

Weight and Volume Overview

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There are three primary units for measuring the amount of weight/volume in standing trees (also referred to as stumpage). They are:

- 1) Tons (green weight).
- 2) Cubic Feet (CF; also referred to as cunits which is obtained by dividing 100).
- 3) Doyle Board Feet (DBF; full name is Doyle Log Rule Board Feet).

There are two primary units measuring the volume in lumber (once the tree is sawn into rectangular boards). They are:

- 1) Board Feet (BF; not the same as Doyle Board Feet).
- 2) Cubic Feet (CF; there are 12 cubic feet in a board; simply divide the number of BF by 12 to obtain cubic feet).

It is important to understand the difference in calculating the volume of a standing tree (stumpage) as opposed to the volume in a manufactured board. The volume in a manufactured board is simply calculated by length x width x depth (all in inches) divided by the square inches in one board foot (which is 1 foot x 1 foot x 1 inch = 144 square inches). This provides the real BF which is not to be mistaken with DBF (which some landowners use for estimating the volume of their standing timber in the forest prior to sale). To obtain cubic feet, simply divide the board feet by 12.

The board feet calculation for three different size boards are illustrated below (inches = “; feet = ‘):

- 14’ x 6”x 1” = 168” x 6” x 1” = 1,008 square inches divided by 144 square inches = 7 board feet = 0.58 cubic foot.
- 12’ x 6”x 1” = 144” x 6” x 1” = 864 square inches divided by 144 square inches = 6 board feet = 0.5 cubic foot.
- 12’ x 6”x 2” = 144” x 6” x 2” = 1,728 square inches divided by 144 square inches = 12 board feet = 1 cubic foot.

Doyle Board Foot (DBF) is the estimation for the predicted Board Foot cut-out into boards of a standing cylindrical-cone shaped tree based on mill cut-out reports dating back to 1825. Increased mill efficiency over the past 178 years has proven DBF estimation to be outdated and inaccurate. Below is an example of the error in DBF to current mill utilization in BF (80 form class):

Standing Tree Measurements (16 feet per log; 80 Form Class)	Doyle Board Feet (DBF)		Cubic Feet (CF)			DBF Utilization Error		Price Error	
	Per Tree	Utilization per Cubic Foot	Average Mill Utilization per Cubic Foot	Cubic Feet per Tree	Mill Utilized Board Feet per Tree	DBF Under-Estimation per Tree	DBF Percent Error	DBF \$/1000 DBF	Actual Price Received Compared to Utilized Board Feet
10” dbh (3 logs)	26	1.6	6.0	16.7	100	74	74%	\$ 350	\$ 91
12” dbh (3 logs)	57	2.4	7.0	23.3	163	106	65%	\$ 350	\$ 122
14” dbh (3 logs)	104	3.3	9.0	31.1	280	176	63%	\$ 350	\$ 130
16” dbh (3 logs)	161	4.0	9.0	40.2	362	201	56%	\$ 350	\$ 156
18” dbh (3 logs)	234	4.5	9.0	52.1	469	235	50%	\$ 350	\$ 175
20” dbh (3 logs)	321	5.2	9.0	62	558	237	42%	\$ 350	\$ 201
22” dbh (3 logs)	420	5.6	9.0	75	673	253	38%	\$ 350	\$ 218
24” dbh (3 logs)	536	6.0	9.0	89	799	263	33%	\$ 350	\$ 235

As illustrated above, the error for Doyle Board Feet is amazingly high and increases as tree dbh decreases. Consequently, our Arkansas legislature with the support of the Arkansas Plant Board and Arkansas Forestry Association removed “Doyle Board

Foot” as a state standard for predicting board feet in standing trees (which dates back to 1901). The above chart also illustrates why wholesale “board foot lumber” prices per 1000 Board Feet are misleadingly close to “Doyle Board Feet standing timber” sales (it is a misrepresentation based on Doyle’s inaccurate estimate of the real cut-out of board feet in standing trees). One board foot of lumber is one board foot, while one Doyle board foot of standing timber is a varying 33% to 74% under-estimation in Doyle Board Feet (depending on dbh). When landowners or consultants report they received \$350/1000 Doyle Board Feet (they usually leave off the word Doyle and just report \$350/1000 Board Feet) for their standing timber, and if their stand was averaging 14” dbh, they actually received \$130/1000 board feet when compared to actual board feet currently utilized by the average North American pine mill.

