

IMPROVING FORM CLASS ESTIMATIONS OF FOREST TREES¹

Abstract—A simple instrument, the "Wiant-f-c-Wedge," facilitates rapid estimations of form classes of forest trees. Results obtained in southern and Appalachian forests indicate the technique may have wide application.

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Foresters have long recognized that the taper of a tree influences its volume. Numerous form class volume tables, relating volumes to diameter, height, and some expression of form, have been developed.

Board-foot volume tables developed by Mesavage and Girard (1946) are widely used in the eastern United States. Those tables are indexed by Girard form classes, the percentage ratios of diameter inside bark (dib) at the top of the first 16-foot log to diameter outside bark at 4.5 feet (dbh). Unfortunately, the dib measurement is difficult and costly to obtain. For that reason, much cruising is done using an assumed form class 78, which may vary considerably from the appropriate value. For each form class by which the estimated varies from the actual, an approximately 3 percent error in volume determination can be expected (Avery, 1967).

The Wiant-f-c-Wedge

A device, the Wiant-f-c-Wedge, was recently described which facilitates rapid estimations of Girard form classes for southern forest species (Wiant, 1972). The instrument consists of a series of tapered lines with ratios of .62, .67, .72, .77, .82, and .87 used to assist in form class estimations. Figures 1 and 2 can be used to construct this device by gluing them on cardboard, with form classes 62, 67, and 72 on one side and 77, 82, and 87 on the other. Each side is covered with clear, self-adhesive vinyl for field use, making a compact instrument measuring about 7 inches square. The Ben Meadows Company (Box 8377, Station F, Atlanta, GA 30306, U. S. A.) produces a see-through model constructed of clear plastic.

Directions for Use of the Wiant-f-c-Wedge

A recommended procedure for use of the Wiant-f-c-Wedge follows:

1. To determine the horizontal distance for your reach from which you should estimate trees:

- (a) mark dbh and 17.3 feet above ground level on a sample tree.
 - (b) holding the Wiant-f-c-Wedge in front of you with both hands in a comfortable manner, move back from the tree until your line of sight through the base and top of the guide lines intersects dbh and 17.3 feet, respectively.
 - (c) pace the distance to the center of the tree, which should be no closer than approximately 30 feet.
2. To use the Wiant-f-c-Wedge thereafter:
 - (a) mark dbh on tree to be estimated.
 - (b) pace off the correct horizontal distance as determined in 1 (c).
 - (c) holding the instrument as described in 1 (b), shift the device laterally to select the set of form-class lines best fitting the taper from dbh (outside bark) to estimated dib at 17.3 feet, with the perpendicular, center line held so as to coincide with the center of the tree.

A knotted string is useful to check your reach from time to time. Also, one should check his pace at intervals.

Results of Field Tests

Twenty-five field tests, involving 30 trees each, have been conducted with east Texas southern forest species and West Virginia

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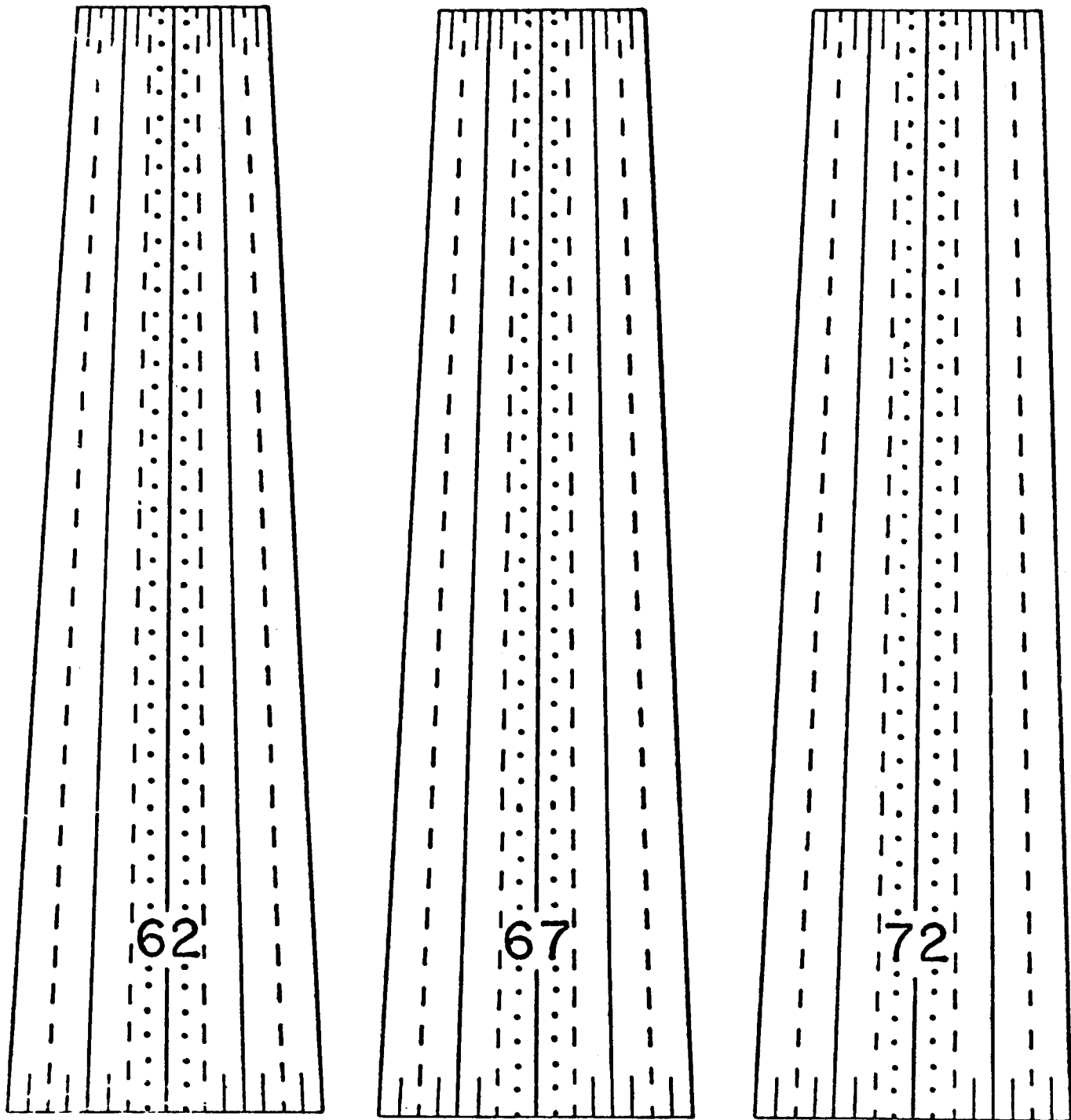


