V
            1VOL(4),SVOL(4),VVOL(5),SVOL(5)
0149          TWTI=TWTI+1.
0150          IF(TWT.GT.TWTMAX)GO TO 22
0151          GO TO 44
        C
        C   SUMMARY PAGE FOR OPTION 4 IS PRINTED
```

```
C
50  WRITE(6,500)
    WRITE(6,100)(NAME(I),I=1,20)
    IF(PWFCTR.LE.1.)GO TO 51
    WRITE(6,502)NOLDS,AMEAN(2),STD(2),AMNPVL,STDPVL,AMNPWT,STDPWT,AMNS
   1ML,STDSML,AMEAN(3),STD(3),AMEAN(6),STD(6)
    GO TO 52
51  WRITE(6,503)NOLDS,AMEAN(2),STD(2),AMNPWT,STDPWT,AMNSML,STDSML,AMEA
   1N(3),STD(3),AMEAN(6),STD(6)
52  WRITE(6,504)(B(I,1),I=1,4)
    WRITE(6,102)RSQR(1),AMSE(1)
    WRITE(6,506)(B(I,2),I=1,4)
    WRITE(6,102)RSQR(2),AMSE(2)
    GO TO 21
C
C   TABLE HEADING FOR OPTION 4 IS PRINTED THEN TABULAR VALUES AQE
C   CALCULATED & PRINTED FOR EACH LINE IN THE TABLES.
C
53  IF(PWFCTR.LE.1.)WRITE(6,510)
    IF(PWFCTR.GT.1.)WRITE(6,508)
54  DO 56 I=1,5
    SVOL(I)=B(1,1)+B(2,1)*TREES+B(3,1)*TWT+B(4,1)*DSQRT(TWT*TREES)
    SWT=B(1,2)+B(2,2)*TREES+B(3,2)*TWT+B(4,2)*DSQRT(TWT*TREES)
    PWT(I)=(TWT-SWT)/PWFCTR
    IF(SVOL(I).LE.0.)SVOL(I)=0.
    IF(PWT(I).LE.0.)PWT(I)=0.
56  TWT=TWT+.2
    ITWT=TWTI
    WRITE(6,512)ITWT,SVOL(1),PWT(1),SVOL(2),PWT(2),SVOL(3),PWT(3),SVOL
   1(4),PWT(4),SVOL(5),PWT(5)
    TWTI=TWTI+1.
    IF(TWT.GT.TWTMAX)GO TO 22
    GO TO 54
C
C   SUMMARY PAGE FOR OPTION 5 IS PRINTED
C
60  WRITE(6.600)
    WRITE(6,100)(NAME(I),I=1,20)
    IF(PWFCTR.LE.1.)GO TO 61
    WRITE(6,602)NOLDS,AMEAN(2),STD(2),AMNPVL,STDPVL,AMNPWT,STDPWT,AMNS
   1ML,STDSML,AMEAN(7),STD(7),AMEAN(3),STD(3),AMEAN(6),STD(6)
    GO TO 62
61  WRITE(6,603)NOLDS,AMEAN(2),STD(2),AMNPWT,STDPWT,AMNSML,STDSML,AMEA
   1N(7),STD(7),AMEAN(3),STD(3),AMEAN(6),STD(6)
62  WRITE(6,504)(B(I,1),I=1,4)
    WRITE(6,102)RSQR(1),AMSE(1)
    WRITE(6,506)(B(I,2),I=1,4)
    WRITE(6,102)RSQR(2),AMSE(2)
    WRITE(6,604)(B(I,3),I=1,4)
    WRITE(6,102)RSQR(3),AMSE(3)
    GO TO 21
C
C   TABLE HEADING FOR OPTION 5 IS PRINTED THEN TABULAR VALUES ARE
C   CALCULATED & PRINTED FOR EACH LINE IN THE TABLES.
C
63  IF(PWFCTR.LE.1.)WRITE(6,607)
    IF(PWFCTR.GT.1.)WRITE(6,606)
64  DO 66 I=1,5
    SVOL(I)=B(1,1)+B(2,1)*TREES+B(3,1)*TWT+B(4,1)*DSQRT(TWT*TREES)
    SWT=B(1,2)+B(2,2)*TREES+B(3,2)*TWT+B(4,2)*DSQRT(TWT*TREES)
    PWT(I)=(TWT-SWT)/PWFCTR
    VVOL(I)=B(1,3)+B(2,3)*TREES+B(3,3)*TWT+B(4,3)*DSQRT(TWT*TREES)
    IF(VVOL(I).LE.0.)VVOL(IJ=0.
    IF(SVOL(I).LE.0.)SVOL(I)=0.
    IF(PWT(I).LE.0.)PWT(I)=0.
    IF(VVOL(I).LT.SVOL(I))GO TO 65
    VVOL(I)=SVOL(I)
    SVOL(I)=0.
    GO TO 66
65  SVOL(I)=SVOL(I)-VVOL(I)
66  TWT=TWT+.2
    ITWT=TWTI
    WRITE(6,608)ITWT,VVOL(1),SVOL(1),PWT(1),VVOL(2),SVOL(2),PWT(2),VVO
   1L(3),SVOL(3),PWT(3),VVOL(4),SVOL(4),PWT(4),VVOL(5),SVOL(5),PWT(5)
    TWTI=TWTI+1.
    IF(TWT.GT.TWTMAX)GO TO 22
    GO TO 64
```

```
          C
          C    IF IO IS 0 GO TO 1 & READ THE NEXT SET OF DATA, OTHERWISE
          C    TERMINITATE    PROGRAM.
          C
0211          80 IF(ID.EQ.0)GOTO 1
0212         100 FORMAT(1H0,///,6X,20A4)
0213         102 FORMAT(1H0,5X,'MULTIPLE R SOUAREO =',F9.4,/,
                1'        STANOARO ERROR =',F9.4,////)
0214         104  FORMAT(1H1,5X,20A4,11X,I3,'LOGS')
0215         106 FORMAT(1H1,5X,20A4,11X,I3,'TREES')
0216         142  FORMAT(1H,1X,I3,4X,5(F7.3,4X,F8.3,5X))
0217         200 FORMAT(1H1,38X,43HWEIGHT SCALING OF LOGS FOR SAWTIMBER VOLUME)
0218         202  FORMAT(1H0,/////,6X,'NUMBER O F LOADS',6X,'=',I4,' (NO.)',///,27X
                1,'MEAN',22X,'STANDARD DEVIATION',//,
                26X,'NUMBER O F  L O G S =',F9.4,' (NO.)',18X,F9.4,'  (NO.)',/,
                36X,'SAWLOG VOLUME    = ',F9.4,'  (MBF)',18X,F9.4,'  (MBF)',/,
                46X,'SAWLOG WEIGHT    = ',F9.4,'  (MLBS)',17X,F9.4,'  (MLBS)')
0219         204 FORMAT(1H0,5X,'THE REGRESSION EQUATION FOR ESTIMATING TOTAL SAWLOG
                1 VOLUMEIS',//,2X,'TOTAL SAWLOG V O L U M E  = ',F9.4,' + ',F9.4,
                2' (NO OF LOGS) + ',F9.4,'(TOTAL WEIGHT) + ',F9.4,
                3' (SQRT(TOTAL WEIGHT * NO OF LOGSJJ'J
0220         206 FORMAT(1H ,59X,'HUNDREDS OF POUNDS',/,' THOUS.',11X,'0',23X,
                1'2',23X,'4',23X,'6',23X,'8',/,'    OF',9X,4(9HSAWTIMBER,15X),
                29HSAWTIMBER,/,' POUNDS',9X,4(5H(MBF),19X),5H(MBF))
0221         208  FORMAT(1H,1X,I3,8X,4(F8.3,16X),F8.3)
0222         300 FORMAT(1H1,41X,40HWEIGHT SCALING OF LOGS FOR VENEER VOLUME)
0223         302  FORMAT(1H0,/////,6X,'NUMBER O F LOADS',6X,'=',I4,' (NO.)',///,27X
                1,'MEAN',22X,'STANDARD DEVIATION',//,
                26X,'NUMBER O    F     LOGS=',F9.4,'(NO. )',18X,F9.4,'  (NO.)',/,
                36X,'VENEER VOLUME    = ',F9.4,'  (MBF)',18X,F9.4,'  (MBF)',/,
                46X,'VENEER WEIGHT    = ',F9.4,'  (MLBS)',17X,F9.4,'  (MLBS)')
0224         304 FORMAT(1H0,5X,'THE REGRESSION EQUATION FOR ESTIMATING TOTAL VENEER
                1 VOLUME IS',//,2X,'VENEER VOLUME = ',F9.4,'+',F9.4,
                2' (NOC F LOGS)+',F9.4,'( T O T A L  WEIGHT) + ',F9.4,
                3' (SQRT(TOTAL WEIGHT * NO OF LOGS))')
0225         306 FORMAT(1H ,59X,'HUNDREDS OF POUNDS',/,' THOUS.',11X,'0',23X,
                1'2',23X,'4',23X,'6',23X,'8',/,'    OF',11X,4(6HVENEER,18X),
                26HVENEER,/,' POUNDS',10X,4(5H(MBF),19X),5H(MBF))
0226         400 FORMAT(1H1,33X,52HWEIGHT SCALING OF LOGS FOR VENEER AN0 SAWMILL VO
