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NORTH CENTRAL FOREST EXPERIMENT STATION, FOREST SERVICE—U.S. DEPARTMENT OF AGRICULTURE

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USING D.B.H. AND BUTT LOG QUALITY TO ESTIMATE TREE YIELDS BY SAW LOG GRADE

ABSTRACT. — Presents a shortcut method of predicting sugar maple tree yields by saw log grade from d.b.h. and butt log grade.

Tree quality is as important as quantity in judging the value of trees. Grading logs in standing trees is one way to estimate quality. This paper analyzes the results of grading sugar maple trees for saw logs and suggests that d.b.h. and butt log grade can be used to estimate saw log yields by grade when evaluating sugar maple stands.

Ninety trees from two old-growth sugar maple stands in Upper Michigan were felled, measured, and graded according to U.S.D.A. Forest Service hardwood factory saw log specifications.[1] The trees were selected from 10 random plots to cover the existing d.b.h. and butt-log quality range. The tree stems were diagrammed, photographed, and "paper bucked" for highest saw-log grade yield. Total log yields by grade were calculated, and tree values were derived from these yields by applying the log prices on the stump using recent National Forest data for Upper Michigan.[2]

Multiple regression analysis was used to find a simple method of estimating saw log yields by grade and tree values. Differences between paper bucked estimates and regression equation estimates were used to measure the success of the method in predicting both log yields by grade and tree values based on these log yield predictions.

Multiple regression analyses of the data showed that d.b.h. and butt log grade can be used to predict saw log yields by grade (table 1). This is because log grades occur in definite patterns in trees of various heights. Trees yielding five variable-length logs had a dominating log-grade pattern of 1-2-2-3-3; 4-log trees 1-2-3-3; 3-log trees 2-3-3; and 2-log trees 3-3 (table 2). Tree values can be derived from the predicted log yields when log prices on the stump are known.

These saw log yield and value estimates describe the stands that were sampled and are based only on paper bucking; so even though estimates of the reliability of the equations are included, the equations should be field tested against actual saw log yields. If this is done, the constants may change in the prediction equations, but the general form of these equations should remain the same.

The equations are to be used for predicting yields and value of stands, and the calculations per tree used only to get the stand values. In this way, individual exceptional trees tend to cancel each other and overall prediction will be good.

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[1] *Vaughan, C. L., Wollin, A. C., McDonald, K. A., and Bulgrin, E. H. Hardwood log grades for standard lumber. U.S.D.A. Res. Pap. FPL 63, 52 p., illus. Forest Products Laboratory, Madison, Wis., 1966.*

[2] *Personal communication from N. O. Nelson, Forest Service Region 9, Milwaukee, Wis. 1968.*

Table 1. — *Tree prediction equations for old-growth sugar maple saw log yields and value*

Equation	R^2	Standard error of estimate
$Y_1 = 0.5589\ X_1^2\ X_2^{-1} - 78.46$	0.79	45 board feet
$Y_2 = 0.329\ X_1^2 - 178.3X_2 - 464.1\ X_2^{-1} + 618.5$	.50	54 board feet
$Y_3 = 0.1518\ X_1^2\ X_2 + 22.11$	.37	59 board feet
$V = P_1Y_1 + P_2Y_2 + P_3Y_3$	.87 [1]	3.25 dollars [1]

where

Y_1 = Grade 1 saw log volume in board feet, Scribner Decimal C, for trees 15.5 to 25.5 inches in d.b.h.

Y_2 = Grade 2 saw log volume in board feet, Scribner Decimal C, for trees 12.0 to 25.5 inches in d.b.h.

Y_3 = Grade 3 saw log volume in board feet, Scribner Decimal C, for trees 11.0 to 25.5 inches in d.b.h.

X_1 = d.b.h. in inches

X_2 = butt log grade

V = tree value, dollars

P_1 = Grade 1 saw log price on the stump, dollars per board foot

P_2 = Grade 2 saw log price on the stump, dollars per board foot

P_3 = Grade 3 saw log price on the stump, dollars per board foot

[1] if P_1 = .081 dollars/board foot
P_2 = .036 dollars/board foot
P_3 = .008 dollars/board foot

Table 2. — *Effect of tree size and log position on log grade distribution (based on number of logs in each log grade)*

Log position	Average length	Log grade 1	Log grade 2	Log grade 3	Total
TWO VARIABLE LENGTH LOGS PER TREE					
	Feet	Percent	Percent	Percent	Percent
Top	9.2	0	0	100	100
Butt	14.0	0	0	100	100
All	11.6	0	0	100	100
THREE LOGS					
Top	11.4	0	4	96	100
2nd	14.0	0	37	63	100
Butt	14.4	26	41	33	100
All	13.3	9	27	64	100
FOUR LOGS					
Top	10.5	0	4	96	100
3rd	11.3	0	28	72	100
2nd	13.1	11	62	27	100
Butt	12.8	51	40	9	100
All	11.9	16	33	51	100
FIVE LOGS					
Top	8.7	0	0	100	100
4th	11.9	0	0	100	100
3rd	11.4	0	71	29	100
2nd	13.7	29	71	0	100
Butt	10.9	71	29	9	100
All	11.3	20	34	46	100
All trees	12.1	14	32	54	100