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Stem Profile Equations for Southern Tree Species

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STEM PROFILE EQUATIONS FOR SOUTHERN TREE SPECIES

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ERRATA

The present page 76 should have been printed as page 78, and the present page 78 should have been printed as page 76. Therefore:

(1) The present page 76 begins (Yellow-poplar through All hardwoods combined) with coefficients for the Appalachian Mountains.

(2) The present page 77 begins (All soft hardwoods combined through All hardwoods combined) with coefficients for the Piedmont.

(3) The present page 78 begins (Longleaf pine through All hardwoods combined) with coefficients for the Gulf and Atlantic Coastal Plain.

(4) The present page 79 begins (White oak through All hardwoods combined) with coefficients for the Upper Coastal Plain.

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Contents

ABSTRACT

Form-class segmented-profile equations for 58 southern tree species and species groups are presented. The profile equations are based on taper data for 13,469 trees sampled in natural stands in many locations across the South. The profile equations predict diameter at any given height, height to given diameter, and volume between two heights. Equation coefficients for use in estimating diameters and volumes inside and outside bark are presented. D.b.h. and total height, d.b.h. and height to 4-inch top, d.b.h. and height to 9-inch top (hardwoods), and d.b.h. and height to 7-inch top (softwoods) are used as predictors. A measure of diameter at 17.3 feet is required also, and equations are presented for estimating d.o.b. and d.i.b. at 17.3 feet from d.b.h. and height. Equations for estimating d.i.b. at 4.5 and 17.3 feet from d.o.b. are given.

Keywords: Taper functions, volume equations, d.o.b. and d.i.b. equations

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The USDA Forest Service, Southern Region of the National Forest System, needs estimates of stemwood volume for timber sale preparation, forest inventory, and planning. For decades, local, hand-derived, board-foot volume tables for various tree species have been used to estimate merchantable stem volume. However, the Forest Service's new policy of expressing timber volume in cubic feet, the need to work with data that can be analyzed by computer, and changing utilization limits dictate that the Southern Region develop accurate but more flexible estimators of stemwood volume. Direct volume estimators can be developed for each utilization limit, but the variety of utilization limits in use and the frequency with which these limits change make direct estimation impractical.

Stem-profile models--taper models--are flexible, accurate, easy to use in the age of computers, and ideally suited to meet the Forest Service's changing needs. Profile models predict stem diameter at any height but can be integrated to solve for volume to a given height or diameter. This paper discusses a form-class segmented-profile model developed to predict the volume of southern tree species. Equations and coefficients for estimating stem volume inside and outside bark, diameter at a given height, and height to a given diameter are presented[1/]. The predictors used are d.b.h. and total height, d.b.h. and height to 4-inch diameter outside bark (d.o.b.) top, d.b.h. and height to 7-inch d.o.b. top (softwoods), and d.b.h. and height to 9-inch d.o.b. top (hardwoods). Coeficients for estimating diamter inside bark (d.i.b.) from d.o.b. at 4.5 and 17.3 feet above ground are included, as are equations for estimating both d.i.b. and d.o.b. at 17.3 feet from d.b.h. and height. Equation coefficients are presented for 58 species and species groups.

[1/] ASCII data files containing coefficients presented are available on floppy disk from the Utilization of Southern Timber RWU, Southeastern Forest Experiment Station, Forestry Sciences Laboratory, Green Street, Athens, GA 30602.

MODEL DEVELOPMENT

Evaluation of Existing Models

Many forms and types of stem profile models have been published (Sterba 1980) and evaluated for accuracy and precision (Czaplewski and others 1988[2/]; Alberta Forest Service 1987; Martin 1981; Cao and others 1980). Martin (1981) evaluated five profile models for predicting diameter, height, and volume and found no single model best for all applications. He reported that the Max and Burkhart (1976) model was best overall. Cao and others (1980) evaluated six profile models for predicting diameter and ranked Max and Burkhart's segmented-profile polynomial model first and Cao's segmented-profile model second. Cao's segmented-profile model was ranked first for estimating volumes to various top diameters. A polynomial ratio model was ranked second, Burkhart's (1977) ratio model was third, and Max and Burkhart's segmented-profile model fourth. The Alberta Forest Service (1987) evaluated 15 stem-profile models and judged Max and Burkhart's model best because of its accuracy and ease of computation.

Based on these evaluations, no one stem-profile model appears to be best for estimating volume, diameter, and height on the basis of measurements of standing trees. Therefore, three flexible stem-profile models that are reported to be accurate were selected for additional testing in the Southern Region. These were the segmented-profile polynomial models developed by Max and Burkhart and by Cao and others, and Schlaegel's (1983) form-class profile model.

Max and Burkhart's model consists of three submodels that describe the neiloid frustum of the lower tree stem, the paraboloid frustum of the middle stem, and the conical shape of the upper bole. The three submodels are spliced together at two join points to form an overall segmented polynomial tree model. The join points are simply proportions of total height. The lower join point is usually close to one-tenth of total tree height, and the upper point is usually close to seven-tenths of total tree height. The Max-Burkhart equation is conditioned so that estimated diameter equals zero when height equals total height and so that the taper line proceeds smoothly and continuously from one parabolic equation to the next. Since the Max-Burkhart model consists of three joined second-degree polynomials, it can be inverted to predict height given a diameter and integrated to estimate stem volume.

The Cao and others model consists of three submodels that join at two points. Each submodel has the form of a modified Goulding and Murray (1976) model. Cao's model can be inverted to predict height and integrated for volume.

Schlaegel's form-class model incorporates Girard's form class into a flexible profile model. Form class is included so that a single species equation can accurately describe trees in a range of geographic or physiographic areas. This model divides the stem into two segments: (1) the lower bole from stump to 17.3 feet, and (2) the upper bole from 17.3 feet to the tip of the tree. The two segment models are conditioned to join and be equal at a bole height of 17.3 feet, the Girard form class measurement point. Schlaegel's model is also conditioned to assure that estimated d.i.b. equals actual d.i.b. when height is 4.5 feet, that estimated d.i.b. equals actual d.i.b. at 17.3 feet, and that estimated diameter is zero when height equals total height.

