UofA UNIVERSITY OF ARKANSAS
DIVISION OF AGRICULTURE
Cooperative Extension Service

Agriculture and Natural Resources

FSA5013

Board Foot Loss Inherent in Scaling Double Length Logs

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Hardwood sawlogs are often stick scaled for board foot volume determination at a mill. That is, log measurements are taken, and the volume contained in the log is read from a log scale written onto the scaling stick, which somewhat resembles a yardstick. The key to stick scaling is the inside bark small-end diameter (in inches) of the log, called the scaling diameter, as well as the log length (in feet). Most scaling sticks account for logs up to 16 feet in length.

There is an increased emphasis on the mechanization of all timber harvesting equipment. As a result of the growth in mechanization, the length of harvested logs delivered to the mill has increased to lengths longer than 16 feet. A problem thus arises when stick scaling such logs, as the scale used to determine board foot volume often only accommodates logs up to 16 feet in length. To determine the volume of a log longer than 16 feet in length, the scaler will most often measure the scaling diameter, read the volume of a 16 foot long log with that scaling diameter and then multiplicatively increase the total volume in the log based on total length.

For example, a 33 foot long log contains two 16 foot logs (an extra 0.5 foot of length is always included for each 16 foot log, making a 16 foot log in reality 16.5 feet long). If this 33 foot log had a scaling diameter of 12 inches, then the volume for a 16 foot log with a 12-inch scaling diameter is read from the scaling stick when scaling this log. Let us assume this scaled volume was 64 board feet. Since the 33 foot log is twice as long as the 16 foot log whose volume was determined using the scaling stick, the scaled volume for that 16 foot log is doubled to obtain the scaled volume of 128 board feet for the 33 foot log. This procedure is inaccurate and will estimate less board foot volume than if the 33 foot log was merchandized into two individual logs of half its total original length (two 16 foot logs in this case) and each 16 foot log scaled separately.

The underestimation occurs because the multiplicative doubling of the 16 foot log volume to obtain the 33 foot log volume ignores log taper. As one increases height above ground in a tree, the stem tapers and stem diameter decreases. This decreasing stem diameter occurs as one moves from the large end of a log to the small end of a log. The method of multiplicatively doubling 16 foot log volumes to obtain 33 foot log volume assumes that both 16 foot logs therein have the same scaling diameter, and this is simply not the case. One of the 16 foot logs present in that 33 foot log (the one coming from a lower part of a tree stem) will have a scaling diameter larger than the scaling diameter of other log (the measured scaling diameter of the 33 foot log). The 16 foot log with the larger scaling diameter will contain more volume than the other log – volume that is not accounted for via the multiplicative method. Figure 1 shows how the smaller scaling portion of the log fits inside the lower portion indicating the amount of volume lost in scaling double length logs.

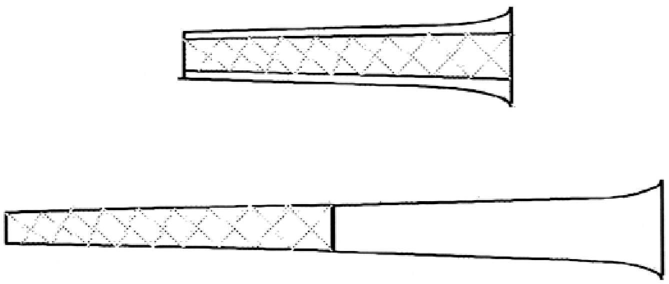

Figure 1. Representation of volume error in double log scaling by comparing the volume of the first log to the volume of the second log.

Weight scaling of timber, commonplace for pine sawtimber, alleviates this issue, though it does pose other problems not addressed here (for example, high-quality logs weigh the same as low-quality logs, yet the former are more valuable than the latter). However, most hardwood sawtimber is still stick scaled, leading to the aforementioned under-estimation of volume issue. This project examines how merchandizing double length logs into two individual logs of half the original length impacts stick scaled board foot volumes.

Methods

Data collected in conjunction with two previous studies on pine and hardwood sawtimber were used in this endeavor. Data from 400 sawlogs were examined, with 360 of those being pine sawlogs and the remaining 40 of those being hardwood sawlogs.

