MISSISSIPPI STATE UNIVERSITY EXTENSION

4-H Forestry Project No. 5 Measuring Standing Sawtimber

One of the most important aspects of forestry is growing a crop of trees. However, timber is measured and sold in a different way than the crops familiar to most of us.

Soybeans are sold by the bushel, and cotton is sold by the pound or bale. Farmers receive a certain amount, depending on crop prices, for each bushel or pound they sell. Have you wondered how a tree farmer measures a timber stand and how the crop is sold? Lumber is bought and sold by the board foot. A board foot is a unit of lumber measurement equal to 1 foot square by 1 inch thick (Figure 1).

Board foot volume in a piece of lumber is determined by length in feet times width in inches times thickness in inches divided by 12 (Figure 2).

The term board foot is also used to measure and express the amount or volume of wood in trees. To find the board foot volume of a tree, the diameter and merchantable (usable) height must be measured. In the past, standing timber was typically bought and sold in increments of 1,000 board feet (MBF). However, over the last couple of decades, a shift to selling timber by the ton has occurred. Currently, the vast majority of timber sold in Mississippi is sold on a per-ton basis.

Converting from board feet to tons is possible, but it is subject to various factors, including tree species, log size, genetics, site differences, and other factors.

Consequently, board feet will be used to measure timber in this publication due to the definite nature of its calculation.

Selling timber is a business proposition, so it is essential that tree farmers accurately determine the volume of sawtimber on their property. To determine timber volumes, farmers must measure their trees. Otherwise, they would not know the value of their timber crops. Measuring timber is not difficult to learn and is one of the most important skills for landowners to have.

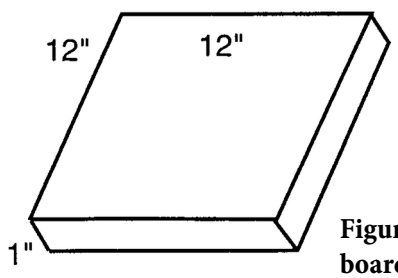
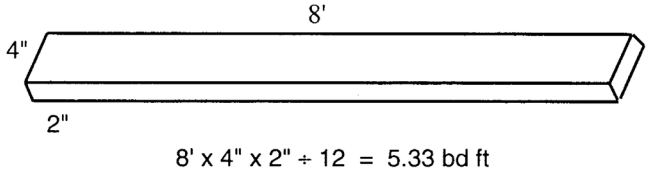


Figure 1. Illustration of 1 board foot of lumber.



8' x 4" x 2" ÷ 12 = 5.33 bd ft

Figure 2. Board foot calculation in 2" × 4" × 8' lumber.

Project References

- MSU Extension Publication 146, Know Your Trees
- MSU Extension Publication 1686, Making a Tree Scale Stick
- MSU Extension Publication 1250, Forestry Terms for Landowners
- MSU Extension Quarterly Timber Price Report, Timber Prices: 2013-Present
- MSU Extension Publication 2244, Pine Timber Volume-to-Weight Conversions
- MSU Extension Publication 3448, Hardwood Timber Volume-to-Weight Conversions

Project Materials

- A tree scale stick
- A tape measure or a piece of non-stretch string 66 feet long
- Notebook and pencil

Sources of Help and Information

- MSU Extension agents, MSU Extension Service county offices
- Area forester, Mississippi Forestry Commission, Find Your Forester - MFC
- District conservationist, Natural Resources Conservation Service, USDA Service Center Locator
- U.S. Department of Agriculture project forester or district ranger, Forest Service, U.S. Department of Agriculture, Mississippi's National Forests
- Registered foresters, Mississippi Board of Registration for Foresters
- Park managers, Department of Wildlife, Fisheries, and Parks, Mississippi's State Parks

Project Description

Measuring Tree Diameter

Tree diameter is the first measurement required to determine timber volume. Known by foresters as DBH, it is taken at 4.5 feet above ground on the uphill side of the tree (Figure 3).