                1LUMEJ
0227         402 FORMAT(1H0,/////,6X,'NUMBER O F LOADS',6X,'=',I4,' (NO.)',///,27X
                1,'MEAN',22X,'STANDARD DEVIATION',//,
                26X,'NUMBER O  F  LOGS =" F 9 . 4 ,'  (NO.)',18X,F9.4,'  (NO.)',/,
                36X,'SAWMILL VOLUME   = ',F9.4,'  (MBF)',18X,F9.4,'  (MBF)',/,
                46X, 'VENEER VOLUME   = ',F9.4,'  (MBF)',18X,F9.4,'  (MBF)',/,
                56X,'SAWLOG WEIGHT    = ',F9.4,'  (MLBS)',17X,F9.4,'  (MLBS)')
0228         404 FORMAT(1H0,5X,'THE REGRESSION EQUATION FOR ESTIMATING TOTAL SAWLOG
                1 W E I G H T IS',//,2X,'TOTAL SAWLOG W E I G H T = ',F9.4,'t ',F9.4,
                2' (NO O F LOGS)t 'rF9.4,' ( T O T A L  WEIGHT)t ',F9.4,
                3' (SQRT(TOTAL W E I G H T * NO O F LOGS))')
0229         408 FORMAT(1H ,59X,'HUNDREDS OF POUNDS',/,' THOUS.',11X,'0',23X,
                1'2',23X,'4',23X,'6',23X,'8',/,'    OF',5X,
                25(18HVENEER      SAWMILL,6X),/,' POUNDS',4X,5(5H(MBF),6X,5H(MBF),8X
                3))
0230         500 FORMAT(1H1,33X,57HWEIGHT SCALING OF TREES FOR SAWTIMBER AN0 PULPWO
                1OD VOLUME)
0231         502 FORMAT(1H0,/////,6X,'NUMBER O F LOADS',6X,'=',I4,' (NO.)',///,27X
                1,'MEAN',22X,'STANDARD DEVIATION',//,
                26X,'NUMBER O  F  TREES=  ',F9.4,' (NO.)',18X,F9.4,'  (NO.)',/,
                36X,'PULPWOOD VOLUME = ',F9.4,'  (CORDS)',16X,F9.4,'  (CORDS)',/,
                46X,'PULPWOOD WEIGHT = ',F9.4,'  (MLBS)',17X,F9.4,'  (MLBS)',/,
                56X;, SAWLOG VOLUME   = ',F9.4,'  (MBF)',18X,F9.4,'  (MBF)',/,
                66X,' TOTAL WEIGHT    = ',F9.4,'  (MLBS)',17X,F9.4,'  (MLBS)',/,
                76X,' SAULOG  WEIGHT  = ',F9.4,'  (MLBS)',17X,F9.4,'  (MLBS)')
0232         503 FORMAT(1H0,/////,6X,'NUMBER O F LOADS',6X,'=',I4,' (NO.)',///,27X
                1,'MEAN',22X,'STANDARD DEVIATION',//,
                26X,'NUMBER OF TREES = ',F9.4,'  (NO.)',18X,F9.4,'  (NO.)',/,
                36X,'PULPWOOD WEIGHT = ',F9.4,'  (MLBS)',17X,F9.4,'  (MLBS)',/,
                46X,'SAWLOG VOLUME    = ',F9.4,'  (MBF)',18X,F9.4,'  (MBF)',/,
                56X,'TOTAL WEIGHT     = ',F9.4,'  (MLBS)',17X,F9.4,'  (MLBS)',/,
                66X,'SAWLOG WEIGHT    = ',F9.4,'  (MLBS)',17X,F9.4,'  (MLBS)')
0233         504 FORMAT(1H0,5X,'THE REGRESSION  EQUATION FOR ESTIMATING  TOTAL SAWLOG
                1  VOLUME IS',//,2X,'TOTAL SAWLOG VOLUME = ',F9.4,'t " F 9 . 4 ,
                2 '  (NO OF TREES)+ ',F9.4,'(TOTAL WEIGHT) +',F9.4,
                3' (SQRT(TOTAL WEIGHT * NO OF TREES))')
0234         506 FORMAT(1H0,5X,'THE REGRESSION EQUATION FOR ESTIMATING TOTAL SAWLOG
                1 WEIGHT IS',//,2X,'TOTAL SAWLOG WEIGHT = ',F9.4,'t 'rF9.4,
                2' (NO O F TREES) + ',F9.4,'(TOTAL W E I G H T) t ',F9.4,
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```
      3' (SQRT(TOTAL WEIGHT * ND OF TREES))')
0235  5 0 8  FORMAT(1H,59X,'HUNDREDS OF POUNDS',/,'THOUS.',11X,'0',23X,
      1'2',23X,'4',23X,'6',23X,'8',/,'   OF',5X,5(17HSAWTIMBER    PULP, 7X
      2),/,' POUNDS', 5X,5(17H(MBF)    (CORDS),7X))
0236  510 FORMAT(1H,59X,'HUNDREDS Of POUNDS',/,* THOUS.',11X,'0',23X,
      1'2',23X,'4',23X,'6',23X,'8',/,'   OF',5X,5(17HSAWTIMBER    PULP,7X
      2),/,' POUNDS',5X,5(17H(MBF)    (POUNDS),7X))
0737  5 1 2  FORMAT(1H,1X,I3,4X,5(F8.3,4X,F7.3,5X))
0238  630 FORMAT(1H1,29X,62HWEIGHT SCALING OF TPEES FOR VENEER,SAWMILL AND P
      1ULPWOOD VOLUME)
0239  6 0 2  FORMAT(1HO,/////,6X,'NUMBER OF LOADS',6X,'=',I4,'(NO.)',///,27X
      1,'MEAN',22X,'STANDARD DEVIATION',//,
      26X,'NUMBER OF TREES = ',F9.4,' (NO.)',18X,F9.4,' (NO.)',/,
      36X,'PULPWOOD VOLUME = ',F9.4,' (CORDS)', 16X,F9.4,' (CORDS)',/,
      46X,'PULPWOOD WEIGHT = ',F9.4,' (MLBS)',17X,F9.4,' (MLBS)',/,
      56X,'SAWMILL VOLUME = ',F9.4,' (MBF)',18X,F9.4,' (MBF)',/,
      66X,'VENEER V O L U M E = ',F9.4,' (MBF)',18X,F9.4,' (MBF)',/,
      76X,'TOTAL WE IGHT = ',F9.4,' (MLBS)',17X,F9.4,' (MLBS)',/,
      86X,'SAWLOG WEIGHT = ',F9.4,' (MLBS)',17X,F9.4,' (MLBS)')
0240  6 0 3  FORMAT(1HO,/////,6X,'NUMBER OF LOADS',6X,'=',I4,' (NO.)',///,27X
      1,'MEAN',22X,'STANDARD DEVIATION',//,
      26X,'NUMBER OF TREES =',F9.4,' (NO.)',18X,F9.4,' (NO.)',/,
      36X,'PULPWOOD WEIGHT = ',F9.4,' (MLBS)',17X,F9.4,' (MLBS)',/,
      46X,'SAWMILL VOLUME = ',F9.4,' (MBF)',18X,F9.4,' (MBF)',/,
      56X,'VENEER VOLUME = ',F9.4,' (MBF)',18X,F9.4,' (MBF)',/,
      66X,'TOTAL WEIGHT = ',F9.4,' (MLBS)',17X,F9.4,' (MLBS)',/,
      76X,'SAWLOG WEIGHT =',F9.4,' (MLBS)',17X,F9.4,' (MLBS)')
0241  604 FORMAT(1HO,5X,'THE REGRESSION EQUATION FOR ESTIMATING TOTAL VENEER
      1 VOLUYE IS',//,2X,'VENEER VOLUME = ',F9.4,'+',F9.4,
      2' (NO OF TREES) + ',F9.4,'(TOTAL WEIGHT) +',F9.4,
      3' (SQRT(TOTAL WEIGHT * NO OF TREES))')
0242  6 0 6  FORMAT(1H,59X,'HUNDREDS O F POUNDS',/,'THOUS.',11X,'0',23X,'2',
      123X,'4',23X,'6',23X,'8',/,'   OF',4X,5(24HVENEER SAWMIL L  PULP
      2),/,' POUNDS',3X,5(24H(MBF)    (MBF)  (CORDS)  ))
0243  6 0 7  FORMAT(1H,59X,'HUNDREDS O F POUNDS',/,'THOUS.',11X,'0',23X,'2',
      123X,'4',23X,'6',23X,'8',/,'   OF',4X,5(24HVENEER SAWMILL  PUI P
      2),/,' POUNDS',3X,5(24H(MBF)  (MBF) (POUNDS) ))
0244  6 0 8  FORMAT(1H,2X,I3,2X,5(F7.3,F8.3,F7.3,2X))
0245       STOP
0246       END
```