[2/] Czaplewski, R.L.; Bechtold, W.A.; McClure, J.P. 1988. Quantification of bias in stem-profile models. USDA Forest Service, SEFES unpublished report. 8 pp.

Schlaegel's form-class profile model can be solved to estimate d.i.b. at any height or volume between any two heights. However, it cannot be solved directly to estimate height at a given diameter above 17.3 feet because the top equation does not have a unique solution. The measurements required to solve the form-class model for stem volume inside bark are d.i.b. at 4.5 feet, d.i.b. at 17.3 feet, and total height. Species bark-thickness equations are required for estimating d.i.b. at 4.5 and 17.3 feet from d.o.b.

Stem taper data collected at 4-foot intervals up the stems of approximately 100 sawtimber-size loblolly pine, yellow-poplar, and white oak trees were used to conduct benchmark tests. Each of the profile models tested was developed for each species. The profile models were evaluated to determine how well they:

1. estimated diameter at a given height,
2. estimated height to a given diameter, and
3. estimated volume between two given heights.

The form-class profile model predicted total stem volume and volume to given heights more accurately than the Max-Burkhart and Cao models because it accounted for differences in taper as measured by form class. The form-class model also performed better than the other models in its ability to estimate height to a given diameter up to 17.3 feet. However, it cannot be used to estimate height to a given diameter above 17.3 feet without interactive procedures. The Max-Burkhart model produced negative squared diameters above the 2-inch d.o.b. top for yellow-poplar and white oak, and Schlaegel's model exhibited some consistent biases in the stem below 4.5 feet.

Form-Class Segmented-Profile Model for Total Height

A segmented-profile model combining the better attributes of Schlaegel's form-class model and Max and Burkhart's segmented-profile model was developed using d.b.h., diameter at 17.3 feet, and total height as the independent variables. The form-class segmented-profile model divides the stem into four segments: (1) butt (groundline to 4.5 feet), (2) lower stem (4.5 to 17.3 feet), (3) middle stem (17.3 feet to 40 to 70 percent of total height), and (4) upper stem (40 to 70 percent of total height to tip of stem) (fig. 1). A Schlaegel-type equation is used to estimate diameter in the butt, and Schlaegel's form-class equation is used to estimate diameter in the lower stem. An equation of the Max-Burkhart type is used to estimate diameters in the middle and upper stem segments. The equation is quadratic for the lower segment and linear for the top segment. The segment equations are conditioned so that the joins between segments are continuous. The total height equation can be applied to trees having both d.b.h. $\geq$ 5.0 inches and total height $>$ 17.3 feet.

Listed below are definitions of basic symbols, indicator variables, and parameters used in the profile model for predicting diameter at a given height from d.b.h., diameter at 17.3 feet, and total height.

Basic Symbols

D = diameter at breast height (4.5 feet above ground) in inches
F = diameter at 17.3 feet above ground (Girard's form class height) in inches
H = total tree height in feet
d = diameter at a particular height, h, in inches
h = height above ground (associated with a particular diameter, d), in feet

