MEASURING VOLUME OF TREES AND LOGS

Extension Circular 490

By Dan D. Robinson

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Timber is a profitable farm crop if marketed on the basis of measured volume. Every farm owner knows the number of livestock and the amount of grain or hay he has on the farm. He also knows the current market prices for these products.

On the other hand, very few farm woodland owners know how to estimate or measure the volume and value of the various wood products contained in their farm woods. Consequently, the farmer often realizes only a fraction of the real market value of his wood products because most farm timber has been sold as stumpage for a lump sum named by the buyer.

By estimating their own timber volume, farm owners can more nearly realize maximum cash returns from their standing timber or harvested forest products such as poles, piling, pulpwood, fuelwood, sawlogs, etc.

This circular has been prepared to assist farm woodland owners in learning simple methods of estimating and measuring tree and log volumes. With a little practice the farm woodland owner can estimate the approximate volume of forest products contained in his woodland or measure the logs he has cut for market.

Measurements Necessary for Determining Volume of Standing Trees.

It is easy to learn how to estimate and measure volumes of standing trees. Volumes of trees are usually measured in board feet, cubic feet, or cords. Two measurements must be made to determine the board foot, cubic foot or cord contents of a tree. It is necessary to measure (1) the diameter of the tree in inches and (2) to estimate the height of the tree in feet or number of 16-foot sawlogs.

Measuring Diameter of Standing Trees.

The diameter of a standing tree is measured to the nearest even inch outside the bark at a point 4-1/2 feet above the ground. This point is commonly referred to as DBH (diameter breast high). Special steel tapes for measuring tree diameters are available at most hardware or logging supply stores. These tapes are called tree diameter tapes.

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* Attached to this circular should be three cards, size 4" x 6" giving volume tables. If cards are not attached they may be obtained from Extension Forester, Oregon State College, Corvallis, Oregon.

A simple device known as a tree calipers for measuring tree diameter may be constructed from strips of wood approximately 1-1/2 inches wide and 1/4 to 1/2 inch thick (See Figure 1). Two such strips are bolted together in the form of a right angle with an arm, A, approximately 24 inches long and a beam, B, about 40 inches long forming the right angle. An old carpenter's square may also be used by bolting extension arms to the steel arms of the square. B should be marked off in inches along the inside edge. By constructing an additional wooden arm, C of the same width and thickness, 26 inches long, and nailing a piece, D, 12 inches long onto the end of C to form a T, the calipers may be easily and quickly used to determine the tree or log diameter.

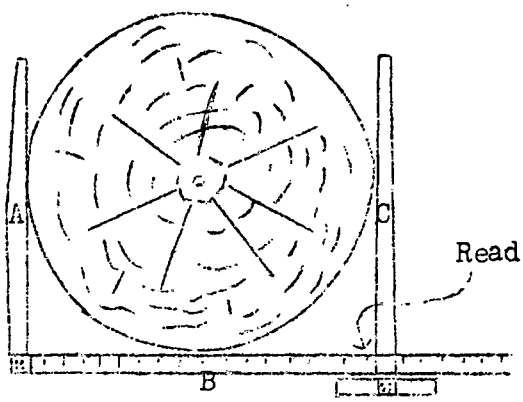

Figure 1. Tree calipers for measuring diameter of trees.

To measure the diameter of a tree:

1. Place the calipers in a horizontal position against the tree 4-1/2 feet above the ground so that both arms of the square touch the bark.
2. Place the base of the T-shaped piece flush against the beam and move it along the beam until it rests against the bark on the opposite side of the tree from the A arm.
3. Read off the diameter to the nearest even inch where the inside edge of the arm, C, crosses B.

If a tree diameter tape is used it is placed around the tree at a point 4-1/2 feet above the ground and the diameter is read directly off the tape.

Estimating Height of Standing Trees.

1. Stand back from the base of the tree and estimate the location of an 8-inch top diameter. (To get volume of tree in cords estimate total height.)
2. Estimate the location of a point on the trunk halfway between the ground and the 8-inch top.
3. Estimate the number of feet or the number of 16-foot logs in the lower half of the tree.
4. Double this number and the result will be the total height in feet or in 16-foot logs to an 8-inch top.