```
0001          DIMENSION  NAME(20),B(3,4),Y(3),VAR(7)
0002        1 ICOUNT=0
0003          ATVV=0.
0004          ATSV=0.
0005          TVVD=0.
0006          ATPV=0.
000 7         TSVD=0.
0008          TPVD=0.
0009          TSLVD=0.
0010          ATSLV=0.
0011          READ(5,3)(NAME(I),I=1,20)
0012        3 FORMAT (20A4)
0013          READ(5,5)IO,PWFCTR
0014        5 FORMAT(I1,F4.3)
0015          IF(IO.EQ.1)WRITE(6,7)(NAME(I),I=1,20)
0016          IF(IO.EQ.2)WRITE(6,8)(NAME(I),I=1,20)
0017          IF(IO.EQ.3)WRITE(6,9)(NAME(I),I=1,20)
0018          IF(IO.EQ.4.AND.PWFCTR.EQ.0)WRITE(6,10)(NAME(I),I=1,20)
0019          IF(IO.EQ.4.AND.PWFCTR.NE.0)WRITE(6,11)(NAME(I),I=1,20)
0020          IF(IO.EQ.5.AND.PWFCTR.EQ.0)WRITE(6,12)(NAME(I),I=1,20)
002 1         IF(IO.EQ.5.AND.PWFCTR.NE.0)WRITE(6,13)(NAME(I),I=1,20)
0022        7 FORMAT(1H1,20A4,/,19X,'CHECK SCALES',//,3X,
             1'DIFFERENCES IN ACTUAL AND CALCULATED DATA',//,
             215X,'(ACTUAL-CALCULATED)',//,29X,'SAWLOG',/,18X,
             3'ID',9X,'(MBF)',//)
0023        8 FORMAT(1H1,20A4,/,19X,'CHECK SCALES',//,3X,
             1'DIFFERENCES IN ACTUAL AND CALCULATED DATA',//,
             215X,'(ACTUAL-CALCULATED)',//,29X,'VENEER',/,18X,
             3'ID',9X,'(MBF)',//)
0024        9 FORMAT(1H1,20A4,/,19X,'CHECK SCALES' ,//,3X,
             1'DIFFERENCES IN ACTUAL AND CALCULATED DATA',//,
             215X,'(ACTUAL-CALCULATED)',//,20X,'VENEER',7X,'SAWMILL',
             3/,13X,'ID',5X,'(MBF)',8X,'(MBF)',//)
0025       10 FORMAT(1H1,20A4,/,19X,'CHECK SCALES' ,//,3X,
             1'DIFFERENCES IN ACTUAL AND CALCULATED DATA',//,
             215X,'(ACTUAL-CALCULATED)',// 22X,'PULP',7X,'SAWLOG',
             3/,13X,'ID',6X,'POUNDS',/,21X,'(MLBS)',7X,'(MBF)',//)
0026       1 1  FORMAT(1H1,20A4,/,19X,'CHECK SCALES',//,3X,
             1'DIFFERENCES IN ACTUAL AND CALCULATED DATA',//,
             215X,'(ACTUAL-CALCULATED)',// 22X,'PULP',7X,'SAWLOG',
             3/,13X,'ID',7X,'CORDS',/,22X,'(NO)',7X,'(MBF)',//)
002 7      1 2  FORMAT(1H1,20A4,/,19X,'CHECK SCALES',//,3X,
             1'DIFFERENCES IN ACTUAL AND CALCULATED DATA',//,
             215X,'(ACTUAL-CALCULATED)',//,10X,'PULP',6X,'VENEER',
             35X,'SAWMILL',/,2X,'ID',5X,'POUNDS',/,9X,'(MLBS)',
             46X,'(MBF)',6X,'(MBF)',//)
0028       1 3  FORMAT(1H1,20A4,/,19X,'CHECK SCALES',//,3X,
             1'DIFFERENCES IN ACTUAL AND CALCULATED DATA',//,
             215X,'(ACTUAL-CALCULATED)',//,10X,'PULP',6X,'VENEER',
             35X,'SAWMILL',/,2X,'ID',6X,'CORDS',/,10X,'(NO)',
             46X,'(MBF)',6X,'(MBF)',//)
0029       1 4  IX=1
0030          IF(IO.EQ.3)IX=2
0031          IF(IO.EQ.4)IX=2
0032          IF(IO.EQ.5)IX=3
0033          no  17 I=1,IX
0034          READ(5,15)(B(I,J),J=1,4)
0035       1 5  FORMAT(4F9.4)
0036       1 7  CONTINUE
         C
         C   VAR(5) - TOTAL LOAD SCALE (ANY SCALE)
         C   VAR(7) - VEYEER VOLUME (ANY SCALE J
         C   VAR(3) - TOTAL YET LOAD WEIGHT (M.LBS. J
         C   VAR(2) - NUMBER OF TREES OR LOGS ON LOAD
         C
0037       19 READ(5,20)IO,VAR(5),SMLVOL,VAR(7),VAR(3),PULPWT,VAR(2)
0038       2 0  FORMAT(I4,3F4.3,2F5.3,F3.0)
0039          IF(IO.EQ.3.OR.IO.EQ.5)GOTO 21
```

```
0040          IF(SMLVOL.EQ.0)SMLVOL=VAR(5)
0041          IF(VAR(5).EQ.0)VAR(5)=SMLVOL
0042          IF(VAR(7).EQ.0)VAR(7)=VAR(5)
0043       21 IF(ID.EQ.0.OR.ID.EQ.9999)GO TO 22
0044          GO TO 23
0045       22 IF(IO.EQ.1)GOTO 32
0046          IF(IO.EQ.2)GOTO 37
0047          IF(IO.EQ.3)GOTO4 5
0048          IF(IO.EQ.4)GO TO 55
0049          IF(IO.EQ.5)GO TO 65
0050       23 ICOUNT=ICOUNT+1
C
C      THE FDLLOWING 12 STATEMENTS ROUND THE TRUCKLOAD
C      WEIGH1 TO THE NEAREST EVEN HUNDRED POUNDS.
C
0051          IWTM=VAR(3)
0052          IFRAC= (VAR(3)-FLOAT(IWTM))*10.0
0053          DO 24 K=1,9,2
0054          IF(IFRAC.EQ.K)IFRAC=IFRAC+1
0055       24 CONT INUE
0056          IF(IFRAC.NE.10)GOTO 25
0057          I FRAC=O
0058          IWTM=IWTM+1
0059       25 XIWTM=IWTM
0060          XIFRAC=IFRAC
0061          XIWT=XIWTM+(XIFRAC/10.)
0062          XNO=VAR(2)
0063          DO 27 I=1,IX
C
C      THIS REGRESSION EQUATION CALCULATES THE SAME
C      VALUES AS PROOUCED IN THE WTVOL TABLES.
