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SPECIFICATIONS

FOR

PROCESSING MILL SCALE STUDY DATA ON A TYPE 650 ELECTRONIC MACHINE

By

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During April 1956, about 20,000 boards from 210 white fir and 290 western hemlock logs were measured at a lumber mill in western Washington. A magnetic drum, data-processing machine (type 650) was then used to calculate board-foot volumes by lumber grade for each log, overrun percent for each log, ^{1/} and average board-foot volumes by lumber grade for each log diameter-class within log grades and within species. ^{2/} This first phase of the analysis was accomplished in 18 minutes of machine time once the board measurements were punched on cards.

An ocular examination of the overrun percentages for logs revealed a few obvious errors in the basic data. This led to the rejection of certain logs, and necessitated adjusting some of the average lumber grade volumes for log diameter classes. Finally, the linear relationship between lumber grade volume and net log scale was exploited to provide mathematical curves of lumber grade in percent of net log scale over log diameter. ^{3/} Under more complete programming the rejection of data and the calculation of curves could also be accomplished on the electronic calculator, but this was left for the future.

The analysis program developed for this mill scale study is available in Portland and will be sent upon request to anyone with a

^{1/} Lumber tally in percent of net log scale.

^{2/} These averages were cumulative.

^{3/} Details of this procedure will be the subject of a later report.

similar problem who has access to a type 650 machine. This program must be punched on cards and fed into the machine ahead of the data cards. Punched program cards are available if the machine in Portland is to be used.

INPUT SPECIFICATIONS

Data tallied at the mill was transferred to form 650-1 (fig. 1) to facilitate punching input data cards according to specifications (table 1). In this transfer, lengths of several boards of the same lumber grade, thickness, and width were added to reduce the quantity of data. The maximum combined length was 99 feet since the program would not accept a three-digit length code.

Table 1.--Specifications for input data card

Card column	:	Information
1	:	Project number
2 & 3	:	Tree species
4	:	Log grade
5 & 6	:	Log diameter
7 - 10	:	Log number
11 - 14	:	Net log scale
15 - 16	:	Lumber grade first board ^{1/}
17 - 18	:	Thickness " "
19 - 20	:	Width " "
21 - 22	:	Length " "
23 - 24	:	Lumber grade second board
25 - 26	:	Thickness " "
27 - 28	:	Width " "
29 - 30	:	Length " "
etc.	:	etc. through eighth board
79 - 80	:	Zeros

Each eight lines of form 650-1 gave data for one punched card, with one line for each board. Data identifying the log (card columns 1-10) and net log scale (card columns 11-14) were repeated

^{1/} Board, as used here, refers to combined lengths of several boards of the same lumber grade, thickness, and width.

Project	Species	Log grade	Log diameter	Log number	Net log scale	Lumber grade	Thickness	Width	Length
x	x x	x	x x	x x x x	x x x x	x x	x x	x x	x x
1	48	2	18	0047	0510	28	01	08	60
						28	02	04	80
						28	02	06	24
						30	02	10	40
						31	01	08	46
						31	04	06	30
						34	01	08	99
						34	01	08	53
1	48	2	18	0047	0510	34	04	04	48
						35	01	06	32
						35	02	10	42
						36	02	06	76
1	31	3	20	0048	0640	29	02	06	12
						29	01	08	12
						29	01	04	22
						33	01	06	18
						33	02	12	32
						33	02	08	14
						33	02	04	26
						34	02	12	24

Figure 1.--Form 650-1, Mill scale study basic data.

whenever more than one card was required for one log. Thus the first two groups of eight lines in figure 1 contain data for two cards from one log. Note that log number 47 in figure 1 contains less than an even multiple of eight boards. In such cases the unused columns of the card were assigned zeros. Zeros were punched in columns 79 and 80 on all cards. No plus or minus signs were punched on the cards.

Net log scale is in terms of board-feet. The program will accommodate up to nine lumber grades which must receive code numbers 28 through 36 or any part of these numbers if there are less than nine lumber grades. Thickness and width must be in inches and length must be in feet. Input data cards must be arranged so that all cards for a particular species, log grade, and log diameter class are together. Within this group, the cards for each log must also be together.

OUTPUT SPECIFICATIONS

Specifications for the first of three types of output cards--individual log volume--are given in table 2. This information is produced only so that large errors in recording data at the mill will be made obvious and erroneous individual-log data eliminated. All lumber volumes on output cards are in terms of board-feet.