A 16-foot pole placed vertically against the tree trunk will aid in estimating log lengths.

How to Use the Volume Tables.

The diameters and heights of the trees should be recorded on a tally sheet similar to page 7 of this circular. When this has been done, the tables on the attached cards are used for determining the board foot or cord wood volume. Care must be exercised to use the correct table.

Board foot volume of standing second-growth Douglas fir is found by using the table entitled, TABLE FOR ESTIMATING VOLUMES OF 2ND GROWTH DOUGLAS FIR STANDING TIMBER. For example, a tree 26" in diameter and 4 logs high contains 500 board feet according to the table. This volume is obtained by following down the DBH in. column on the extreme left side of the table to 26 and then following over the right to the column headed 4 log or 48 ft.

Cord wood volume of a tree may be obtained from the table entitled FUEL-WOOD VOLUME TABLE FOR SECOND GROWTH DOUGLAS FIR (Cords). A tree 26 inches in diameter and 80 feet high contains 1.36 cords according to the table.

The third cord gives a volume table for Mature Western Yellow (Ponderosa) Pine, for use in eastern Oregon.

Volumes for each tree may be determined as the measurements are recorded, or may be figured after the entire stand of timber has been measured. It is suggested that the volume of a few trees be determined as the measurements are recorded to give the estimator an idea of the board foot or cord volume in a tree of a given diameter and height.

How to Estimate Volume of Standing Timber.

The procedure of measuring diameters and heights of standing timber is known as timber cruising. Many farm woodlands are so small and irregular in shape and stand density that it is necessary to measure each tree and add the individual volumes for the total board foot or cord volume of the stand.

If the trees are scattered, they can be measured without much chance of measuring the same tree twice. If the trees are close together, much time and many unnecessary steps may be saved by laying off strips across the tract and measuring the trees contained in each strip. In the average Douglas fir stand on farms of western Oregon, the most convenient width of such strips is between 60 and 80 feet. Strips in Ponderosa pine stands in eastern Oregon may be much wider because the trees and underbrush are scattered.

If the strips are to be 60 feet wide we can proceed in the following manner.

1. Start at one corner of the woodland and pace off 30 feet along one edge of the timber. (See X in Figure 2)
2. With a hand compass determine the line you should follow in order to keep approximately 30 feet in from the edge of the tract.
3. The estimator walks along this line and measures diameters, and estimates heights of all trees within a distance of 30 feet on each side of the compass line. The measurements are recorded on a form similar to the one shown on page 7. (It is often necessary to mark the point where the estimator leaves the line of sight to measure trees on the outside edges of the strip. The estimator may then readily locate the line to follow as he proceeds through the stand.)

4. Upon reaching the opposite edge of the tract, the estimator turns at right angles to the compass line he has been following, paces 60 feet along the edge of the timber, turns another right angle into the timber, and follows a line parallel to the one previously run. All trees within 30 feet on each side of this line are measured and tallied.
5. This grid system is continued until all trees in the stand have been measured.

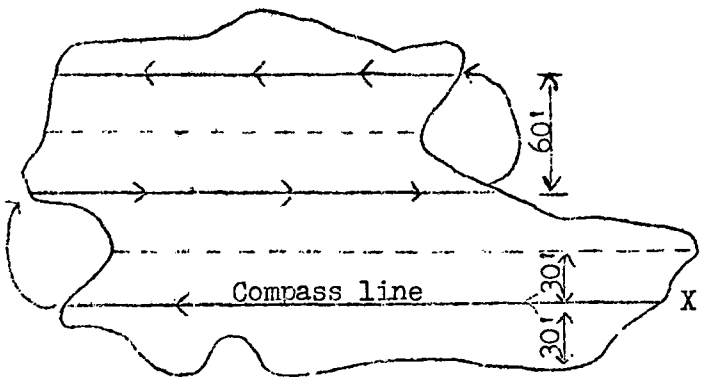

Figure 2. How to Measure an uneven stand of trees in an irregular tract.

There are many farm woodlands too large in area to permit measurement of each tree. For example, it would require several days for one man to measure each tree in a 50-acre tract of timber. In such cases a sample plot cruise may be run as follows.