Of the 360 pine sawlogs, 270 were butt logs (logs that were harvested from stem positions immediately above the stump) and 90 were upper logs (logs that were harvested from stem positions above the butt logs).

These merchandized pine logs were either 26.5 or 35 feet in length, and scaling diameters ranged from 6.75 to 22 inches in diameter. The inside bark diameter of each of these logs was measured at their midpoints (or half their total lengths). Each 26.5 or 35 foot log was scaled using the multiplicative method based on its scaling diameter and half of its total length (13.25 feet or 17.5 feet). Then each log was theoretically merchandized into two individual logs – one log based on the scaling diameter and half of its total length and a second log based on the inside bark midpoint diameter and half of its total length. The inside bark midpoint diameter (outside bark minus two bark thicknesses) serves as the scaling diameter of the second log. The scaled volumes of the two individual logs were summed and compared to the scaled volume of the double length log.

The 40 hardwood sawlogs were all 32 feet in length, and scaling diameters ranged from 6.5 inches to 12.6 inches. Unlike the pine sawlogs where just one midpoint diameter was measured, inside bark diameters were recorded at 8 foot increments along each hardwood sawlog. The multiplicative method was used to stick scale board foot volume of each

32 foot log based on its scaling diameter and half its total length (16 feet). Since diameters at four locations along the logs were measured for the hardwoods, each 32 foot log was theoretically merchandized into 16 foot logs as well as 8 foot logs for scaled volume comparisons to the multiplicative method, with the incrementally measured diameters serving as the respective scaling diameters. The scaled volumes from the 16 foot logs or the 8 foot logs were summed and compared to the scaled volumes from the double length logs.

The Doyle log rule was used for all board foot volume scale calculations. The log rule employs the following formula for volume determination:

$$\text{Doyle Board Foot Volume} = \left(\frac{D-4}{4}\right)^2 \times L$$

Where: D = scaling diameter of the log in inches, and L = length of the log in feet.

For example, a 32 foot log with a scaling diameter of 8 inches scales to 32 board feet, whereas a 16 foot log with a scaling diameter of 10 inches scales to 36 board feet.

Results

Pine logs – Analyses indicate that the scaled volumes from the double length pine butt logs were, on average, 18 percent lower than the scaled volumes obtained by theoretically merchandizing the double length logs into two individual logs and summing their scaled volumes. More specifically, the double length 35 foot logs scaled 18 percent less than the 17 foot logs therein, and the 26.5 foot logs scaled 13 percent less than the 13 foot logs therein. The difference was more pronounced in the 35 foot logs because the difference between the scaling diameter and the midpoint diameter is greater for 35 foot logs than the difference between diameters for the 26.5 foot logs. If a log has uniform taper, greater distance between diameters will result in greater difference in diameters.

Pine upper logs exhibited a similar pattern. Double length 35 foot upper logs scaled 30 percent less than the single length logs therein, and double length 26.5 foot logs scaled 31 percent less than the single length logs therein.

Hardwood logs – Double length 32 foot hardwood logs scaled 29 percent less than the single length 16 foot logs therein. Furthermore, quadruple length 32 foot logs scaled 36 percent less than the four single length 8 foot logs therein. Also, double length 16 foot logs scaled 11 percent less than the single length 8 foot logs therein. Though 8 foot logs are not commonly delivered to a mill, the analysis is included to emphasize the argument being made – the multiplicative method underestimates board foot volume when stick scaling double length logs.

Conclusions

Board foot log volumes of logs are underestimated when applying the multiplicative method to stick scale double length logs. This should be of concern if one is being paid according to delivered volume and the multiplicative method is being used. In these instances, since the single length logs will scale more board foot volume than the double length logs, an individual should consider delivering single length logs to a mill provided the mill accepts them.

If one were to sell 100,000 board feet of double length logs at $350 per 1,000 board feet, they would receive $35,000. If those logs were cut into single logs and sold with a 25 percent increase in volume, they would receive $43,750.

Printed by University of Arkansas Cooperative Extension Service Printing Services.

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FSA5013-PD-5-06N