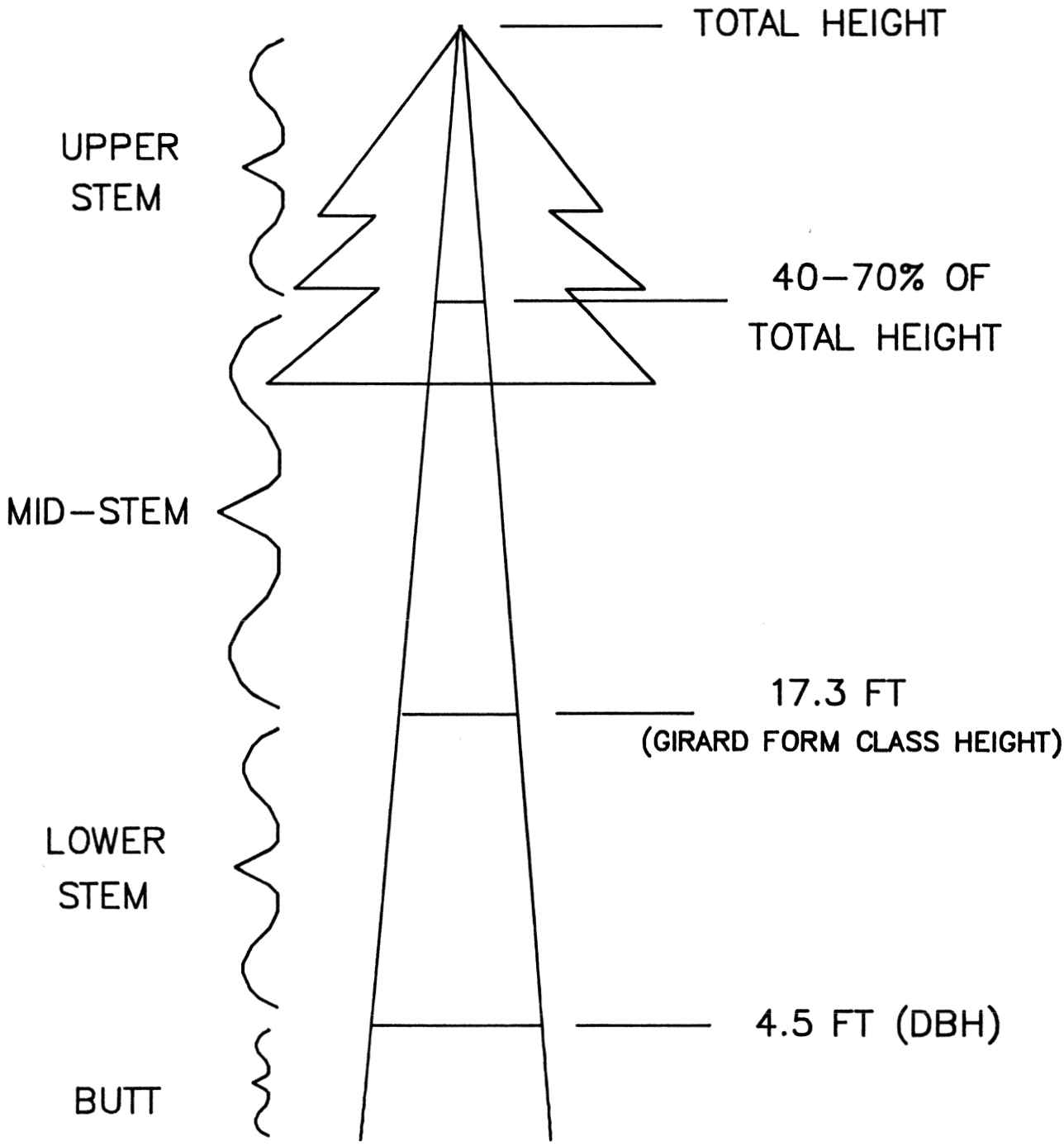

Figure 1.--Schematic showing stem segments of the form-class segmented-profile model.

Indicator Variables

I_S = 1 if $h < 4.5$

= 0 otherwise

I_B = 1 if $4.5 \leq h \leq 17.3$

= 0 otherwise

I_T = 1 if $h > 17.3$

= 0 otherwise

I_M = 1 if $h < (17.3 + a(H-17.3))$

= 0 otherwise

Parameters

r, c, e: regression coefficients for stem section below 4.5 feet

p: regression coefficients for stem section between 4.5 and 17.3 feet

a, b: regression coefficients for stem section above 17.3 feet

The equation for predicting stem diameter (d) at a given height (h) from d.b.h. and total height is:

$$d = [I_S\{D^2(1+(c+e/D^3)((1-h/H)^r-(1-4.5/H)^r)/(1-(1-4.5/H)^r))\} + I_B\{D^2-(D^2-F^2)((1-4.5/H)^p-(1-h/H)^p)/((1-4.5/H)^p-(1-17.3/H)^p)\} + I_T\{F^2(b(((h-17.3)/(H-17.3))-1)^2 + I_M((1-b)/a^2)(a-(h-17.3)/(H-17.3))^2)\}]^{0.5} \quad (1)$$

Under the assumption that h is a decreasing function of d^2, the definitions for the indicator variables for estimating height to a given diameter are as follows:

Indicator Variables

I_S = 1 if $d^2 \geq D^2$

= 0 otherwise

I_B = 1 if $D^2 > d^2 \geq F^2$

= 0 otherwise

I_T = 1 if $F^2 > d^2$

= 0 otherwise

I_M = 1 if $d^2 > b(a-1)^2 F^2$

= 0 otherwise

Combined Variables

$$G = (1-4.5/H)^{r}$$

$$W = (c+e/D^{3})/(1-G)$$

$$X = (1-4.5/H)^{p}$$

$$Y = (1-17.3/H)^{p}$$

$$Z = (D^{2}-F^{2})/(X-Y)$$

$$T = D^{2}-ZX$$

$$Q_a = b+I_M(1-b)/a^{2}$$

$$Q_b = -2b-I_M 2(1-b)/a$$

$$Q_c = b+(1-b)I_M-d^{2}/F^{2}$$

Height (h) at a given diameter (d) is estimated by:

$$h = I_S H\{1-((d^{2}/D^{2}-1)/W+G)^{1/r}\} + I_B H\{1-(X-(D^{2}-d^{2})/Z)^{1/p}\} + I_T\{17.3+(H-17.3)((-Q_b-(Q_b{}^{2}-4Q_aQ_c)^{0.5})/(2Q_a))\} \quad (2)$$

The form-class segmented-profile model based on d.b.h. and total height has been integrated to solve for the volume of the stem between any two heights. Listed below are additional basic symbols, combined variables, and indicator variables used in the volume equation:

Basic Symbols

V = stem volume between two heights, L and U, in cubic feet
L = lower height of interest in feet
U = upper height of interest in feet

Combined Variables

L_1 = maximum of L and 0

U_1 = minimum of U and 4.5

L_2 = maximum of L and 4.5

U_2 = minimum of U and 17.3

L_3 = maximum of L and 17.3

U_3 = minimum of U and H

Indicator Variables

$I_1 = 1$ if $L < 4.5$

$= 0$ otherwise

$I_2 = 1$ if $L < 17.3$

$= 0$ otherwise

$I_3 = 1$ if $U > 4.5$

$= 0$ otherwise

$I_4 = 1$ if $U > 17.3$

$= 0$ otherwise

$I_5 = 1$ if $(L_3-17.3) < a(H-17.3)$

$= 0$ otherwise

$I_6 = 1$ if $(U_3-17.3) < a(H-17.3)$

$= 0$ otherwise

Stem volume (V) between any two heights is predicted by:

$$V = 0.005454154[I_1 D^2\{(1-GW)(U_1-L_1)+W((1-L_1/H)^r(H-L_1) - (1-U_1/H)^r(H-U_1))/(r+1)\} + I_2I_3\{T(U_2-L_2)+Z((1-L_2/H)^p(H-L_2) - (1-U_2/H)^p(H-U_2))/(p+1)\} + I_4F^2\{b(U_3-L_3)-b((U_3-17.3)^2-(L_3-17.3)^2)/(H-17.3) + (b/3)((U_3-17.3)^3-(L_3-17.3)^3)/(H-17.3)^2 + I_5(1/3)((1-b)/a^2)(a(H-17.3)-(L_3-17.3))^3/(H-17.3)^2 - I_6(1/3)((1-b)/a^2)(a(H-17.3)-(U_3-17.3))^3/(H-17.3)^2\}] \quad (3)$$

Form-Class Segmented-Profile Model for Height to 4-, 7-, or 9-Inch D.O.B. Top

A profile model based on d.b.h. and height to 4-inch d.o.b. top was developed for each species. Also, a form-class segmented-profile model based on d.b.h. and height to 7-inch d.o.b. top was developed for each softwood species, and a model based on d.b.h. and height to 9-inch d.o.b. top was developed for each hardwood species.