With a measuring tape, measure 4.5 feet from the ground and see where it falls on your body. Use this mark as a guide in measuring diameter.

There are many tools that can measure diameter, but one of the easiest to use is the tree scale stick (Biltmore Stick), which is a straight wooden stick graduated for direct readings of DBH. A Doyle Rule tree scale stick will be used in this project because the Doyle Rule is a commonly used volume rule in Mississippi (Figure 4).

Use the flat side of the tree scale stick, labeled "Diameter of Tree (inches) (Figure 4). This side is the Biltmore Stick. Hold the stick level at 25 inches from your eye, against the tree at 4.5 feet above the ground (Figure 5).

With the stick placed against the tree, close one eye and look at the left or zero end. This end and the tree bark should be in the same line. Move your eye across the stick to the right-hand edge of the tree. **Be sure not to move your head**; only your eye should move. Read the tree diameter where the right side of the tree meets the stick. Foresters often measure DBH using evenly numbered 2-inch diameter classes. For example, a tree with a measured diameter from 9.1 to 11.0 inches will be recorded as a 10-inch tree. Also, a tree measured between 11.1 and 13.0 inches will be recorded as a 12-inch tree.

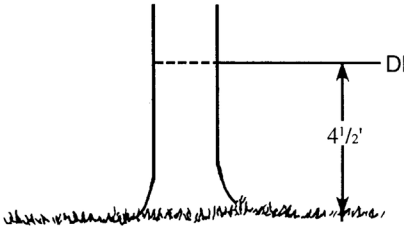


Figure 3. Diameter at breast height (DBH) measurement.

DIAMETER OF TREE (IN INCHES)	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
TREE SCALE STICK			16	16	16	25	32	42	52	64	78	94	110	125	144	162	180	200	225	250	275	300	330	360	390	420	455	490	530	570	610	650	690	735	780
DOYLE RULE				32	32	41	62	66	65	107	132	158	185	213	244	277	313	355	400	545	495	545	600	655	715	775	835	895	960	1030	1100	1180	1270	1360	1460
Hold stick level at 25 inches					48	57	72	80	110	135	163	195	230	268	310	358	412	470	533	600	670	740	815	890	970	060	150	240	330	430	540	650	760	880	2000
from eye against tree at							68	104	126	155	188	225	265	310	360	415	475	535	600	670	750	830	920	020	130	240	350	465	585	710	840	975	115	260	2410
height of 4½ feet											204	245	290	340	390	445	505	570	640	720	810	900	000	110	230	360	495	635	760	930	085	245	410	580	2750

For average southern timber read scale direct.

For tall timber with little taper add 10 percent.

For short timber with much taper deduct 10 percent.

Tree Scale Stick

Figure 4. Tree scale stick (Biltmore stick) used to measure diameter breast height (DBH) in inches.

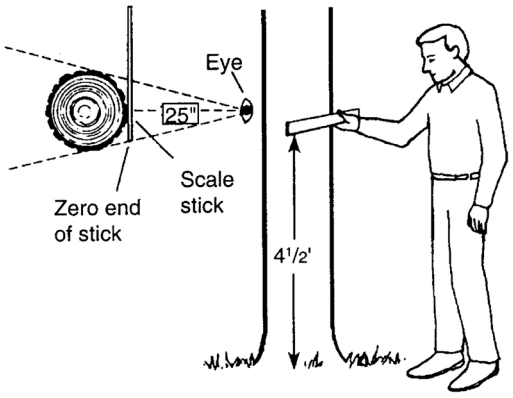


Figure 5. Measuring DBH using a tree scale stick.