The good feelings a seller experiences from thinking he/she actually received \$350/1000 Doyle Board Feet are purely superficial. Such a landowner is similar to the King who thought he was parading the streets in fine apparel until a young boy innocently yet truthfully reported, “The King is naked”. Tons and Cubic Feet do not have this problem as they respectively report in biomass.

Tons and CF differ from DBF by estimating the total biomass without regards to varying mill utilization. By estimating gross weight/volume the error of predicted utilization is eliminated. What would you do if the Cattle Sale Barn deducted 200 pounds from your calf’s 500 gross weight before applying 85 cents/pound? Upon your inquiry, they responded, “the predicted utilized meat cut-out based on a slaughter house cut-out to steak, roast, and hamburger meat in 1825 only had a 60% utilization, so we deducted 200 pounds from your 500 pounds. Even worse, if they printed the scale readout with the deduction built in to reduce detection, then all you would see is 300 pounds, and you would think that is your calf’s weight. Meanwhile due to increased efficiency and by product usage, current meat utilization had increased to 90%. Tons and cubic feet operate off the gross weights, which prevent the above scenario from taking place.

A comparison between measurement methods are as follows:

	<u>Tons</u>	<u>Cubic Feet</u>	<u>Doyle Board Feet</u>	<u>Board Feet</u>
Predicts Utilization	No	No	Yes	No
Biomass Reported	Yes	Yes	No	Yes
Measurement Type	Total Weight	Total Volume	Utilized Volume	Total Volume
Accuracy	High	Highest	Lowest	Highest
Pay-As-Cut Sales	95%	0%	5% (High Quality Butt Logs)	No
Lump Sum Sales	Increasing	Increasing	Decreasing	No
Mill Procurement	High	Reference in-house	Low	No
Intermediate Buyers	High	No	Decreasing	No
Consultant Usage	Increasing	Increasing	Decreasing	No
Lumber Sales	No	No	No	Yes

In Summary, timber should be reported and sold in biomass for accurate representation. Of the three available timber measurements, Doyle Board Feet is the oldest and contains the highest error, and has slowly been replaced by two more accurate methods: tons (green weight) and cubic feet. Tons and cubic-foot tables by dbh and height are available on this site. Since cubic feet and tons both deal in biomass, they have simple linear conversions from one to the other as follows for the Coastal Plains:

- 1) 3.37 tons/cunit for pine (≤ 18 " dbh).
- 2) 3.30 tons/cunit for pine (≥ 20 " dbh).
- 3) 3.65 tons/cunit for oak.
- 4) 3.40 tons/cunit for miscellaneous hardwood.

As previously mentioned, a cunit is 100 cubic-feet. Simply divide the cubic-feet in the appropriate table by 100 and then multiply by the above numbers for the appropriate tree class to obtain corresponding tons.

Even though tons provide a better representation than DBF, tons have one weakness. This weakness only expresses itself in pay-as-cuts and is not realized in lump sum sales (even though both are performed in tons; refer to “Timber Selling Methods”). Ton green weight varies by tree and fluctuates by season. Pine trees tend to weigh more with sap drop in the fall and sap rise in the spring. Pine trees generally weigh more in the summer and less in the winter. Stressed pine trees naturally over pruned to less than 1/5-crowns on top of sandy ridges in the middle of dry winters, experiencing minimal transpiration, weigh least of all comparable stands and conditions. Reason, pine has a lower specific density than water (dry pine floats on water). The greater the ratio of water to wood, the heavier green pine weighs. However, varying tree weights typically balance out over the whole stand (some

trees weigh more and others less), but there are rare occasions when natural water to wood ratios, in unique conditions, bias pay-as-cut reports high and low.

Even with the fluctuation in tonnage due to moisture, tons are still more accurate than Doyle Board Feet, and therefore tons is the preferred unit of measurement by prudent persons growing, selling and procuring standing timber in Arkansas.