The form-class segmented-profile models based on d.b.h. and height to a fixed d.o.b. top divide the stem into three segments: butt (groundline to 4.5 feet, lower stem (4.5 to 17.3 feet), and upper stem (17.3 feet to a fixed d.o.b. top). Schlaegel-type form-class equations are used to estimate diameter in the butt, lower stem, and upper stem. The segment equations are conditioned for smooth joins between segments.

The form-class segmented-profile model based on d.b.h. and height to a 4-inch top can be applied to all trees having both d.b.h. $\geq$ 5.0 inches and height to 4-inch top $>$ 17.3 feet. The softwood form-class model based on d.b.h. and height to 7-inch top is to be applied to trees with d.b.h. $\geq$ 9.0 inches and height to 7-inch top $>$ 17.3 feet. The hardwood form-class model based on d.b.h. and height to 9-inch top is to be applied to trees with d.b.h. $\geq$ 11.0 inches and height to 9-inch top $>$ 17.3 feet.

Listed below are definitions of basic symbols, indicator variables, and parameters used in the profile model for predicting diameter (d) at a given height (h) from d.b.h., diameter at 17.3 feet, and height to a fixed diameter top.

Basic Symbols

D = diameter at breast height (4.5 feet above ground) in inches

D_x = 4 inches if outside-bark prediction is based on height to 4-inch d.o.b. top or = d.i.b. at 4-inch d.o.b. top for inside-bark prediction
= 7 inches if outside-bark prediction is based on height to 7-inch d.o.b. top or = d.i.b. at 7-inch d.o.b. top for inside-bark prediction for softwood species
= 9 inches if outside-bark prediction is based on height to 9-inch d.o.b. top or = d.i.b. at 9 inches d.o.b. for inside-bark prediction for hardwoods

F = diameter at 17.3 feet above ground, in inches

H_x = tree height to a 4-inch or 7-inch d.o.b. top for softwoods, or height to a 9-inch d.o.b. top for hardwoods, in feet

d = diameter at a particular height, h, in inches

h = height above ground (associated with a particular diameter, d) in feet

Indicator Variables

I_S = 1 if $h < 4.5$
= 0 otherwise

I_B = 1 if $4.5 \leq h \leq 17.3$
= 0 otherwise

I_T = 1 if $h > 17.3$
= 0 otherwise

Parameters

r, c, e: regression coefficients for stem section below 4.5 feet

p: regression coefficients for stem section between 4.5 and 17.3 feet

q: regression coefficients for stem section above 17.3 feet

The equation for predicting stem diameter (d) at a given height (h) from d.b.h., diameter at 17.3 feet, and height to a fixed d.o.b. is:

$$d = [I_S\{D^2(1+(c+e/D^3)((1-h/H_x)^r-(1-4.5/H_x)^r)/(1-(1-4.5/H_x)^r))\} + I_B\{D^2-(D^2-F^2)((1-4.5/H_x)^p-(1-h/H_x)^p)/((1-4.5/H_x)^p-(1-17.3/H_x)^p)\} + I_T\{F^2-(F^2-D^2_x)(1-((H_x-h)/(H_x-17.3))^q)\}]^{0.5} \quad (4)$$

Below are listed the indicator variables and combined variables used in the equation for estimating height (h) to a given diameter (d).

Indicator Variables

$I_S = 1$ if $d^2 \geq D^2$

$= 0$ otherwise

$I_B = 1$ if $D^2 > d^2 \geq F^2$

$= 0$ otherwise

$I_T = 1$ if $F^2 > d^2$

$= 0$ otherwise

Combined Variables

$G = (1-4.5/H_x)^r$

$W = (c+e/D^3)/(1-G)$

$X = (1-4.5/H_x)^p$

$Y = (1-17.3/H_x)^p$

$Z = (D^2-F^2)/(X-Y)$

$T = D^2-ZX$

$J = (1-17.3/H_x)^q$

$R = (F^2-D_x^2)/J$

$N = F^2-RJ$

The equation for estimating height (h) at a given diameter (d) from d.b.h., diameter at 17.3 feet, and height to a fixed-d.o.b. top is:

$$h = I_S H_x\{1-((d^2/D^2-1)/W+G)^{1/r}\} + I_B H_x\{1-(X-(D^2-d^2)/Z)^{1/p}\} + I_T H_x\{1-(J-(F^2-d^2)/R)^{1/q}\} \quad (5)$$

The form-class segmented-profile model has been integrated to solve for volume of the stem between any two heights. Listed below are additional basic symbols, combined variables, and indicator variables used in the volume equation based on d.b.h., diameter at 17.3 feet, and height to a fixed-d.o.b. top:

Basic Symbols

V = stem volume between two heights, L and U, in cubic feet
L = lower height of interest in feet
U = upper height of interest in feet

Combined Variables

L_1 = maximum of L and 0

U_1 = minimum of U and 4.5

L_2 = maximum of L and 4.5

U_2 = minimum of U and 17.3

L_3 = maximum of L and 17.3

U_3 = minimum of U and H_x

Indicator Variables

I_1 = 1 if $L < 4.5$

= 0 otherwise

I_2 = 1 if $L < 17.3$

= 0 otherwise

I_3 = 1 if $U > 4.5$

= 0 otherwise

I_4 = 1 if $U > 17.3$

= 0 otherwise

The equation for predicting stem volume (V) between any two heights from d.b.h., diameter at 17.3 feet, and height to a fixed-d.o.b. top is:

$$V = 0.005454154[I_1 D^2\{(1-GW)(U_1-L_1)+W((1-L_1/H_x)^r(H_x-L_1) - (1-U_1/H_x)^r(H_x-U_1))/(r+1)\} + I_2I_3\{T(U_2-L_2)+Z((1-L_2/H_x)^p(H_x-L_2) - (1-U_2/H_x)^p(H_x-U_2))/(p+1)\} + I_4\{N(U_3-L_3)+R((1-L_3/H_x)^q(H_x-L_3) - (1-U_3/H_x)^q(H_x-U_3))/(q+1)\}] \quad (6)$$

When solving for a diameter inside bark (d), a height (h) to an inside-bark diameter (d), or a stem volume inside bark (V), use inside-bark values for D and F and inside-bark parameters in equations (1-6).