Figure 1. Wiant-f-c-Wedge for Girard form classes 62, 67, and 72.

Table 1. Comparison of estimated and measured average form classes.

Location and species	Test number	Estimated average form class ¹	Measured average form class ²	Mean difference (Estimated-Measured)
East Texas:				
Shortleaf pine (<i>Pinus echinata</i> Mill.)	1	83.7	83.8	-0.1
	2	84.5	83.8 ⁴	0.7
	3	82.5	83.1	-0.6
	4	83.3	84.4	-1.1
Loblolly pine (<i>P. taeda</i> L.)	5	74.5	74.3	0.2
	6	73.8	74.3 ⁴	-0.5
Slash pine (<i>P. elliottii</i> Engelm.)	7	84.5	86.0	-1.5*
	8	71.9	71.1	0.8
Sweetgum (<i>Liquidambar styraciflua</i> L.)	9	79.8	78.2	1.6
Black tupelo (<i>Nyssa sylvatica</i> Marsh.)	10	81.5	79.8	1.7
Southern red oak (<i>Quercus falcata</i> Michx.)	11	80.0	83.2	-3.2*
Water oak (<i>Q. nigra</i> L.)				
Appalachians:				
Yellow-poplar (<i>Liriodendron tulipifera</i> L.)	12	80.8	81.1	-0.3
	13	80.2	81.1 ⁴	-0.9
White oak (<i>Q. alba</i> L.)	14	81.0	81.1	-0.1
	15	81.5	81.1 ⁴	0.4
Northern red oak (<i>Q. rubra</i> L.)	16	76.7	78.8	-2.1*
	17	77.3	78.8 ⁴	-1.5*
Black oak (<i>Q. velutina</i> Lam.)	18	79.3	77.4	1.9*
Black cherry (<i>Prunus serotina</i> Ehrh.)	19	79.5	77.4 ⁴	2.1*
	20	82.7	83.5	-0.8
Mixed hardwoods ³	21	83.0	83.5 ⁴	-0.5
	22	83.0	82.2	0.8
	23	83.0	82.2 ⁴	0.8
	24	82.3	80.0	2.3*
	25	81.7	80.0 ⁴	1.7*

¹The sum of the estimated form class groups divided by the number of trees estimated.

²The sum of the measured form classes, determined to the nearest form class for each tree, divided by the number of trees measured.

³Thirty trees measured as found in the forest regardless of species.

⁴Same trees as on line above estimated independently by another field worker.