C
0064          Y(I)=B(I,1)+B(I,2)*XNO+B(I,3)*XIWT+B(I,4)*SQRT(XNO*XIWT)
0065          IF(Y(I).LE.0)Y(I)=0.
0066       27 CONTINUE
0067          IF(IO.EQ.1)GOTO 29
0068          IF(IO.EQ.2)GOTO3 4
0069          IF(IO.EQ.3)GOTO 39
0070          IF(IO.EQ.4)GOTO4 9
0071          IF(IO.EQ.5)GOTO 59
C
C      STATEMENT #29 THRU 'GO TO 1' IS OPTION NUMBER 1
C
0072       29 SLVD=VAR(5)-Y(1)
0073          IF(ICOUNT.EQ.40)WRITE(6,30)
0074          IF(ICOUNT.EQ.82)WRITE(6,30)
0075          IF(ICOUNT.EQ.124)WRITE(6,30)
0076          IF(ICOUNT.EQ.166)WRITE(6,30)
0077       30 FORMAT(1H1)
0078          WRITE(6,31)ID,SLVD
0079       31 FORMAT(1H,15X,I4,9X,F6.3)
0080          TSLVD=TSLVD+SLVD
0081          ATSLV=ATSLV+VAR(5)
0082          GO TO19
0083       32 PSLVD=(TSLVD/ATSLV)*100.
0084          WRITE(6,33)TSLVD,PSLVD
0085       33 FORMAT(1H ,/,' - - - - - - - - - - - - - - - - - - - - - -',
         1/,17X,'TOTAL',/,17X,'DIFF.',6X,F7.3,//,17X,'PERCENT',/,
         218X,'OF',9X,F5.1,/,17X,'ACTUAL')
0086          IF(ID.EQ.9999)GOTO 69
0087          GO TO 1
C
C      STATEMENT #34 THRU 'GO TO 1' IS OPTION NUMBER 2
C
0088       34 VVD=VAR(7)-Y(1)
0089          IF(ICOUNT.EQ.40)WRITE(6,35)
0090          IF(ICOUNT.EQ.82)WRITE(6,35)
0091          IF(ICOUNT.EQ.124)WRITE(6,35)
0092          IF(ICOUNT.EQ.166)WRITE(6,35)
```

```
0093          3 5  FORMAT(1H1)
0094               WRITE(6,36)ID,VVD
0095          3  6   FORMAT(1H,15X,I4,9X,F6.3)
0096               TVVD=TVVD+VVD
0097               ATVV=ATVV+VAR(7)
0098               GO TO 19
0099          3 7  PVVD=(TVVD/ATVV)*100.
0100               WRITE(6,38)TVVD,PVVD
0101          38  FORMAT(1H ,/,' - - - - - - - - - - - - - - - - - - - - - -',
             1/,17X,'TOTAL',/,17X,'DIFF.',6X,F7.3,//,17X,'PERCENT',/,
             218X,'OF',9X,F5.1,/,17X,'ACTUAL')
0102               IF(ID.EQ.9999)GOTO 69
0103               GO TO 1
        C
        C    STATEMENT #39 THRU 'GO TO 1' IS OPTION NUMBER 3
        C
0104          3 9  VVD=VAR(7)-Y(2)
0105               CSMV=Y(1)-Y(2)
0106               SVD=SMLVOL-CSMV
0107               IF(ICOUNT.EQ.32)WRITE(6,41)
0108               IF(ICOUNT.EQ.74)WRITE(6,41)
0109               IF(ICOUNT.EQ.116)WRITE(6,41)
0110               IF(ICOUNT.EQ.158)WRITE(6,41)
0111          4 1  FORMAT(1H1)
0112               WRITE(6,43)ID,VVD,SVD
0113          4  3   FORMAT(1H,10X,I4,5X,F6.3,7X,F6.3)
0114               TVVD=TVVOtVVD
0115               TSVD=TSVD+SVD
0116               ATSV=ATSV+SMLVOL
0117               ATVV=ATVV+VAR(7)
0118               GO TO 19
0119          45  TSLVD=TVVD+TSVD
0120               ATSLV=ATSV+ATVV
0121               PSVD=(TSVD/ATSV)*100.
0122               PVVD=(TVVD/ATVV)*100.
0123               PSLVD=(TSLVD/ATSLV)*100.
0124               WRITE(6,47)TVVD,TSVD,PVVD,PSVD,TSLVD,PSLVD
0125          47  FORMAT(1H ,/,'- - - - - - - - - - - - - - - - - - - - - - -',/,
             110X,'TOTAL',/,10X,'DIFF.',4X,F7.3,6X,F7.3,//,10X,
             2'PERCENT',/,11X,'OF',7X,F5.1,8X,F5.1,/,10X,'ACTUAL',/,
             3'- - - - - - - - - - - - - - - - - - - - - - - - -',/,10X,
             4'TOTAL SAWLOG',/,10X,'DIFF.',12X,F7.3,/,10X,
             5'(V.VOL.DIFF.+S.VOL.DIFF.)',//,10X,'TOTAL SAWLOG DIFF',/,
             610X,'AS PERCENT OF',5X,F5.1,/,10X,'ACTUAL SAWLOG VOL.',//)
0126               IF(ID.EQ.9999)GOTO 69
0127               GO TO 1
        C
        C    STATEMENT #49 THRU 'GO TO 1' IS OPTION NUMBER 4
        C
0128          49 IF(PWFCTR.EQ.0)GOTO 50
0129               CPV=(XIWT-Y(2))/PWFCTR
0130               APV=PULPWT/PWFCTR
0131               PVO=APV-CPV
0132               GO TO 51
0133          5 0  CPV=(XIWT-Y(2))
0134               APV=PULPWT
0135               PVD=APV-CPV
0136          5  1   SLVD=VAR(5)-Y(1)
0137               IF(ICOUNT.EQ.40)WRITE(6,52)
0138               IF(ICOUNT.EQ.82)WRITE(6,52)
0139               IF(ICOUNT.EQ.124)WRITE(6,52)
0140               IF(ICOUNT.EQ.166)WRITE(6,52)
0141          5 2  FORMAT(1H1)
0142               WRITE(6,53)ID,PVD,SLVD
0143          5  3   FORMAT(1H,10X,I4,6X,F6.3,6X,F6.3)
0144               TPVD=TPVD+PVD
0145               TSLVD=TSLVD+SLVD
0146               ATPV=ATPV+APV
0147               ATSLV=ATSLV+VAR(5)
0148               GO TO 19
```

```
0149          55 PPD=(TPVD/ATPV)*100.
0150             PSLVD=(TSLVD/ATSLV)*100.
0151             WRITE(6,57)TPVD,TSLVD,PPD,PSLVD
0152          57 FORMAT(1H ,/,' - - - - - - - - - - - - - - - - - - - - - -',/,
                112X,'TOTAL',/,12X,'DIFF.',3X,F7.3,5X,F7.3,//,12X,'PERCENT',
                2/,13X,'OF',6X,F5.1,7X,F5.1,/,12X,'ACTUAL')
0153             IF(ID.EQ.9999)GO TO 69
0154             GO TO 1
          C
          C   STATEMENT #59 THRU 'GO TO 1' IS OPTION NUMBER 5
          C
0155          59 IF(PWFCTR.EQ.0)GO TO 60
0156             CPV=(XIWT-Y(2))/PWFCTR
0157             APV=PULPWT/PWFCTR
0158             PVD=APV-CPV
0159             GO TO 61
0160          60 CPV=(XIWT-Y(2))
0161             APV=PULPWT
0162             PVO=APV-CPV
0163          61 VVD=VAR(7)-Y(3)
0164             CSMV=Y(1)-Y(3)
0165             SVD=SMLVOL-CSMV
0166             IF(ICOUNT.EQ.32)WRITE(6,62)
0167             IF(ICOUNT.EQ.74)WRITE(6,62)
0168             IF(ICOUNT.EQ.116)WRITE(6,62)
0169             IF(ICOUNT.EQ.158)WRITE(6,62)
0170          62 FORMAT(1H1)
0171             WRITE(6,63)ID,PVD,VVD,SVD
0172          63 FORMAT(1H,I4,4X,F6.3,5X,F6.3,5X,F6.3)