Table 2.--Specifications for individual log volume output card

Card columns	:	Information
1	:	Project number
2 & 3	:	Tree species
4	:	Log grade
5 & 6	:	Log diameter
7 - 10	:	Log number
11 - 14	:	Net log scale
15 - 18	:	Total volume, all lumber grades
19 - 22	:	Overrun percent
23 - 26	:	Volume, lumber grade no. 1
27 - 30	:	" " " " 2
31 - 34	:	" " " " 3
35 - 38	:	" " " " 4
39 - 42	:	" " " " 5
43 - 46	:	" " " " 6
47 - 50	:	" " " " 7
51 - 54	:	" " " " 8
55 - 58	:	" " " " 9

The second type output card, called the total volume card, contains total cumulative volumes by lumber grades and also total net log scale volume. These totals cover all logs in a log grade--diameter class. Specifications for this card are found in table 3.

Table 3.--Specifications for the total volume output card

Card Columns	:	Information
1	:	Card indicator (always zero)
2 - 4	:	Log count
5 - 10	:	Total net log scale, all logs in a log grade--diameter class
11 - 16	:	Vol. in lmbr. grade 1, all logs in a log grade--dia. class
17 - 22	:	" " grades 1&2 " " " "
23 - 28	:	" " " 1-3 " " " "
29 - 34	:	" " " 1-4 " " " "
35 - 40	:	" " " 1-5 " " " "
41 - 46	:	" " " 1-6 " " " "
47 - 52	:	" " " 1-7 " " " "
53 - 58	:	" " " 1-8 " " " "
59 - 64	:	" " " 1-9 " " " "

Average volumes in the third type output card (table 4) are the result of dividing totals in the second type output card by number of logs in the log grade--diameter class. These averages were the vital information from the study. They were used to develop lumber grade recovery estimates for log diameter classes.

Table 4.--Specifications for the average volume output card

Card Columns	:	Information
1 - 4	:	Leading zeros
5 - 10	:	Average net log scale, all logs in a log grade--diam. class
11 - 16	:	Av. vol., lmbr. grade 1, all logs in a log grade--dia. class
17 - 22	:	" " " " 1&2 " " " "
23 - 28	:	" " " " 1-3 " " " "
29 - 34	:	" " " " 1-4 " " " "
35 - 40	:	" " " " 1-5 " " " "
41 - 46	:	" " " " 1-6 " " " "
47 - 52	:	" " " " 1-7 " " " "
53 - 58	:	" " " " 1-8 " " " "
59 - 64	:	" " " " 1-9 " " " "

Log volume cards for all logs in a species-log grade-log diameter class emerge from the machine consecutively. They are followed by the total and average volume cards for that class. Table 5 is a sample listing from cards of all three types.

OPERATING INSTRUCTIONS

1. Card sequence
 - (a) Drum clear (LA9990) 4/ 1 card
 - (b) Loading routine (LA9995) 4/ 8 cards
 - (c) Program; on LA9995 type cards 68 cards
 - (d) Transfer 1 card
 - (e) Input data ---
 - (f) Trailer card (80 cols. of zero) 1 card
2. Place control panel in 533.
3. Set +70 1952 2000 in storage entry switches.
4. Set programmed switch to stop.
5. Set half cycle to run.
6. Set display switch to distributor.
7. Set overflow switch to stop.
8. Set error switch to stop.
9. Place program deck and data in card reader.
10. Ready blank cards in punch hopper.
11. Depress computer reset button.
12. Depress program start.

TIMING

A rough approximation based on operational experience indicates that an average mill scale study (3 cards per log) takes about 0.1 second per card, including both input and output time.

533 WIRING

First Reading

Column 1 to Lead Hub

Storage Exit B

Columns	1	- 10	to	storage	Exit	B	Word	1	positions	10	- 1
11 - 16	"	"	"	"	2	"	6	-	1		
17 - 22	"	"	"	"	3	"					
23 - 28	"	"	"	"	4	"					
29 - 34	"	"	"	"	5	"					
35 - 40	"	"	"	"	6	"					
41 - 46	"	"	"	"	7	"					
47 - 52	"	"	"	"	8	"					
53 - 58	"	"	"	"	9	"					
59 - 69	"	"	"	"	10	"					

4/ Utility routines of International Business Machines Corporation's Los Angeles Scientific Computing Center were used in this program.