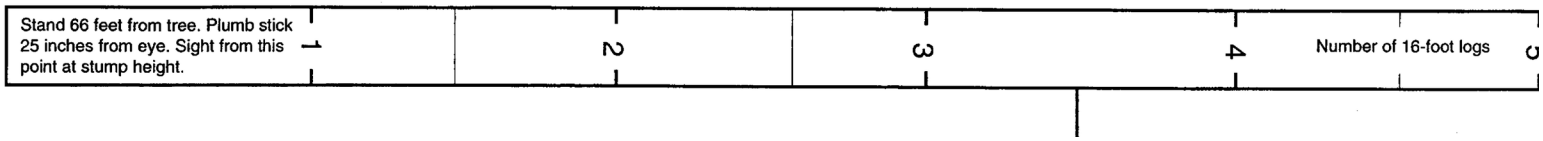


Figure 6. The Merritt hypsometer on a tree scale stick is used to determine merchantable height in 16-foot logs

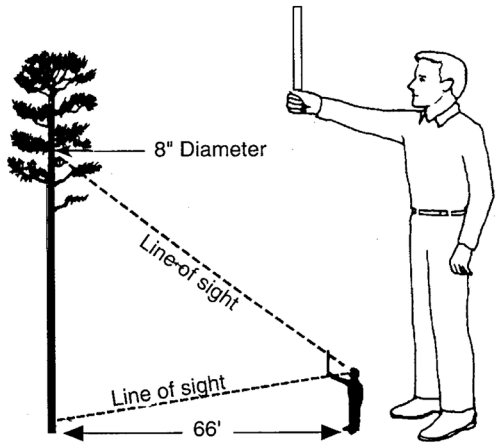


Figure 7. Measuring merchantable height in 16-foot logs with a Merritt hypsometer on a tree scale stick.

Measuring Tree Height

Merchantable tree height is the second measurement used to find board foot volume. You can use this same tree scale stick to find both diameter and tree height. Many different types of height-measuring devices are available; however, the Merritt hypsometer is one of the easiest to use. The Merritt hypsometer (Figure 6) is the linear scale imprinted on one face of a tree scale stick.

To measure the merchantable (usable) height of a tree, you must first stand 66 feet from the base (Figure 7). You can use a tape measure or a non-stretchable string to measure this distance. With practice, you can save time by stepping off (pacing) this distance.

Always be sure you can see the entire height of the tree. Hold the stick vertical to the ground with the "number of 16-foot logs" side facing you and the zero end pointed toward the ground. Holding the stick in this position, 25 inches from your eye, sight the zero end at the stump height of the tree. Then, **without moving your head**, run your eye up the stick to the point where the top of the last merchantable log would be cut (Figure 7).

Merchantable height extends to a minimum top diameter of 8 inches or where the tree forks. Read the number of 16-foot logs that can be cut from the tree to the nearest one-half log (8 feet). The Merritt hypsometer scale is marked in 16-foot logs, so you will have to estimate the half logs. If the top of the last merchantable log falls halfway between two 16-foot log readings, then add one-half log to the reading. If the tree does not reach the midway point or make an additional full log, always round down. For example, if a tree measures 2¾ logs, 2½ should be recorded.

Determining Tree Volume

Volume tables are used to determine the number of board feet of wood in a standing tree based on DBH and merchantable height (Table 1). For example, if the DBH is measured to be 18 inches and the merchantable height is three 16-foot logs, the volume would be 235 board feet (Doyle Rule) (Table 1).

Volume tables can be based on different Tree Form Classes (tree taper) and may not all have the same volume figures. The standard Form Class most often used is 78.

Determining Timber Value

The MSU Extension Service publishes a quarterly timber price report. Current and historical prices, dating back to 2013, are available on this website: Timber Prices: 2013-Present. This price information must be converted from dollars per ton ($/ton) to dollars per 1000 board feet ($/MBF) for this project (Tables 2 and 3). For example, the pine sawtimber conversion factor for trees with an average DBH of 12 inches is 9.8 tons per MBF (Table 2). A sawtimber price of $20 per ton can be converted to $/MBF by multiplying by 9.8 ($20/ton x 9.8 tons/MBF = $196/MBF). Refer to MSU Extension Service publications P2244 *Pine Timber Volume-to-Weight Conversions* and P3448 *Hardwood Timber Volume-to-Weight Conversions* for further explanation. A professional forester can help make these conversions.