0173             TVVD=TVVD+VVD
0174             TSVD=TSVD+SVD
0175             TPVD=TPVD+PVD
0176             ATSV=ATSV+SMLVOL
0177             ATVV=ATVV+VAR(7)
0178             ATPV=ATPV+APV
0179             GO TO 19
0180          65 TSLVD=TVVD+TSVD
0181             ATSLV=ATSV+ATVV
0182             PSLVD=(TSLVD/ATSLV)*100.
0183             PPD=(TPVD/ATPV)*100.
0184             PSVD=(TSVD/ATSV)*100.
0185             PVVD=(TVVD/ATVV)*100.
0186             WRITE(6,67)TPVD,TVVD,TSVD,PPD,PVVD,PSVD,TSLVD,PSLVD
0187          67 FORMAT(1H ,/,' - - - - - - - - - - - - - - - - - - - - - -',
                1/,' TOTAL',/,' DIFF.',2X,F7.3,4X,F7.3,4X,F7.3,//,' PERCENT',/,
                22X,'OF',5X,F5.1,6X,F5.1,6X,F5.1,/,' ACTUAL',/,
                3' - - - - - - - - - - - - - - - - - - - - - -',/,' TOTAL SAWLOG',
                4/,' DIFF.',20X,F7.3,/,' (V.VOL.DIFF.+S.VOL.DIFF.)',//,
                5' TOTAL SAWLOG DIFF.',/,'AS PERCENT OF',12X,F5.1,/,
                6' ACTUAL SAWLOG VOL.')
0188             IF(ID.EQ.9999)GO TO 69
0189             GO TO 1
          C
          C   CHECK SCALE DATA ARE CHECKED AGAINST
          C   PREVIOUS MONTH'S WEIGHT/VOLUME TABLES
          C
0190          69 STOP
0191             END
```

```
000 1          DIMENSION KARRAY(31,11),TOTWT(31,11),SAWWT(31,11),B(3,2),RSQR(2),A
              2MSE(2),TITLE(20),ID(31),SPXY(5,5),VAR(5),SPX(3,3),RHS(3,2),AMEAN(5
              3),SOLRHS(2),SSE(2),SSY(2),REGSS(2),STD(5)
0002           DOUBLE PRECISION TOTWT,SAWWT,RSQR,AMSE,B,VAR,SPXY,SPX,RHS,AMEAN,SO
              2LRHS,SSE,SSY,REGSS,DET,STD,ANLOGS,SCALE,SAWVOL,VENVOL,TOTWHT,PULPW
              3T,ATREES,TOSAWL
0003           DO 1 I=1,5
0004           DO 1 J=1,5
0005         1 SPXY(I,J)=0.
0006           DO 2 I=1,5
0007           VAR(I)=0.
0008         2 CONTINUE
0009           DO 4 I=1,3
0010           DO 3 J=1,3
0011           SPX(I,J)=0.
0012         3 CONTINUE
0013         4 CONTINUE
0014           DO a I=1,2
0015           SOLRHS(I)=0.
0016         8 CONTINUE
0017           DO 9 I=1,2
0018           SSE(I)=0.
0019           SSY(I)=0.
0020           REGSS(I)=0.
002 1        9 CONTINUE
002 2          DO 10 I=1,5
0023           STD(IJ=0.
002 4       10 CONTINUE
0025           K=0
0026           ND=0
          C
          C  AT THIS POINT A SINGLE CARD IS READ WHICH DEFINES THE NUMBER OF FORM
          C  CLASSES FOR WHICH TABLES ARE TO BE CDMPUTFD (NCASE), THE KIND OF LOG
          C RULE TABLES USED (LOGRL), AND THF MINIMUM AND MAXIMUM DIAMETERS FOR
          C WHICH THE RANGE OF DIAMETERS IS TO BE DEFINED (MIND AND YAXOJ.
          C
0027       11 READ(5,12)NCASE,LOGRL,MIND,MAXD
0028       12 FORMAT(I3,I1,2I3)
0029          ND= (MAXD-MIND)+1
          C
          C  NEXT A TITLE CARD IS QEAD INDICATING THE NAME OF THE ORGANIZATION FOR
          C WHICH THE TABLES ARE BEING COMPUTFD.
          C
0030          READ(5,13)(TITLE(IJ ,I=1,20)
0031       13 FORMAT (20A4)
          C
          C AT THIS POINT IN THE PROGRAM ALL TRUCK LOAD DATA IS READ INTO THE COM-
          C  PUTER AND VAR(1) THROUGH VAR(5) ARE DEFINFD.  THESE VARIABLES REPRESENT
          C  1.0, A V E Q A G E VOLUME PER TREE, AVFQAGE SAWLOG LENGTH PER TREE, AVERAGE
          C WEIGHT P E R TRFE, AND AVERAGE SAWLOG WEIGHT PER TREE, RESPECTIVELY.
          C
0032       14 READ(5,15)IDNO,SCALE,SAWVOL,VENVOL,TOTWHT,PULPWT,ATREES,TOSAWL
0033       15 FORMAT(1X,I3,3F4.3,2F5.3,F3.0,F5.0)
0034          IF(SCALE.EQ.0. J SCALE=SAWVOL
0035          IF(IDNO.EQ.0.OR.IDNO.EQ.999)GO TO 17
0036          VAR(1)=1.0D0
003 7         VAR(2)=SCALE/ATREES
0038          VAR(3)=((TOSAWL)/ATREES)/16.D0
0039          VAR(4)=TOTWHT/ATREES
0040          VAR(5)=(TOTWHT-PULPWT)/ATREES
0041          DO1 6 I=1,5
0042          DO 16 J=1,5
0043       16 SPXY(I,J)=SPXY(I,J)+VAR(I)*VAR(J)
0044          GO TO14
0045       17 DO1 8 I=1,5
0046          DO 18 J=1,5
0047       18 IF(SPXY(I,J).EQ.0) SPXY(I,J)=1.
004 a         DO 20 I=1,3
GO49          DO1 9 J=1,3
0050       19 SPX(I,J)=SPXY(I,J)
005 1         RHS(I,1)=SPXY(I,4)
0052       70 RHS(I,2)=SPXY(I,5)
0053          CALL MATINV(SPX,3,DET)
0054          CALL MULT(SPX,RHS,3,2,3,B)
0055          DO 21 I=2,5
```

```
0056          STD(I)=(SPXY(I,I)-((SPXY(1,I)**2)/SPXY(1,1)))/(SPXY(1,1)-1.0D0)
005 7         STD(I)=DSQRT(STD(I))
0058       21 AMEAN(I)=SPXY(1,I)/SPXY(1,1)
0059          0 0  2 3 J=1,2
0060          SOLRHS(J)=0.
0061          0 0  2 2 I=1,3
0062       22 SOLRHS(J)=SOLRHS(J)+B(I,J)*RHS(I,J)
0063          SSE(J)=SPXY(J+3,J+3)-SOLRHS(J)
0064          SSY(J)=SPXY(J+3,J+3)-(RHS(1,J)**2/SPXY(1,1))
0065          REGSS(J)=SSY(J)-SSE(J)
0066          AMSE(J)=SSE(J)/(SPXY(1,1)-2.0D0)
0067          AMSE(J)=DABS(AMSE(J))
0068          AMSE(J)=DSQRT(AMSE(J))
0069          RSQR(J)=REGSS(J)/SSY(J)
0070       23 RSQR(J)=RSQR(J)*100.D0
0071       24 K=K+1
        C
        C ONE SET OF FORM CLASS VOLUMES ARE READ AT A TIME AND ALL TOTAL WEIGHT
        C  AND SAWLOG WEIGHT CALCULATIONS ARE MADE BEFORE ANOTHER FORM CLASS IS
        C  READ IN.
        C
0072          DO2 6  I=1,ND
0073          READ(5,25)(KARRAY(I,J),J=1,11),ID(I)
0074       2 5 FORMAT(11I5,21X,I4)
0075       26 CONTINUE
0076          D O 27 I=1,ND
0077          ANLOGS=.5
0078          DO2 7  J=1,8
0079          ANLOGS=ANLOGS+.5
0080          TOTWT(I,J)=B(1,1)+B(2,1)*((DFLOAT(KARRAY(I,J)))/1000.D0)+(B(3,1)*A
             2NLOGS)
008 1         SAWWT(I,J)=B(1,2)+B(2,2)*((DFLOAT(KARRAY(I,J)))/1000.D0)+(B(3,2)*A
             2NLOGS)
0082       27 CONTINUE
        C
        C  THIS SET OF STATEMENTS DETERMINES THE FORM CLASS FOR WHICH THE CAL-
        C  CULATIONS HAVE BEEN MADE FROM THE IO PREVIOUSLY READ IN.