Table 5.--Sample listing of individual log volume cards, total volume cards,
and average volume cards

Project	Species	Log grade	Log diameter	Log number	Net log scale	Lumber tally	Overrun percent	Volume B	Volume C	Volume D	Volume SM	Volume SS	Volume Construction	Volume Standard	Volume Utility	Volume Economy
1	31	2	20	131	490	711	145	0	2	0	5	37	271	19	305	72
1	31	2	20	156	520	386	74	0	10	0	0	33	76	75	192	0
1	31	2	20	170	700	879	125	68	80	5	0	208	375	64	79	0
1	31	2	20	228	560	654	116	11	182	0	0	96	175	100	62	28
1	31	2	20	369	600	767	127	0	0	0	7	428	117	28	187	0
1	31	2	20	418	660	893	135	0	23	0	0	342	304	112	112	0
1	31	2	20	420	600	775	129	0	16	11	0	203	484	0	54	7
1	31	2	20	455	560	616	110	83	0	0	8	97	280	9	95	44
1	31	2	20	457	660	857	129	0	0	0	0	235	270	136	204	12

	Log Count	Total net log scale	Total cumulative volume by lumber grade for all logs in a log grade--diam. class								
			B & Better	C & Better	D & Better	SM & Better	SS & Better	Const. & Better	Stand. & Better	Util. & Better	Econ. & Better
0	009	05350	000162	000475	000491	000511	002190	004542	005085	006375	006538

Average net log scale	Average cumulative volume by lumber grade for all logs in a log grade--diam. class								
	B & Better	C & Better	D & Better	SM & Better	SS & Better	Const. & Better	Stand. & Better	Util. & Better	Econ. & Better
	0000000594	000018	000052	000054	000056	000243	000504	000565	000708

Storage Exit C

Columns 1 - 10	to storage	Exit C	Word 1	positions	10 - 1
11 - 14	"	"	" 2	"	10 - 7
15 - 18	"	"	" 3	"	"
19 - 22	"	"	" 4	"	"
23 - 26	"	"	" 2	"	4 - 1
27 - 30	"	"	" 3	"	"
31 - 39	"	"	" 4	"	"
35 - 38	"	"	" 5	"	9 - 1
39 - 42	"	"	" 6	"	"
43 - 46	"	"	" 7	"	"
47 - 50	"	"	" 8	"	"
51 - 54	"	"	" 9	"	"
55 - 58	"	"	" 10	"	"

Other

Control Information position 10 to Punch Card B.
Jackplug PSU switch.

ADDITIONAL INFORMATION

The pictures of input and output in memory (figs. 2 and 3) and the block diagram from which the analysis was developed (fig. 4) may be useful to anyone interested in modifying the program to accommodate different input or output specifications.

Memory

Cell	1	2	3	4	5	6	7	8	9	10
0001	Proj.	Species		Log Grade	Log Diam.		Log Number			
0002	Net Log Scale				Bd.1 Grade		Bd.1 Thick.		Bd.1 Width	
0003	Bd.1 Lgth.		Bd.2 Grade		Bd.2 Thick.		Bd.2 Width		Bd.2 Lgth.	
0004	Bd.3 Grade		Bd.3 Thick.		Bd.3 Width		Bd.3 Lgth.		Bd.4 Grade	
0005	Bd.4 Thick.		Bd.4 Width		Bd.4 Lgth.		Bd.5 Grade		Bd.5 Thick.	
0006	Bd.5 Width		Bd.5 Lgth.		Bd.6 Grade		Bd.6 Thick.		Bd.6 Width	
0007	Bd.6 Lgth.		Bd.7 Grade		Bd.7 Thick.		Bd.7 Width		Bd.7 Lgth.	
0008	Bd.8 Grade		Bd.8 Thick.		Bd.8 Width		Bd.8 Lgth.		0	0

Figure 2.--Input in memory.

(First punch band)										
Memory Cell	Position in Word									
	1	2	3	4	5	6	7	8	9	10
0027	Proj.	Species		Log Grade	Log Diam.		Log Number			
0028	Log scale						Volume Lbr. grade 1			
0029	Lbr. tally						"	"	"	2
0030	Overrun percent						"	"	"	3
0031							"	"	"	4
0032							"	"	"	5
0033							"	"	"	6
0034							"	"	"	7
0035							"	"	"	8
0036							"	"	"	9

	(Second punch band)									
	Position in Word									
Memory Cell	1	2	3	4	5	6	7	8	9	10
0077	0	Log count			Total net log scale					
0078					Total volume lumber grade 1					
0079					"	"	"	"	"	1-2
0080					"	"	"	"	"	1-3
0081					"	"	"	"	"	1-4
0082					"	"	"	"	"	1-5
0083					"	"	"	"	"	1-6
0084					"	"	"	"	"	1-7
0085					"	"	"	"	"	1-8
0086	8				"	"	"	"	"	1-9

	(Third punch band)									
	Position in Word									
Memory Cell	1	2	3	4	5	6	7	8	9	10
0127	0				Average net log scale					
0128					Average volume lumber grade 1					
0129					"	"	"	"	"	1-2
0130					"	"	"	"	"	1-3
0131					"	"	"	"	"	1-4
0132					"	"	"	"	"	1-5
0133					"	"	"	"	"	1-6
0134					"	"	"	"	"	1-7
0135					"	"	"	"	"	1-8
0136	8				"	"	"	"	"	1-9

Figure 3.--Output in memory.