Linear equations for estimating d.i.b. at 4.5 feet from d.o.b. at 4.5 feet were developed for each species and species group. The equations have the form:

$$DIBD = a + b(D) \quad (7)$$

where

DIBD = d.i.b. at breast height (4.5 feet above ground), in inches
D = d.o.b. at breast height, in inches (d.b.h.)
a and b = regression coefficients

D.o.b. at 17.3 feet above ground can be estimated visually or measured using devices such as a pentaprism caliper. For each species and species group, linear equations were developed for estimating d.i.b. from d.o.b. at 17.3 feet. These equations have the form:

$$DIB17 = a + b(F) \quad (8)$$

where

DIB17 = d.i.b. at 17.3 feet above ground, in inches
F = d.o.b. at 17.3 feet above ground, in inches
a and b = regression coefficients

Equations for estimating d.i.b. or d.o.b. at 17.3 feet from d.b.h. and total height were developed for each species or species group for use when diameter at 17.3 feet is not measured. These equations have the forms:

$$DIB17 = D(a + b(17.3/H)^2) \quad (9)$$

where

DIB17 = d.i.b. at 17.3 feet in inches
H = tree total height in feet
D = d.b.h. in inches
a and b = regression coefficients

and

$$DOB17 = D(a + b(17.3/H)^2) \quad (10)$$

where

DOB17 = d.o.b. at 17.3 feet, in inches

Equations for estimating d.i.b. or d.o.b. at 17.3 feet from d.b.h. and height to 9-, 7-, or 4-inch d.o.b. top were also developed. These equations have the forms:

$$DIB17 = D(a + b(17.3/H_x)^2) \quad (11)$$

and

$$DOB17 = D(a + b(17.3/H_x)^2) \quad (12)$$

where

H_x = tree height to a 9-, 7-, or 4-inch d.o.b. top, in feet

a and b = regression coefficients

When inside-bark volume is to be calculated, d.i.b. at the fixed-d.o.b. top must be determined. Various models for estimating d.i.b. at the fixed d.o.b. were tested and accounted for only 5 to 17 percent of the variation in d.i.b. D.i.b. was therefore estimated as species average d.i.b. at 4- and 7-inch d.o.b. tops (softwoods) and 4- and 9-inch d.o.b. tops (hardwoods).

The model based on height to a 7- or 9-inch d.o.b. top cannot provide topwood volume estimates to a 4-inch top. Thus, the exponential ratio model shown below was developed to estimate a ratio for expanding stem volume to a 7- or 9-inch top to a 4-inch top.

$$Y_R = e^{(a(DFC)^b (H)^c)} \quad (13)$$

where: Y_R = stem volume to 4-inch top/stem volume to 7- or 9-inch top

D = d.b.h. in inches

FC = Girard Form Class--when form class is not measured, d.i.b. at 17.3 feet (F) estimated using equation 9 or 11 can be substituted for DFC in equation 13

H = tree height to a 7- or 9-inch d.o.b. top in feet

a,b,c = regression coefficients

e = base of natural logs = 2.71828

DATA

Stem taper measurements were collected on 13,469 trees of 48 species. Most of the trees measured were on National Forest lands. Contractors working for the Southern Region measured 11,472 trees, and the Utilization of Southern Timber Research Work Unit of the Southeastern Forest Experiment Station measured 1,997. All measured trees were growing in natural fully stocked stands.

Trees measured by contractors were felled, and their d.b.h. and total height were recorded. D.o.b. and bark thickness were measured at stump height and at 1-inch taper intervals from the stump to the tip of the tree. Diameters were measured with a diameter tape and recorded to the nearest 0.1 inch. At each measurement height, bark thickness was measured with a bark gauge at two points separated by 1/3 of the stem's circumference. The two readings were added and recorded as double bark thickness. Trees measured by research were felled also. Their diameters were measured at groundline, 1 and 2 feet, breast height, and at intervals of approximately 4 feet above breast height. Bark thickness was determined by examining cross-sectional disks cut from boles.

The tree data collected by contractors and research were merged and edited for bark thickness, butt flare, taper, and excessive reverse taper. Max-Burkhart d.o.b. and d.i.b. profile functions developed for each species and national forest were used in editing the data. When the distance between 1-inch taper points was ≥ 8 feet, d.i.b. and d.o.b. at 4-foot intervals between measurement points was estimated by interpolation based on the observed d.i.b. and d.o.b. and the appropriate Max-Burkhart profile coefficients. Inside- and outside-bark stem volumes of each tree were calculated for each measurement point by Smalian's formula. Table 1 summarizes measurement characteristics of trees sampled by species and species groups.

The Southern Region was divided into seven geographic areas based on physiographic region, species form and distribution, and Forest Service administrative units (fig. 2). The national forests on which trees were sampled are listed below:

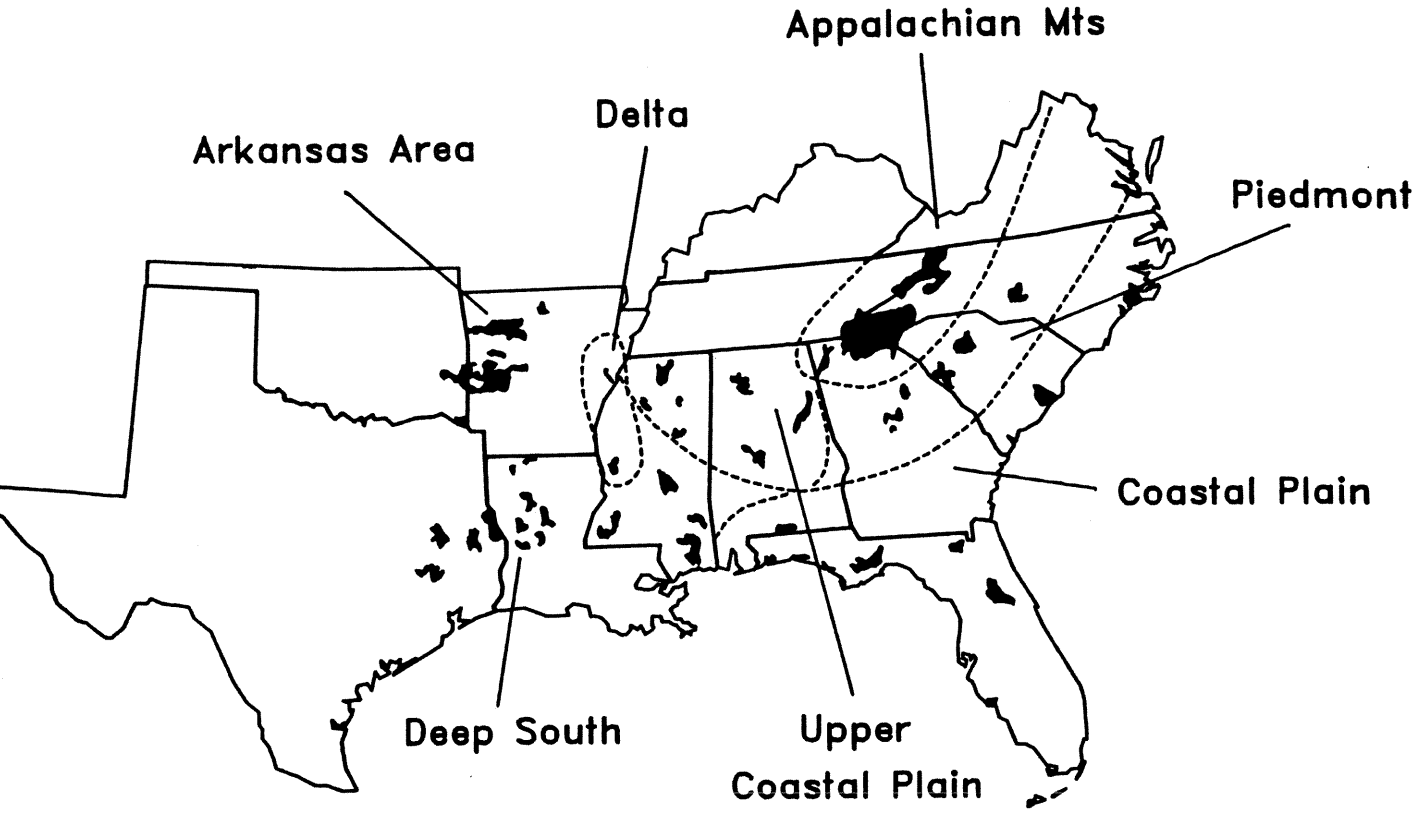

Figure 2.--Location of seven geographic areas and national forests on which trees were sampled for equation development and verification.

National forests in which trees were measured for development of subregional species equations

Gulf and Atlantic Coastal Plain	Piedmont	Appalachian Mountain	Upper Coastal Plain	Deep South	Arkansas Area	Delta Area
Croatan	Uwharrie	George Washington	Talladega	Desoto	Ozark	Delta
Francis Marion	Sumter*	Jefferson	Bankhead	Bienville	Ouachita	St. Francis
Osceola	Oconee	Cherokee	Holly Springs	Kisatchie		
Savannah River Plant		Pisgah	Tombigbee	Sabine		
Ocala		Nantahala	Tuskegee	Angelina		
Appalachicola		Chattahoochee		Davy Crockett		
Conecuh		Sumter**		Sam Houston		
				Homochitto		

*All districts except Andrew Pickens

**Andrew Pickens District

PROCEDURE

Form-class segmented-profile equations were developed for the 48 species and also for major species groups--all pines, major southern pines, other pines, all cypress, soft hardwoods, hard hardwoods, white oaks, red oaks, all oaks, and all hardwoods combined.

Taper data for each geographic area and species were divided into two data sets--a profile data set and a validation data set (Picard and Berk 1990). For species equation development, two of every three trees were selected at random from each 2-inch d.b.h. class for profile equation development and the third tree used for equation validation when 90 or more trees of the same species were measured within an equation area. For development of species-group equations, one-third of the trees were used for equation development and two-thirds used for validation. Coefficients for polynomial form-class segmented-profile equations were developed for each species and species group sampled in each of the seven subregions. The data from the geographic areas were pooled and Southwide equations were developed. For the Southwide equations, one-third of the trees were randomly selected for use in equation development and two-thirds for use in validation. Southwide coefficients and coefficients based on data from each area were used to calculate volumes of the same trees in each area, and the volume estimates obtained by the two methods were compared.

The accuracy of estimates obtained by applying the form-class segmented profile equations was compared to the accuracy of estimates obtained by the Max-Burkhart method of estimating stem volume inside bark to various heights. The form-class segmented-profile model and the Max-Burkhart model were evaluated using observed stem measurements. The Southwide form-class model was also evaluated using several procedures to simulate possible tree measurement practices. The Southwide form-class segmented-profile equations for loblolly pine and yellow-poplar (excurrent species) and white oak (deliquescent species) were used in the comparison. The Max-Burkhart equations were developed from the same profile data used to develop the form-class segmented-profile equations, and both models were applied to the same validation data.

RESULTS

Statistical analysis of the P coefficients for the major species showed that differences among subregional coefficients were significant at the 0.05 level. However, Southwide equations and equations developed for use in specific areas yielded very similar estimates of stemwood volume. The two types of equations were used to estimate volumes of loblolly pine, yellow-poplar, white oak, slash pine, shortleaf pine, sweetgum, hickory, southern red oak, and other species. The loblolly pine, yellow-poplar, and white oak estimates generated by the two methods are compared in table 2.