        C
0083          0 0  2 8 I=6510,9010,100
0084          IF(ID(1).EQ.(I)) IFC=((I)-10)/100
0085       28 CONTINUE
        C
        C FROM THIS POINT ON THE PROGRAM DETERMINES AND PRINTS OUT THE APPROPRIATE
        C TITLE HEADINGS, FORM CLASS HEADINGS, AND WEIGHT CALCULATIONS.
        C
0086          0 0  5 3 N=1,2
0087          WRITE(6,29)(TITLE(I),I=1,20)
0088       2 9 FORMAT(1H1,2X,20A4)
0089          IF(N.EQ.2) GO TO 31
0090          WRITE(6,30)IFC
009 1      30 FORMAT(1H0,2X,'FORM CLASS ',I2,17X,'AVERAGE TOTAL WEIGHT PER TREE*
             2')
009 2         GO TO 33
0093       3 1 WRITE(6,32)IFC
0094       32 FORMAT(1H0,2X,'FORM CLASS ',I2,17X,'AVERAGE SAWLOG WEIGHT PER TREE
             2*')
0095       33 WRITE(6,34)
0096       3 4 FORMAT(1H,3X,'TREE',17X,'WEIGHT (M.LBS.) BY NUMBER OF USABLE 16-F
             2 0 0 T LOGS',28X/2X,'DIAMETER',90X/2X,'(INCHES)',8X,'1.0        1.5
             3        2.0        2.5        3.0        3.5        4.0        4.5
             4'/)
009 7         IF(N.EQ.2)G O TO 47
0098          JJ=9
0099          D O  38I=1,ND
0100          JJ=JJ+1
0101          IF(JJ.LE.11)WRITE(6,35)JJ,(TOTWT(I,J),J=1,5)
0102       3 5 FORMAT(1H,3X,I3,9X,F7.3,3X,F7.3,3X,F7.3,3X,F7.3,3X,F7.3,4X,'-----
             2-',4X,'-------',4X,'-------',6X)
0103          IF(JJ.GT.11.AND.JJ.LT.20)WRITE(6,36)JJ,(TOTWT(I,J),J=1,7)
0104       3 6  FORMAT(1H,3X,I3,9X,F7.3,3X,F7.3,3X,F7.3,3X,F7.3,3X,F7.3,3X,F7.3,3
             2X,F7.3,4X,'-------',6X)
0105          IF(JJ.GT.19.AND.JJ.LE.MAXD)WRITE(6,37)JJ,(TOTWT(I,J),J=1,8)
0106       3 7  FORMAT(1H,3X,I3,9X,F7.3,3X,F7.3,3X,F7.3,3X,F7.3,3X,F7.3,3X,F7.3,3
             2X,F7.3,3X,F7.3,6X)
0107       3 a CONT INUE
0108          WRITE(6,39)B(1,1),B(2,1),B(3,1),AMEAN(4),STD(4),AMEAN(2),STD(2),RS
```

```
                2QR(1),AMSE(1),AMEAN(3),STD(3)
0109         39 FORMAT(1HO,'THE ABOVE TABLE FOR ESTIMATING AVERAGE TOTAL WEIGHT PE
                2R TREE WAS DERIVED BY SOLVING THE FOLLOWING---'/3X,'*AVERAGE TOTAL
                3 WEIGHT PER TREE = ',F9.5,' + ',F9.5,' (AVER. VOL./TREE)' ,' + ',F9
                4.5,' (NO. OF USABLE 16-FOOT LOGS)'/6X,'MEAN AVERAGE TOTAL WEIGHT P
                5ER TREE = ',F8.3,' (M.LBS.)'/6X,'STANDARD DEVIATION OF AVERAGE TOT
                6AL WEIGHT PER TREE = ',F8.3,' (M.LBS.)'/6X,'MEAN TOTAL VOLUME PER
                7TREE = ',F8.3,'(M.B.F.)'/6X,'STANDARD DEVIATION OF AVERAGE VOLUME
                8PER TREE =',F8.3,' (M.B.F.)'/6X,'VARIATION EXPLAINED BY REGRESS1
                90N EQUATION = ',F7.2,' PERCENT'/6X,'STANDARD ERROR OF REGRESSION E
                1QUATION = ',F8.3,' (M.LBS.)'/6X,'MEAN NO. OF USABLE 16-FOOT LOGS =
                2 ',F8.3,'(16-FOOT LOGS)'/6X,'STANDARD DEVIATION OF NO. OF USABLE
                316-FOOT LOGS = ',F8.3,'(16-FOOT LOGS)')
0110            IF(LOGRL.NE.1) GO TO 41
0111            WRITE(6,40)
0 1 1 2      40 FORMAT(1HO,2X,'*NOTE: AVERAGE VOLUME PER TREE WAS BASED ON SCRIBNE
                2 4 LOG RULE VOLUMES'/10X,'MESAVAGE AND GIRARDO
0113            GO TO 53
0114         41 fFTLOGRL.NE.2) GO TO 43
0115            WRITE(6,42)
0116         42 FORMAT(1HO,2X,'*NOTE:AVERAGE VOLUME PER TREE WAS BASED ON INTERNA
                2TIONAL 1/4-INCH LOG RULE VOLUMES--'/10X,'MESAVAGE AND GIRARD')
0117            GO TO 53
0118         43 IFLLDGRL.NE.3) GO TO 45
0119            WRITE(6,44)
0120         44 FORMAT(1HO,2X,'*NOTE:AVERAGE VOLUME PER TREE WAS BASED ON DOYLE L
                2OG RULE VOLUYES--*/LOX,'MESAVAGF AND GTRARD' )
0121            GO TO 53
0122         45 IF(LOGRL.EQ.4) WRITE(6,46)
0123         46 FORMAT(1HO,2X,'*NOTE:AVERAGE VOLUME PER TREE WAS BASED ON LOCAL V