Table 1. Doyle log rule volume table (form class 78). DBH (inches) and number of usable 16-foot logs are used to determine tree volume in board feet.

Tree Diameter (inches)	Tree Height (16-ft logs)								
	1	1½	2	2½	3	3½	4	4½	5
10	18	22	26	28	30	32	33		
12	33	42	51	57	63	65	68	71	
14	54	70	85	96	107	113	119	125	
16	79	98	128	146	165	178	189	198	
18	109	144	179	207	235	254	272	283	
20	144	193	242	281	320	348	375	396	417
22	184	249	313	366	418	455	484	525	557
24	228	310	392	459	527	574	645	667	713
26	279	380	482	566	651	713	775	835	894
28	331	454	577	682	787	861	935	1,011	1,087
30	392	539	687	814	940	1,032	1,122	1,216	1,310
32	457	631	805	958	1,110	1,222	1,334	1,441	1,548
34	525	727	929	1,106	1,284	1,416	1,548	1,675	1,803
36	599	834	1,068	1,276	1,484	1,638	1,793	1,945	2,097
38	676	943	1,210	1,450	1,690	1,868	2,046	2,223	2,400
40	740	1,035	1,330	1,594	1,858	2,059	2,260	2,248	2,636

Table 2. Volume (MBF) conversions for pine sawtimber, MSU Extension Publication 2244 *Pine Timber Volume-to-Weight Conversions*.

Average DBH	Tons per Unit Volume Conversion
10	14.0 tons per MBF
12	9.8
14	8.5
16	7.7
18	7.2
20	6.7
22	6.3
24	5.9
26	5.5
28	5.2
30	5
32	4.8
34	4.6
36	4.4

Table 3. Volume (MBF) conversions for mixed-hardwood sawtimber, MSU Extension Publication 3448 *Hardwood Timber Volume-to-Weight Conversions*.

Average DBH	Tons per Unit Volume Conversion
14	12.1 tons per MBF
16	10.7
18	9.8
20	9.1
22	8.6
24	8.1
26	7.8
28	7.5
30	7.3
32	7.1
34	6.9
36	6.8

Project Instructions

1. Contact a local forester or MSU Extension agent for help in obtaining a tree scale stick (Doyle rule).
2. Locate an area with suitable sawtimber trees to measure. Pine trees must be at least 10 inches DBH, and hardwoods must be at least 14 inches DBH. Trees must have at least one 16-foot log and have a minimum top diameter of 8 inches. Your own yard may have enough suitable trees, or your family may have land with sawtimber trees. State parks and national forests are ideal areas. If you have trouble locating suitable trees, get help from a local forester or Extension agent.
3. Measure DBH (2-inch diameter classes) and merchantable height (to the nearest one-half log) of 20 different sawtimber trees and enter measurements on the record sheet. Try to measure several species of both pine and hardwood trees.
4. Using the volume table in this publication to find the board foot volumes of each tree (Table 1). Enter them on the record sheet included in this publication.
5. After you have measured and recorded information on all 20 trees, total the board foot volumes of all the trees. Pine and hardwood volumes are recorded separately because they are usually sold separately. Divide your total tree volumes by 1,000 board feet to get MBF.
6. Contact a local forester or Extension agent and find out what the current average stumpage price is for pine and hardwood sawtimber and how to convert this information from price per ton to price per MBF. Enter this information on the record sheet.
7. Multiply pine and hardwood volumes by current average timber prices. This will give you the value of the trees you have measured. Pine and hardwood prices differ because they are used to produce different types of wood products. The supply and demand of these products contribute to the value of the standing timber (stumpage price).
8. If you borrowed a tree scale stick, be sure to return it to the owner after you finish measuring your trees and recording your volumes.
9. If possible, get a forester to check your tree measurements and answer any questions you may have. Ask the forester to sign your record sheet when your project has been completed.
10. Have your adult 4-H leader check your project and sign your record sheet. Include the record sheet in your 4-H member's record. Save the project sheet and other materials as future references as you continue in other 4-H Forestry projects.

