Landowner's Guide to Determining Weight of Standing Hardwood Trees

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Introduction

Hardwood procurement has changed with the times. In the past, hardwood sawtimber trees were sold based upon the board foot volumes as estimated by the Doyle log rule. The tree diameter and number of logs were determined and the board footage calculated. The medium of exchange was dollars per thousand board feet of volume.

Today the most common medium of exchange is dollars per ton based on the outside bark weight of the timber. At the mill, the loaded log truck is weighed. After unloading, the truck is re-weighed. The difference in the two weights is the amount of wood for which the logger is paid. Therefore, the procurement agent must relate standing tree board foot volume to the log weights at the mill to arrive at a purchase price of the standing trees.

The objective of this fact sheet is to provide landowners and procurement foresters with a method of accurately estimating the weight of the merchantable portion of standing hardwood trees. The weight tables herein were derived from equations resulting from research conducted by the Arkansas Forest Resources Center. Data were collected at five sites from 272 total trees and a total of 14 species of hardwood trees. The weight tables are based on all species analyzed together. Tables of species-specific adjustment factors were then created so that one can easily modify the generic weight estimate to make it species specific.

Option One:
Measure Diameter Only

This option is predicated on the landowner having only a standard tape measure to determine the size of the tree stem and no way of estimating the tree height. The tree stem should be measured at a point 4.5 feet above the ground (breast height). The tape should measure the

TABLE 1. Merchantable weight (tons) of hardwood trees *by diameter or circumference at breast height in inches*.

Diameter Inches	Circumference Inches	Weight Tons
12	38	0.75
13	41	0.92
14	44	1.09
15	47	1.28
16	50	1.48
17	53	1.69
18	57	1.92
19	60	2.16
20	63	2.41
21	66	2.68
22	69	2.95
23	72	3.25
24	75	3.55
25	79	3.87
26	82	4.20
27	85	4.54
28	88	4.90
29	91	5.26
30	94	5.65
31	97	6.04
32	100	6.45
33	104	6.87
34	107	7.30
35	110	7.75
36	113	8.21

TABLE 2. Merchantable weight (tons) of hardwood trees *by DBH in inches and total height in feet*.

DBH Inches	Total Tree Height (feet)						
	60	70	80	90	100	110	120
12	0.33	0.53	0.73	0.93			
13	0.48	0.68	0.88	1.08			
14	0.64	0.84	1.04	1.24			
15	0.81	1.01	1.21	1.41	1.61		
16	0.99	1.19	1.39	1.59	1.79	1.99	
17	1.18	1.38	1.58	1.78	1.98	2.18	
18	1.38	1.59	1.79	1.99	2.19	2.39	
19	1.60	1.80	2.00	2.20	2.40	2.60	2.81
20	1.83	2.03	2.23	2.43	2.63	2.83	3.03
21		2.27	2.47	2.67	2.87	3.07	3.27
22		2.52	2.72	2.92	3.12	3.32	3.52
23		2.78	2.99	3.19	3.39	3.59	3.79
24		3.06	3.26	3.46	3.66	3.86	4.06
25			3.55	3.75	3.95	4.15	4.35
26			3.85	4.05	4.25	4.45	4.65
27			4.16	4.36	4.56	4.76	4.96
28			4.48	4.68	4.88	5.08	5.28
29			4.81	5.01	5.21	5.41	5.61
30				5.36	5.56	5.76	5.96
31				5.71	5.91	6.11	6.32
32				6.08	6.28	6.48	6.68
33				6.46	6.66	6.86	7.06
34				6.85	7.05	7.26	7.46
35				7.26	7.46	7.66	7.86
36						8.07	8.27

circumference of the tree stem in inches. This value can be used in Table 1 or it can be divided by 3.1416 (pi) to provide the diameter (DBH) of the tree stem in inches. If the landowner has a diameter tape (D-tape), it will indicate the diameter directly. Either diameter or circumference can be used with Table 1. If the measurement is between the sizes shown in the table, it can be rounded. Table 1 is based upon an equation that accounts for 85 percent of the variation in tree weight.

Option Two:
Measure Diameter and Height

This option is predicated on the landowner having a D-tape for measuring the diameter at breast height (DBH) and an instrument for measuring total tree height (for example, a clinometer). Including height increases the accuracy of the estimated weight. The equation on which Table 2 is based accounts for 88 percent of the variation in tree weight. In this case, both the diameter and the height estimates may need to be rounded before using the table or the weight estimates can be interpolated.

Adjustment for Species

Some of the variation in weight that is not accounted for in Tables 1 or 2 is due to the variation in the wood density of the different species. Adjustment factors have been developed to account for the variation by species. The adjustment factors were created by dividing the average density of the trees of each species by the average density of all of the trees. Multiplying the weight estimate from the table by the species adjustment factor will move the weight value either up or down according to the wood density of the species as compared to the other species. Table 3 shows the adjustment factors for the red oak group, Table 4 shows the factors for the white oak group and Table 5 shows the factors for the other tree species included in the research by the Arkansas Forest Resources Center.

TABLE 3. Adjustment factors for RED OAK group of tree species.

Species	Factor
Southern Red Oak	1.054
Black Oak	1.033
Northern Red Oak	1.018
Cherrybark Oak	1.015
Nuttall Oak	0.999
Water Oak	0.996
Willow Oak	0.963

TABLE 4. Adjustment factors for WHITE OAK group of tree species.

Species	Factor
Post Oak	1.026
Overcup Oak	0.997
White Oak	0.958

TABLE 5. Adjustment factors for MISCELLANEOUS tree species.

Species	Factor
Mockernut Hickory	1.013
Shagbark Hickory	0.987
Bitter Pecan	0.966
Sweetgum	0.974

Example 1.

A landowner had some hardwood trees to sell and wanted to know their weights in order to estimate what they are worth. The first tree to be measured was a post oak, and the circumference at 4.5 feet above ground was 60 inches. The landowner looked in Table 1 and found that the merchantable portion of a hardwood tree of that size is estimated to weigh 2.16 tons. Post oak is listed in Table 4 and has an adjustment factor of 1.026. The estimated merchantable weight for a post oak of that size is 2.22 tons (2.16 X 1.026).

Example 2.

Another landowner had some bottomland hardwoods to sell. A consultant forester was hired to assist with the sale. The first tree measured was a sweetgum with a DBH of 21 inches and an estimated total height of 90 feet. Table 2 shows that the merchantable portion of a hardwood tree of that size should weigh 2.67 tons. The sweetgum adjustment factor (0.974) is listed in Table 5. As a result, the estimated merchantable weight for that sweetgum tree is 2.60 tons (2.67 X 0.974).

Tree Quality

There is still a good market for high-quality hardwood lumber, but sawmill operators must work at finding markets for low-quality lumber. Since high-quality trees produce more high-quality lumber, many procurement foresters are willing to pay a higher price per ton for high-quality trees. Hardwood trees are graded according to the quality of the first 16-foot log. The lower 16 feet of the tree is divided into four equal faces. The best continuous 12 feet of each face is graded. The grade of the third best face (which can also be thought of as the second worst face) of the tree is the grade of the tree. For a more detailed discussion of hardwood tree grading, please consult the University of Arkansas Cooperative Extension Service's fact sheet *FSA5015, Forest Landowner's Guide to Field Grading Hardwood Trees*, by Cunningham and Patterson.