1. The total acreage of the woodland is determined.

2. A series of square or circular plots 1/4 acre or 1 acre in area are laid out at regular intervals along two or more compass lines run at right angles to the general drainage pattern. (See Figure 3). The compass lines should be far enough apart to give a representative sample of the area. The number of plots and their distance apart will depend on the per cent of cruise desired. (A 10 or 20% cruise is usually sufficient.)
3. All trees contained within the plots are measured and volumes determined.
4. The total volume obtained from these sample plots is then multiplied by 10 if a 10% cruise, or by 5 if a 20% cruise. The result is the gross volume of the entire tract.

Example: Area of timber tract is 50 acres. Ten 1-acre plots are located along two compass lines. All trees within each of these plots are measured and the total volume found to be 250,000 board feet. This result is multiplied by 5 (total area of 10 plots is 10 acres which is 1/5 of total area) which gives 1,250,000 bd. ft. gross volume.

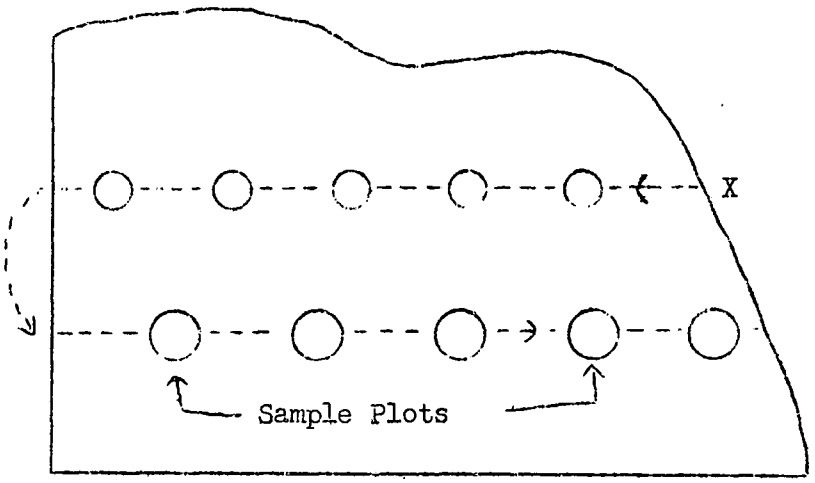

Figure 3. How to estimate volume of a stand by sample plots.

A one-acre square plot is 208 feet on each side.
A one-acre circular plot has a radius of 118 feet or diameter of 236 ft.
A one-fourth-acre square plot is 104 feet on each side.
A one-fourth-acre circular plot has a radius of 59 feet or diameter of 118 feet.

If one man is doing the cruising, a one-tenth-acre circular plot (radius 37 feet) is generally simpler to lay out, particularly in younger stands 20 to 40 years old. Particular care should be exercised in locating the plots an equal distance apart along the compass lines. The common tendency is to locate the plots in timber of above average density which does not give a true sample.

Measuring Volumes of Logs

The procedure of measuring board foot volume of logs which have been felled and bucked is known as scaling.

To scale a log:

1. Measure the diameter to the nearest even inch inside the bark at the small end of the log with a rule or scale stick. (See figure 4)
2. Measure the length of the log to the nearest even foot. A six-inch trimming allowance is required by most mills.
3. Read off the board foot volume from the table entitled SCRIBNER DECIMAL C LOG RULE.

As noted in the table a 0 is added to all the values in the log table for the correct gross board foot volume. No allowance is made in the table for defects such as rot, pitch seam, windshake, or mechanical injuries.