                2OLUME TABLES')
0124            GO TO 53
0125         47 JJ=9
0126            DO 48 I=1,ND
0127            JJ=JJtI
0128            IF(JJ.LE.11)WRITE(6,35)JJ,(SAWWT(I,J),J=1,5)
0129            IF(JJ.GT.11.AND.JJ.LT.20)WRITE(6,36)JJ,(SAWWT(I,J),J=1,7)
0130            IF(JJ.GT.19.AND.JJ.LE.MAXD)WRITE(6,37)JJ,(SAWWT(I,J),J=1,8)
0131         48 CONTINUE
0132            WRITE(6,49)B(1,2),B(2,2),B(3,2),AMEAN(5),STD(5),AMEAN(2),STD(2),RS
                2QR(2),AMSE(2),AMEAN(3),STD(3)
0133         49 FORMAT(1HO,'THE ABOVE TABLE FOR ESTIMATING AVERAGE SAWLOG WEIGHT P
                2ER TREE WAS DERIVED BY SOLVING THE FOLLOWING---'/3X,'*AVERAGE SAWL
                3OG WEIGHT PER TREE = ',F9.5,'t ',F9.5,'(AVER. VOL./TREE)'.' t ',
                4F9.5,' (NO. OF USABLE 16-FOOT LOGS)'/6X,'MEAN AVERAGE SAWLOG WEIGH
                5T PER TREE =',F8.3,' (M.LBS.)'/6X,'STANDARD DEVIATION OF AVERAGE
                6SAWLOG WEIGHT PER TREE = ',F8.3,' (M.LBS.)'/6X,'MEAN TOTAL VOLUYE
                7PER TREE = ',F8.3,' (M.B.F.)'/6X,'STANDARD DEVIATION OF AVERAGE VO
                8LUME PER TREE= ',F8.3,'(M.B.F.)'/6X,'VARIATION FXPLAINED BY REGR
                9ESSION EQUATION = ',F7.2,'PERCENT'/6X,'STANDARD ERROR OF REGQESSI
                1ON EQUATION = ',F8.3,' (M.LBS.)'/6X,'MEAN NO. OF USABLE 16-FOOT LO
                2GS = ',F8.3,' (16-FOOT LOGS)'/6X,'STANDARD DEVIATION Of NO. OF USA
                3BLE 16-FOOT LOGS = 'rF8.3,' (16-FOOT LOGS)')
0134            IF(LOGRL.NE.1) GO TO SO
0135            WRITE(6,40)
0136            GO TO 53
0137         SO IF(LOGRL.NE.2) GO TO 51
0138            WRITE(6,42)
0139            GO TO 53
0140         51 IF(LOGRL.NE.3) GO TO 52
0141            WRITE(6,44)
0142            GO TO 53
0143         52 IF(LOGRL.EQ.4) WRITE(6,46)
0144         53 CONTINUE
0145            IF(K.EQ.NCASE) GO TO 54
0146            GO TO 24
0147         54 K=O
0148            IFLIDY0.NE.999) GO TO 11
0149            STOP
0150            END
```

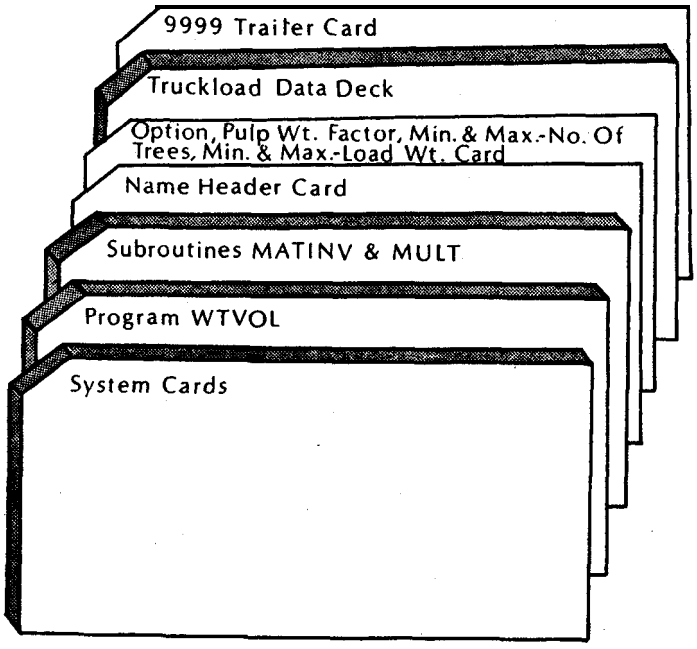
Appendix 2d. Listing for MATINV

```
      SUBROUTINE MATINV(A,N,DET)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION IPIVOT(20),INDEX(20,2)
      DOUBLE PRECISION A(4,4),PIVOT(20)
      EQUIVALENCE (IROW,JROW),(ICOLUM,JCOLUM),(AMAX,T,SWAP)
      IF(N.NE.1) GO TO 20
      DET=A(1,1)
      A(1,1)=1./A(1,1)
      GO TO 18
   20 DET=1.
      DO 1 J=1,N
    1 IPIVOT(J)=0
      DO 14 I=1,N
      AMAX=0.
      DO 6 J=1,N
      IF(IPIVOT(J).EQ.1)GO TO 6
    2 DO 5 K=1,N
      IF(IPIVOT(K)-1)3,5,18
    3 IF(DABS(AMAX)-DABS(A(J,K)))4,5,5
    4 IROW=J
      ICOLUM=K
      AMAX=A(J,K)
    5 CONTINUE
    6 CONTINUE
      IPIVOT(ICOLUM)=IPIVOT(ICOLUM)+1
      IF(IROW-ICOLUM)7,9,7
    7 DET=-DET
      DO 8 L=1,N
      SWAP=A(IROW,L)
      A(IROW,L)=A(ICOLUM,L)
    8 A(ICOLUM,L)=SWAP
    9 INDEX(I,1)=IROW
      INDEX(I,2)=ICOLUM
      PIVOT(I)=A(ICOLUM,ICOLUM)
      DET=DET*PIVOT(I)
      A(ICOLUM,ICOLUM)=1.
      DO 10 L=1,N
   10 A(ICOLUM,L)=A(ICOLUM,L)/PIVOT(I)
   11 DO 14 L1=1,N
      IF(L1.EQ.ICOLUM) GO TO 14
   12 T=A(L1,ICOLUM)
      A(L1,ICOLUM)=0.
      DO 13 L=1,N
   13 A(L1,L)=A(L1,L)-A(ICOLUM,L)*T
   14 CONTINUE
      DO 16 I=1,N
      L=N+1-I
      IF(INDEX(L,1).EQ.INDEX(L,2))GO TO 16
      JROW=INDEX(L,1)
      JCOLUM=INDEX(L,2)
      DO 16 K=1,N
      SWAP=A(K,JROW)
      A(K,JROW)=A(K,JCOLUM)
      A(K,JCOLUM)=SWAP
   16 CONTINUE
   18 RETURN
      END
```

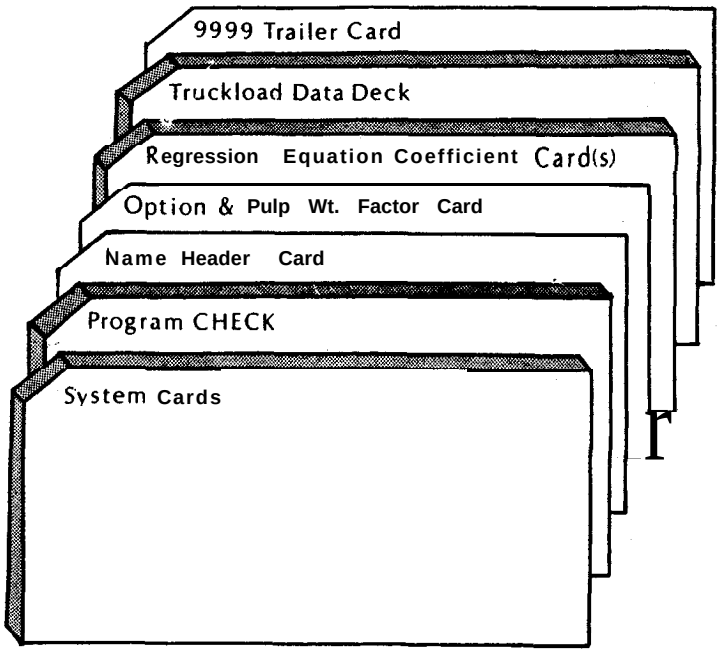
Appendix 2e. Listing for MULT

```
      SUBROUTINE MULT(A,B,N,L,M,C)
      DIMENSION A(N,M),B(M,L),C(N,L)
      DOUBLE PRECISION A,B,C
      DO 10 I=1,N
      DO 10 J=1,L
      C(I,J)=0.