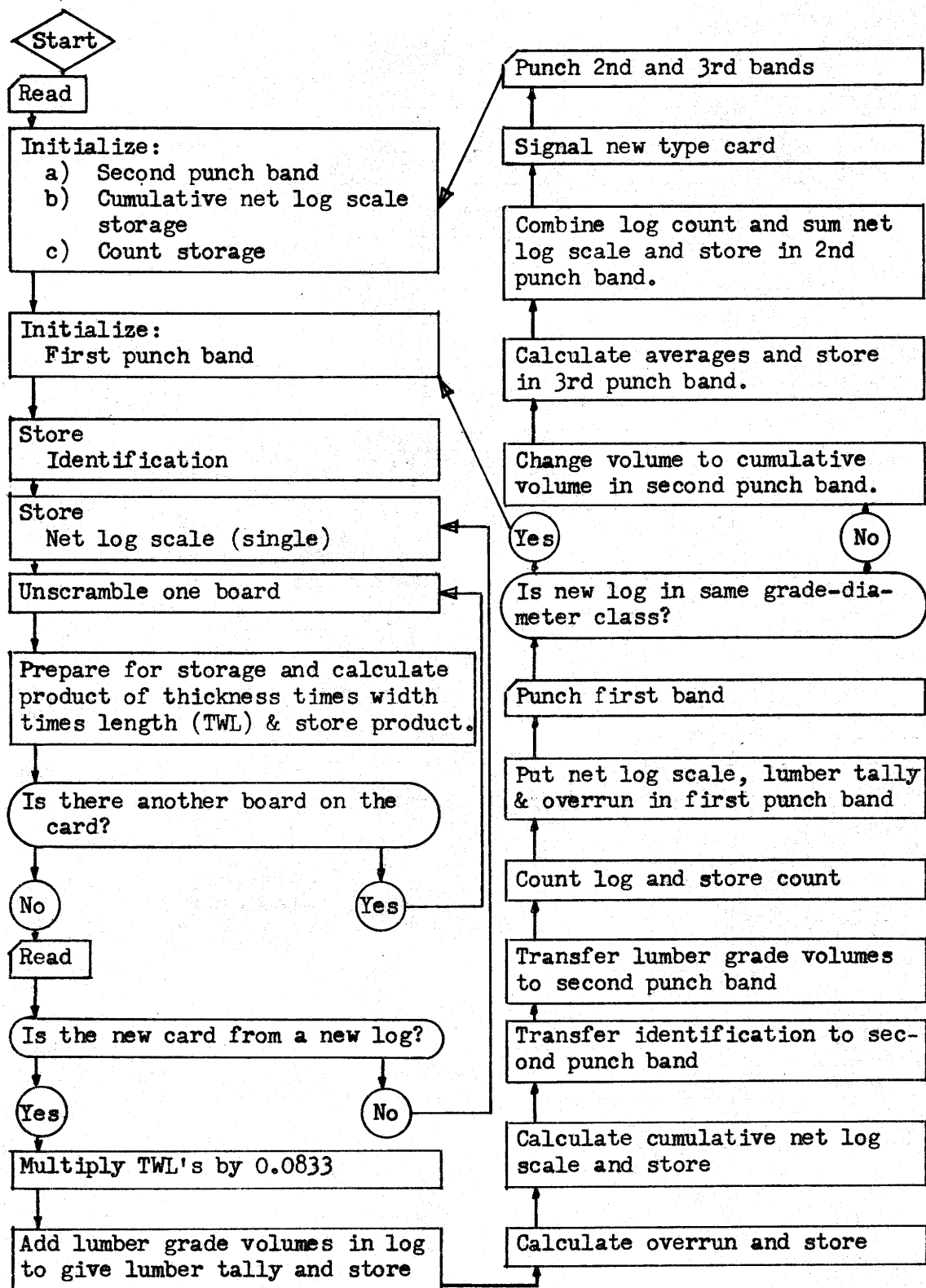


Figure 4.--Block diagram for processing mill scale study data.