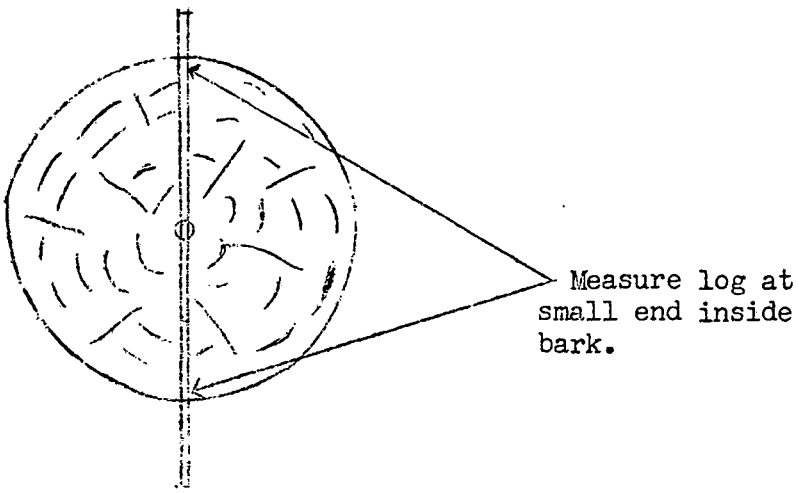

Figure 4. How to measure diameter of a log

With a little field practice, the farm woodland owner can obtain satisfactory results in determining the approximate volume of timber contained in his woodland. It should be understood that the procedure of estimating volume of standing trees is at best a rough approximation, and even though the estimator is 5 to 10% too high or too low from the actual log scale, he will have a much better idea of the amount of timber contained in his woodland than if no estimate were made.

TALLY SHEET FOR RECORDING HEIGHT AND DIAMETER OF TREES

Name of owner_____ Legal Description_____
Township Range Section

Date estimate was made_____ Number Acres_____

Estimated by_____ Total Volume_____
bd. ft., cords

Diameter in inches DBH	Height of tree in number of 16 ft. logs or total feet to 8" top							
	Logs– $1\frac{1}{4}$	2	3	4	5	6	7	8
	Feet– 20	32	48	64	80	96	112	128
12								
14		XX	0–					
16		X						
18								
20			0000X X0X–X					
22								
24								
26				X000				
28			00–					
30								
32								
34								
36								
38								
40								

Each symbol represents one tree of a diameter and height indicated. Board feet or cord wood volume can be determined for each tree and added for total volume.

Explanation of symbols
0 = Douglas fir
X = hardwood
– = spruce, hemlock

Any combination of symbols may be used if it is desired to separate all species.

Cooperative Extension Work in Agriculture and Home Economics
Corvallis, Oregon

VOLUME TABLE FOR MATURE WESTERN YELLOW PINE (Scribner rule)

Diameter at breast high outside bark	Number of 16-foot Logs in Tree								
	1	2	3	4	5	6	7	8	9
Inches	Volume, Board Feet								
8	20	50							
10	30	60	100						
12	40	70	120	180					
14	50	90	150	220	280				
16	60	100	180	270	340	420			
18	70	120	220	320	420	520			
20	90	140	260	390	510	640	750		
22	110	170	310	460	620	780	910		
24	130	200	370	560	740	940	1120		
26	150	230	440	660	890	1120	1340		
28	170	270	520	780	1050	1320	1600	1860	
30	210	310	600	900	1210	1540	1870	2180	
32	250	350	680	1030	1390	1770	2140	2500	2800

Diameter Inches	Number of 16-foot Logs in Tree							
	1	2	3	4	5	6	7	8	9
34		390	770	1160	1570	2000	2420	2820	3180
36		430	870	1290	1760	2240	2700	3150	3560
38		480	950	1440	1950	2480	2970	3480	3950
40			1040	1580	2150	2720	3260	3820	4350
42			1140	1730	2350	2980	3570	4170	4750
44			1240	1890	2570	3250	3910	4550	5180
46			1350	2050	2790	3530	4250	4950	5630
48				2230	3030	3840	4620	5380	6150
50				2400	3280	4150	5000	5830	6700
52				2590	3540	4490	5400	6320	7230
54				2780	3800	4830	5800	6780	7880
56				2980	4080	5180	6220	7270	8350
58				3190	4350	5440	6650	7770	8900
60				3400	4620	5900	7100	8300	9500
62				3610	4910	6270	7550	8840	10050
64				3820	5200	6660	8000	9390	10700

Adapted from U. S. Forest Service - Form 54-R.6

FUELWOOD VOLUME TABLE FOR SECOND GROWTH DOUGLAS FIR (Cords)

D.B.H. inches	Total height of tree in feet					
	20	40	60	80	100	120
2	.003	.0062	.0094			
4	.012	.023	.034	.043		
6	.0265	.0500	.073	.096		
8	.045	.086	.124	.167	.200	.241
10	.0695	.131	.193	.254	.303	.366
12		.186	.271	.355	.429	.520
14		.247	.359	.473	.581	.693
16		.317	.457	.602	.740	.872
18		.391	.567	.740	.917	1.07
20			.686	.886	1.08	1.27
22			.806	1.04	1.26	1.48
24			.931	1.20	1.43	1.68
26				1.36	1.63	1.90
28					1.81	2.11
30					2.01	2.32
32					2.19	2.55
34						2.76
36						2.97
38						3.19
40						3.40

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CORVALLIS

FUELWOOD VOLUME TABLE FOR SECOND GROWTH DOUGLAS FIR (Cords) (cont.)