These comparisons indicate that a single form-class segmented-profile species equation based on data collected across the South can be used to estimate stem volume accurately anywhere in the region. The Southwide species equations yield accurate estimates because they account for location-to-location differences in stem form. Form-class segmented-profile equation coefficients based on d.b.h., diameter at 17.3 feet, and total height are listed in table 3 (d.i.b.) and in table 4 (d.o.b.). Tables 3 and 4 also show that the model used to estimate diameters in the butt of the stem below 4.5 feet accounted for over 90 percent of variation in stem diameter in all species except lowland blackgum, water tupelo, and pond cypress. Schlaegel's (1983) form-class taper model accounted for 97 to 99 percent of the variation in diameter of the lower stem (4.5 to 17.3 feet). The Max-Burkhart-type model accounted for 93 to 99 percent of the variation in stem diameter at heights above 17.3 feet.

Form-class segmented-profile equation coefficients based on d.b.h. and height to 4-inch d.o.b. top are listed in table 5 (inside bark estimates) and in table 6 (outside bark estimates). Form-class segmented-profile equation coefficients based on d.b.h. and height to 7-inch d.o.b. top (softwoods) and d.b.h. and height to 9-inch d.o.b. top (hardwoods) are listed in table 7 (inside bark estimates) and in table 8 (outside bark estimates).

To illustrate the flexibility of the form-class segmented-profile model, the estimated d.i.b. profiles of northern red oak, water tupelo, yellow-poplar, loblolly pine, and bald cypress trees of the same d.b.h., diameter at 17.3 feet, and total height are plotted in figure 3. The three-coefficient segmented-profile model used to estimate stem profile from groundline to 4.5 feet is flexible and allows each species equation to estimate butt profile characteristics of the species.

To use the form-class segmented-profile models (1-6) to estimate inside-bark diameter, volume, or height, d.i.b. at breast height and 17.3 feet are required. Regression coefficients for estimating d.i.b. at 4.5 feet using equation (7) and d.b.h. as the independent variable are presented in table 9. Table 10 gives regression coefficients for estimating d.i.b. at 17.3 feet using equation (8) and d.o.b. at 17.3 feet as the independent variable. Tables 9 and 10 also give the standard error of estimate, coefficient of determination, and coefficient of variation for each equation. The equations in tables 9 and 10 do a good job of predicting d.i.b. from d.o.b., accounting for 97 to 99 percent of the variation in d.i.b.

Southwide species regression coefficients for estimating d.i.b. at 17.3 feet using equation (9) and d.b.h. and total height as the independent variables are listed in table 11. Also included in table 11 are species regression coefficients based on trees sampled in each geographic area. For general volume estimates the Southwide coefficients will provide good estimates. However, for accurate local estimates the regional coefficients should be used to account for geographic variation in stem form when diameter at 17.3 feet or form class is not measured.

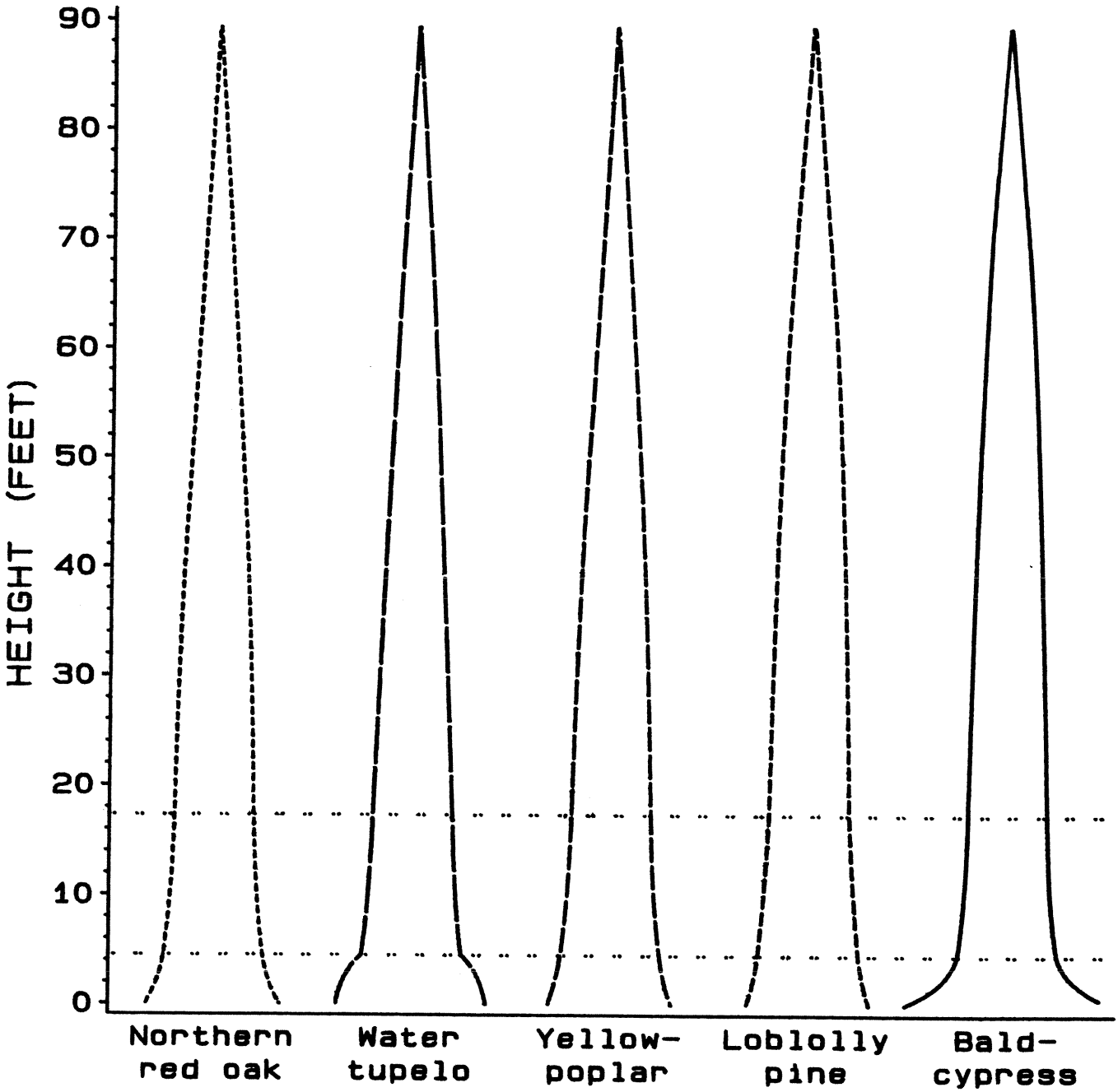

Figure 3.--Comparison of species stem profiles estimated with the form-class segmented-profile equation for trees of identical d.b.h., diameter at 17.3 feet, and total height.