*A t-test indicates a significant difference in means at the 5% level of probability where:

$$t = \frac{\bar{x} \text{ estimated} - \bar{x} \text{ measured}}{S\bar{x} \text{ measured}}$$

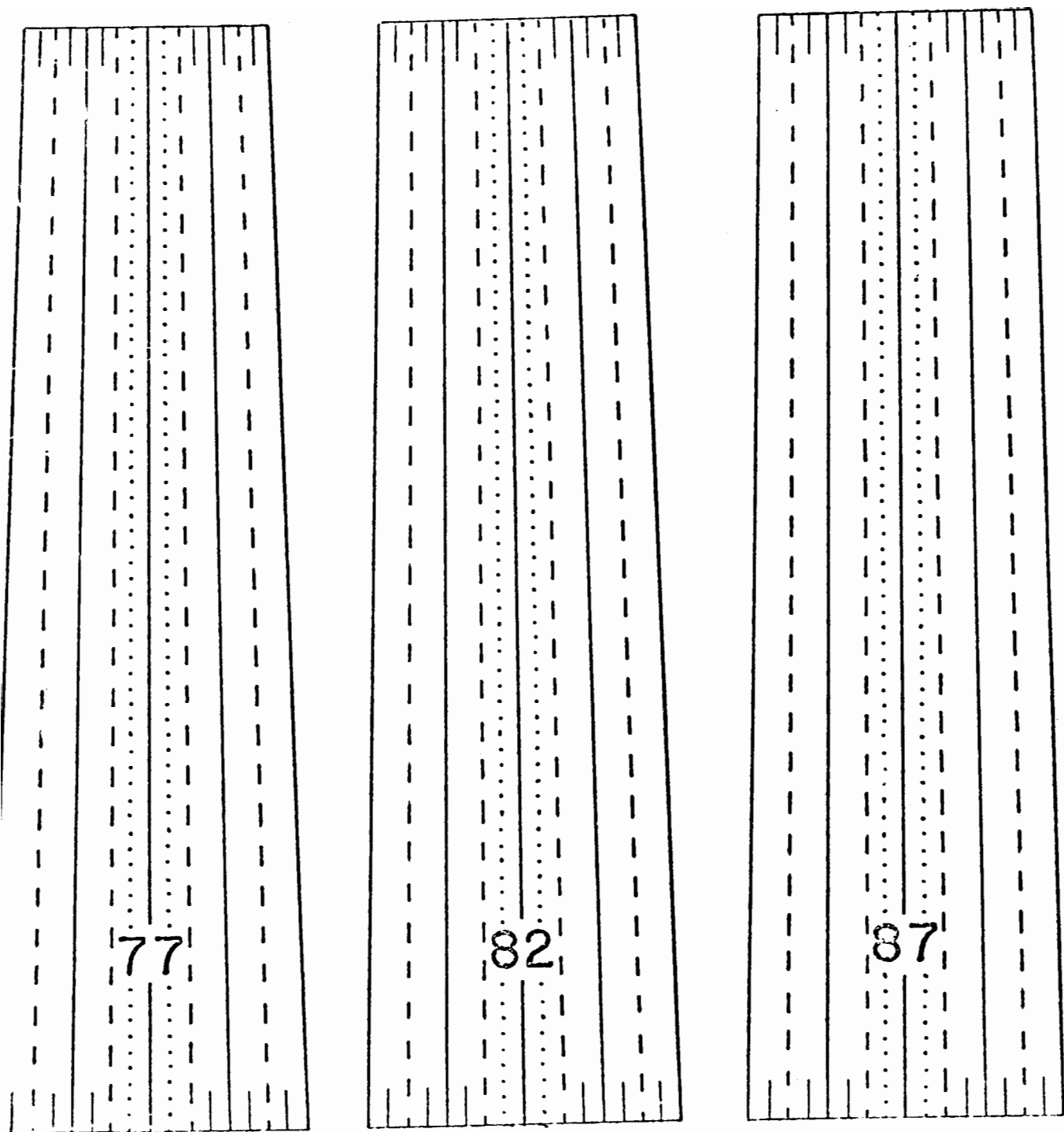


Figure 2. Wiant-f-c-Wedge for Girard form classes 77, 82, and 87.

Table 2. Deviations of mean form class estimates made using the Wiant-f-c-Wedge and an assumed form class 78 from measured values.

<u>When using</u>	<u>Deviation in form classes</u>								
	<u>0</u>	<u>±1</u>	<u>±2</u>	<u>±3</u>	<u>±4</u>	<u>±5</u>	<u>±6</u>	<u>±7</u>	<u>±8</u>
	- - -cumulative percent of tests- - -								
Wiant-f-c-Wedge	28	60	96	100					
Assumed form class 78	4	20	32	48	64	72	92	96	100


Appalachian hardwoods (Table 1). Although 8 of 25 mean differences were significant, Table 2 indicates the superiority of estimates made using the Wiant-f-c-Wedge to assuming a form class 78. While 60 percent of the mean estimates made using the Wiant-f-c-Wedge were within ± 1 form class of the measured values and 96 percent within ± 2 form classes, only 20 percent and 32 percent, respectively, of assumed form classes 78 would have been that close. Errors of up to 8 form classes, or 24 percent in terms of volume, would have been introduced by assuming a form class of 78.

The Appalachian hardwoods were estimated by two field workers alternating in use of the commercial plastic and homemade paper models of the Wiant-f-c-Wedge. In no case was there a significant difference between workers or instruments.

These results indicate that use of the Wiant-f-c-Wedge is an inexpensive means of improving form class estimates and related volume determinations.

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