Resource Inventory Notes

BLM 4 March 1977

MESAVAGE AND GIRARD'S VOLUME TABLES FORMULATED

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ABSTRACT

Formulas developed for form class 78 volume tables for International 1/4", Scribner, and Doyle log rules predicted 90 to 98 percent of tables values within ± 2 per cent.

INTRODUCTION

The availability of sophisticated dendrometers, efficient sampling systems, and versatile computer programs may eventually replace volume tables. Today, however, volume tables are used widely. Form class volume tables developed by Mesavage and Girard (1946) are very popular in the eastern United States.

Searching through volume tables is a slow and costly procedure, and this can be eliminated by acceptable formulization for use with large computers or desk-top calculators. Parker (1972) attempted to formulate Mesavage and Girard's tables using various models and stepwise regressions. Results were not especially useful. For example, our calculations showed the formula recommended for the International 1/4" log rule gave an average absolute difference from form class 78 table values of 10 percent. A different approach to formulization, which should prove useful in many studies, is presented here.

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Published by:
USDI, Bureau of Land Management, D 340
Denver Service Center, Denver Federal Center, Bldg. 50
Denver, Colorado, 80225

PROCEDURE

These steps were followed to formulate the form class 78 volume table for each log rule:

1. Empty cells in those tables were filled in by graphing and projecting volume over number of logs for each dbh class between 10 and 27 inches.

2. Volumes were related to dbh for each log height class using second degree polynomials of the form:

$$Y = a + bX + cX^2$$

where: Y = volume
a = intercept value
b and c = regression coefficients
X = dbh

All fits had R^2's of 0.999.

3. The eleven equations for each log rule and height class, except 5 1/2- and 6-log equations for the Scribner rule which were eliminated due to unusual trends, were combined by fitting a-values to second degree polynomials of the form:

$$Y = a + bX + cX^2$$

where: Y = a-values
a = intercept value
b and c = regression coefficients
X = number of logs

4. Step 3 was done for b- and c-values also, yielding combined equations (Table 1). All R^2's were .983 or better.

RESULTS

The combined equations in Table 1 provided for close predictions of table values. As shown in Table 2, average absolute differences were 1.5 percent or less, and 90 to 98 percent of predicted values were within ±2 percent of table values. Maximum differences, 7 percent for International 1/4", 10 percent for Scribner, and 27 percent for Doyle, were for 10-inch, 3-log trees. No difference for trees above 10 inches exceeded 5 percent.

Although the resulting equations appear rather formidable, they are easily programmed on calculators with six memories. If the appropriate form class is higher or lower than 78, an approximate adjustment can be made by increasing or decreasing volume figures 3 percent for each form class change (Avery 1967).

Table 1 - Combined equations for predicting form class 78 volumes by International 1/4", Scribner, and Doyle log rules.

Log rule	Equation
Int. 1/4"	$Vol. = (1.52968L^2 + 9.58615L - 13.35212) + (1.79620 - 0.27465L^2 - 2.59995L)\ D + (0.04482 - 0.00961L^2 + 0.45997L)\ D^2$
Scribner	$Vol. = (17.53508L - 0.59242L^2 - 22.50365) + (3.02988 - 0.02302L^2 - 4.34381L)\ D + (0.51593L - 0.02035L^2 - 0.01969)\ D^2$
Doyle	$Vol. = (0.55743L^2 + 41.51275L - 29.37337) + (2.78043 - 0.04516L^2 - 8.77272L)\ D + (0.04177 - 0.01578L^2 + 0.59042L)\ D^2$

Where: L = number of 16-foot logs

D = dbh

Table 2 - Percentage differences between the 281 form class 78 table and formula values.

Log Rule	Percentage differences (cumulative) 0	±1	±2	±3	±4 or more	Average absolute difference (%)
Int. 1/4"	22	76	98	99	100	1.1
Scribner	40	81	94	94	100	1.0
Doyle	17	65	90	97	100	1.5