4-H Forestry Project Record No. 5 Measuring Standing Sawtimber

Your full name _____ Your age _____ Grade in school _____

No. years in 4-H _____ Date of birth _____ Your parent/guardian's name _____

Your address _____ County _____

Name of club _____ Adult leader's name _____

When did you measure your trees? (month, day, year) _____

Describe in detail the location of the area where you measured your trees. Include number of miles, direction, town or city, and county. (Example: On John Doe's farm near the Hickory Grove Community, 6 miles north of Grenada, in Grenada County.)

1. List the different trees you measured and enter the species, DBH, merchantable height, and board foot volume measurements on the Tree Measurement Worksheet on page 8 of this project guide. Calculate total board foot volumes for both pine and hardwood species.

2. How many different species did you measure? _____

3. What is the current average sawtimber stumpage price (Doyle Rule) for your area? (Example: $350/MBF)

   Pine sawtimber ($/MBF) _____ Hardwood sawtimber ($/MBF) _____

4. Whom did you contact for help in finding the current average stumpage prices for sawtimber?

   _____

5. Where did he/she find the stumpage prices he/she gave you?

   _____

6. Calculate the current stumpage value for the trees you measured.
   Example: Pine (MBF) 4.7 × $350 = $1,645

   Pine volume (MBF) _____ × stumpage price $_____ = $_____

   Hardwood volume (MBF) _____ × stumpage price $_____ = $_____

   Total value = $_____

7. Which species group (pine or hardwood) had the highest stumpage prices? ◯ Pine ◯ Hardwood

8. What reasons can you give for the differences in stumpage prices?

   _____

9. Were you surprised at the value of the trees you measured? ◯ yes ◯ no
   Explain:

   _____

10. List five wood products that can be made from trees like the ones you measured.
Example: Pine – Plywood Hardwood – Baseball bats

Pine	Hardwood

11. Where did you get the tree scale stick you used to measure the trees? _____

12. List two other tree scales (other than the Doyle Scale) that are used to determine board foot volumes.

_____

13. What other types of tools do foresters use to measure tree diameters?

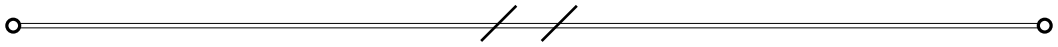
_____

14. Name two tools (other than the Merritt hypsometer) used to measure tree heights.

_____

15. What sources of help and information did you consult on this project?

16. Write any suggestions you have on how this project could be improved.



As a forester, I have checked these standing tree measurements and found them to be in accordance with proper forest measurement techniques.

_____
Forester

As an adult 4-H leader, I have checked this Measuring Standing Sawtimber Project and Record and found it to be completed satisfactorily.

_____
4-H Leader

Tree Measurement Worksheet

Tree number	Species	DBH (inches)	Number of 16-ft logs	Board foot volume (hardwood)	Board foot volume (pine)
Example:	**Loblolly pine**	**18**	**3½**	**247**	**–**
Example:	**Southern red oak**	**18**	**3**	**–**	**231**
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

Total board foot volume:

Thousand board feet (MBF) to nearest tenth (Example: 4,680 ÷ 1,000 = 4.680 MBF or 4.7 MBF).

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Revised by **James Shannon**, PhD, Extension Specialist I, North Mississippi Research and Extension Center, from an earlier version revised by **Brady Self**, PhD, Extension Professor, Forestry, and Stephen G. Dicke, PhD, Extension Professor (retired).

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