D.B.H. inches	Total height of tree in feet					
	140	160	180	200	220	240
2						
4						
6						
8						
10	.437					
12	.616	.724				
14	.822	.962	1.11			
16	1.04	1.21	1.40	1.62		
18	1.27	1.49	1.72	1.98	2.30	
20	1.51	1.78	2.07	2.38	2.74	3.09
22	1.76	2.08	2.42	2.80	3.22	3.64
24	1.99	2.37	2.78	3.23	3.73	4.22
26	2.23	2.68	3.16	3.69	4.27	4.84
28	2.49	2.99	3.53	4.15	4.84	5.49
30	2.74	3.30	3.93	4.59	5.40	6.20
32	3.00	3.63	4.34	5.07	5.94	6.86
34	3.27	3.98	4.69	5.51	6.50	7.56
36	3.52	4.24	5.06	5.99	7.08	8.24
38	3.78	4.54	5.42	6.47	7.66	8.93
40	4.04	4.81	5.79	6.93	8.24	9.63

TABLE FOR ESTIMATING VOLUME OF 2ND-GROWTH DOUGLASFIR STANDING TIMBER

From Tech. Bul. No. 201 U.S.D.A.

Scribner Log Rule

	No. 16 ft. logs & total ht. to 8 in. to							
DBH*	1½	2 log	3 log	4 log	5 log	6 log	7 log	8 log
In.	20 ft	32 ft	48 ft	64 ft	80 ft	96 ft	112 ft	128 ft
12	62	80	133	183	235	286	338	
14	64	88	147	210	274	338	400	
16	67	96	163	242	320	399	478	
18	71	109	190	280	370	459	550	640
20	75	123	221	330	435	543	651	758
22	80	136	258	383	509	633	760	884
24		151	292	438	584	728	882	1035
26		170	333	500	666	832	1013	1190
28		188	371	560	750	941	1144	1346
30				638	850	1062	1291	1518
32				716	955	1195	1449	1700
34				791	1059	1333	1614	1898
36				882	1175	1494	1782	2095
38				978	1290	1614	1955	2305
40					1410	1779	2150	2523
42					1541	1937	2340	2735
44					1663	2090	2520	2949
46					1790	2255	2724	3180
48					1920	2420	2927	3414

*DBH(Diameter breast high) measured outside bark 4½ ft. above the ground

Diameter inches inside bark	SCRIBNER DECIMAL C LOG RULE Length of log in feet												
	8	10	12	14	16	18	20	22	24	26	28	30	32
	Volume in tens of board feet (Add 0 for true volume)												
12	4	5	6	7	8	9	10	11	12	13	14	15	16
14	6	7	9	10	11	13	14	16	17	19	20	21	23
16	8	10	12	14	16	18	20	22	24	26	28	30	32
18	11	13	16	19	21	24	27	29	32	35	37	40	43
20	14	17	21	24	28	31	35	38	42	45	49	52	56
22	17	21	25	29	33	38	42	46	50	54	58	63	67
24	21	25	30	35	40	45	50	55	61	66	71	76	81
26	25	31	37	44	50	56	62	69	75	82	88	94	100
28	29	36	44	51	58	65	73	80	87	95	102	109	116
30	33	41	49	57	66	74	82	90	99	107	115	123	131
32	37	46	55	64	74	83	92	101	110	120	129	138	147
34	40	50	60	70	80	90	100	110	120	130	140	150	160
36	46	58	69	81	92	104	115	127	138	150	161	173	185
38	54	67	80	93	107	120	133	147	160	174	187	200	214
40	60	75	90	105	120	135	150	166	181	196	211	226	241

Small end of log