      DO 10 K=1,M
   10 C(I,J)=C(I,J)+A(I,K)*B(K,J)
      RETURN
      END
```

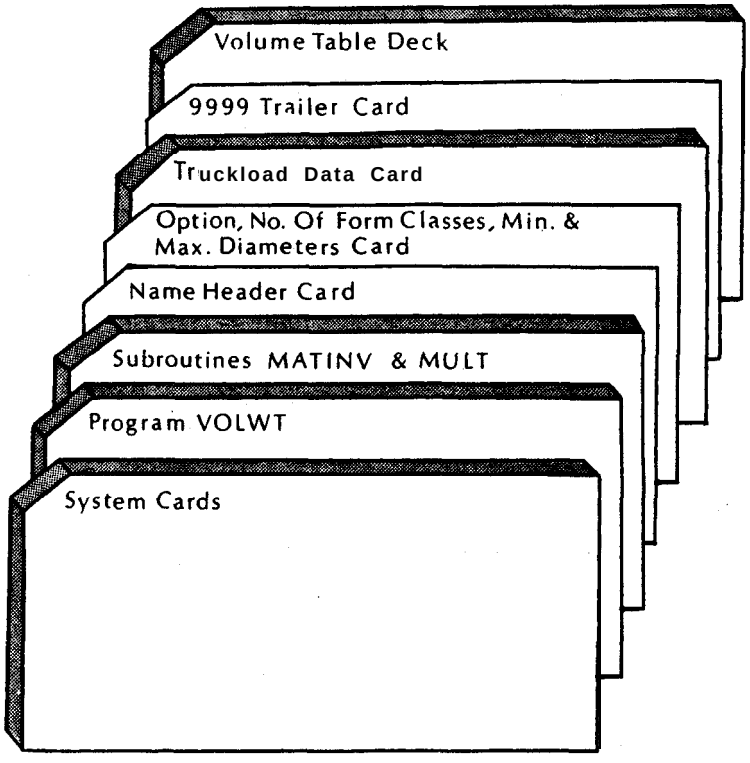
Appendix 3a. Illustration of deck setup for WTVOL

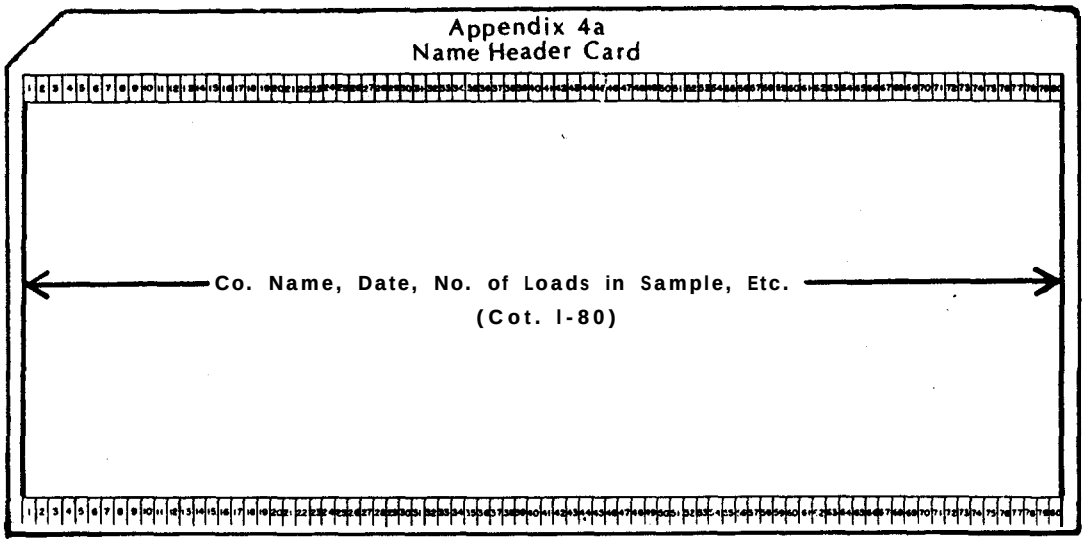


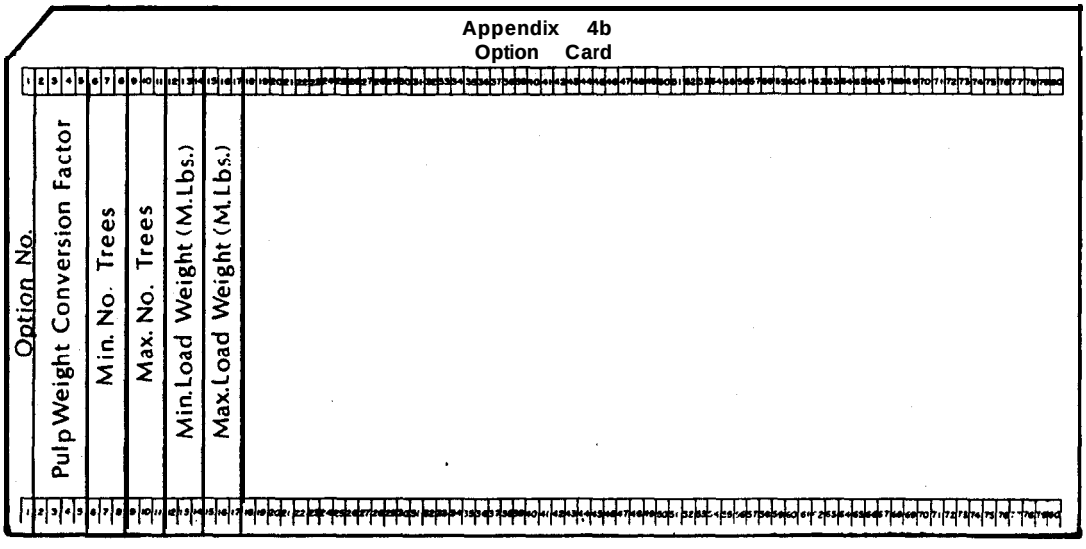
Appendix 3b. Illustration of deck setup for CHECK

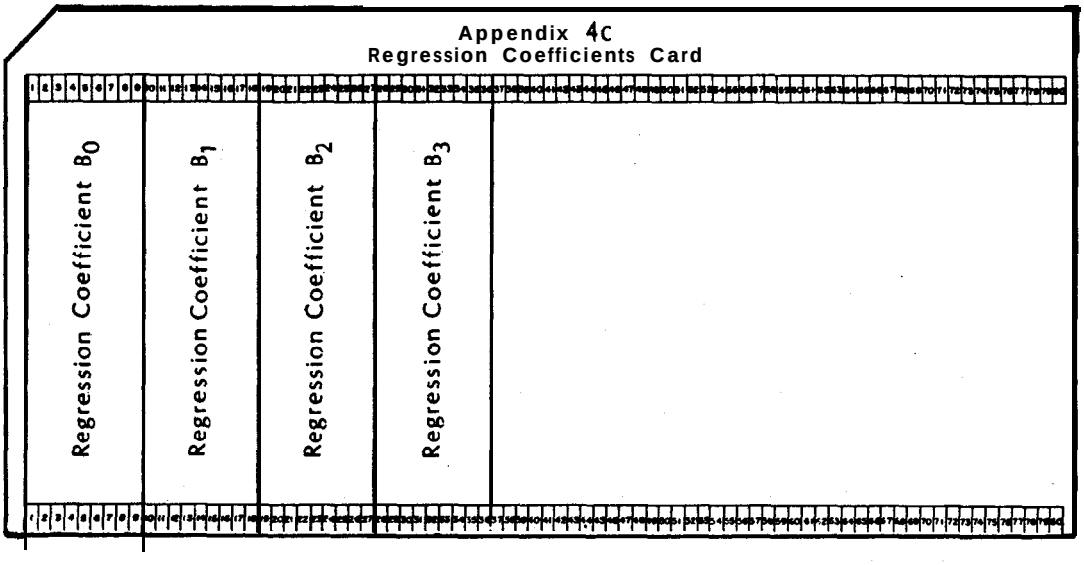


Appendix 3c. Illustration of deck setup for VOLWT




Appendix 4a
Name Header Card
Co. Name, Date, No. of Loads in Sample, Etc.
(Cot. I-80)


Appendix 4b
Option Card
Option No.
Pulp Weight Conversion Factor
Min. No. Trees
Max. No. Trees
Min. Load Weight (M.Lbs.)
Max. Load Weight (M.Lbs.)


Appendix 4c
Regression Coefficients Card
Regression Coefficient B_0
Regression Coefficient B_1
Regression Coefficient B_2
Regression Coefficient B_3

Appendix 4d
Truckload Data Card

Identification	Total Load Scale	Sawmill Vol.	Veneer Vol.	Total Load Weight	Pulp Weight	No. Stems or Butts	Sawlog Length

Appendix 4e
Trailer Card

End Code

Appendix 4f
Volume Table Card

Volume Data by 16-Foot Logs													
.0 Log	1.5 Logs	2.0 Logs	2.5 Logs	3.0 Logs	3.5 Logs	4.0 Logs	4.5 Logs	5.0 Logs	5.5 Logs	6.0 Logs	Blank	Form Class	Diameter Class

*U.S. G.P.O.: 1974-747-899/1420, Region No. 4

Tyre, Gary L., Fasick, Clyde A., Riley, Frank M., Jr., and Lege, Frank 0.
1973. **Program** manual for producing weight-scaling conversion tables. Southeast. For. Exp. Stn., USDA For. Serv. Gen. Tech. Rep. SE-3, 43 pp.

Three computer programs are presented which can be applied by individual firms to establish a weight-scaling information system, The first generates volume estimates from truckload weights for any combination of veneer, sawmill, and pulpwood volumes. The second provides quality-control information by tabulating differences bet'ween estimated volumes and observed check-scale volumes. The third produces weight estimates from volumes and generates tables that can be used to relate back to stumpage sales and current harvesting operations. The system depends upon regression analysis.