Table 12 gives species coefficients for estimating d.o.b. at 17.3 feet using d.b.h. and total height as independent variables for all trees sampled and trees sampled within each geographic area.

Tables 13 and 14 list species coefficients for estimating d.i.b. and d.o.b. at 17.3 feet from d.b.h. and height to 4-inch d.o.b. top. Tables 15 and 16 give species coefficients for estimating d.i.b. and d.o.b. at 17.3 feet from d.b.h. and height to 7-inch d.o.b. top (softwoods) and d.b.h. and height to 9-inch d.o.b. top (hardwoods). Tables 13-16 list species coefficients for all trees sampled across the South and for species sampled within each subregion.

To use the form-class segmented-profile model based on height to a 4-, 7-, or 9-inch d.o.b. top to estimate inside-bark volume, one must know d.i.b. at a 4-, 7-, or 9-inch top. Average d.i.b. at 4.0- and 7.0-inch d.o.b. tops (softwoods) and at 4.0- and 9.0-inch d.o.b. tops (hardwoods) is shown in table 17.

Table 18 gives regression coefficients for estimating topwood ratios using equation (13). These topwood ratios are used to expand estimated stem volume to a 7- or 9-inch top to stem volume to a 4-inch top. Regression coefficients are presented for expanding stem volume inside and outside bark.

The Southwide species coefficients for estimating stem volume inside bark based on d.b.h. and total height were applied to the loblolly pine, yellow-poplar, and white oak validation data. For comparison purposes, Max-Burkhart equations were developed from the same profile data and applied to the same validation data. The Max-Burkhart model fit the loblolly pine data well but did not accurately predict upper-stem diameter of white oak or yellow-poplar. The Max-Burkhart equation predicted negative diameters above 88 percent of total height for white oak and above 92 percent of total height for yellow-poplar.

When observed tree measurements are used to predict stem volume to a 4-inch top, both profile models do a good job (table 19). However, the form-class segmented-profile model is more accurate. For example, the form-class segmented-profile model predicted volume to 4-inch tops to within 3.7 to 4.1 percent of observed values, while the Max-Burkhart model predicted these volumes to within 6.9 to 7.7 percent of observed values. The form-class segmented-profile model is more accurate because it can account for differences in stem form when diameter at 17.3 feet is measured. The two models estimate volumes at heights above 17.3 feet equally well, but the form-class segmented-profile model gives better estimates of volume in the first log, the most valuable portion of the tree.

It is difficult to measure diameter at 17.3 feet, the additional measurement required to solve the form-class segmented-profile model, on standing trees. The effects of estimating inside-bark diameters on the accuracy of the form-class segmented-profile model are summarized in table 19 for five simulated field measurement procedures and the loblolly pine, yellow-poplar, and white oak validation data. The procedures simulated were:

1. D.o.b. at 4.5 feet and 17.3 feet is observed, and d.i.b. at 4.5 feet and 17.3 feet is estimated using equations (7) and (8).
2. D.b.h. is observed, and d.i.b. at 4.5 feet is estimated using equation (7). D.o.b. at 17.3 feet is measured to within a constant bias of $\pm$ 0.2 inches, and d.i.b. at 17.3 feet is estimated using equation (8).
3. D.i.b. at 4.5 feet is estimated from observed d.b.h. using equation (7), and Girard's form class is estimated to within a constant bias of $\pm$ 2 units. The estimated form class is used to calculate d.i.b. at 17.3 feet.

4. D.i.b. at 4.5 feet is estimated from observed d.b.h. using equation (7) and d.i.b. at 17.3 feet is estimated using equation (9), d.b.h., and total height.
5. D.i.b. at 4.5 feet is estimated from observed d.b.h. using equation (7), and an average form class is used for pole timber and an average used for sawtimber.

The results, which are given in table 19, show that the form-class segmented-profile model yields accurate volume estimates under each of these data-collection regimes. The most accurate estimates are obtained when d.b.h. and d.o.b. at 17.3 feet are observed and d.i.b. is estimated using the appropriate equations. If d.o.b. at 17.3 feet is measured to within $\pm$ 0.2 inches or form class estimated within $\pm$ 2 units, estimates of stem volume are more accurate than those obtained by using the Max-Burkhart model. When d.i.b. at 17.3 feet is estimated based on d.b.h. and total height, the form-class segmented-profile model is slightly more accurate than the Max-Burkhart model.

The bias of the form-class segmented-profile equation was also examined for the loblolly pine, yellow-poplar, and white oak validation data. Biases in predicted stem volume to a 4-inch top when diameter at 17.3 feet is measured, when diameter at 17.3 feet is estimated from d.b.h. and total height, and when volume is estimated using the Max-Burkhart model are shown in figure 4. The form-class segmented-profile model has less bias associated with it than the Max-Burkhart model for loblolly pine or yellow-poplar and about as much bias as the Max-Burkhart model for white oak. Because the bias of the form-class segmented-profile model was less than 3 percent for any diameter class when diameter at 17.3 feet was measured and because bias was not consistent from species to species, no correction for bias was made. When diameter at 17.3 feet is not measured, equations (9-12) do a good job estimating diameter at 17.3 feet for sawtimber-size trees. Caution should be used when applying equations (9-12) to short poletimber trees because some bias may occur in estimating diameter at 17.3 feet. Equations (9-12) should not be used indiscriminately across tree sizes without testing.

When using the form-class segmented-profile model to estimate volume, timber cruisers can measure total height, height to a 4-inch d.o.b. top, or height to a 9-inch d.o.b. top for hardwoods or height to a 7-inch d.o.b. top for softwoods. The accuracy of stemwood volume estimates to merchantable sawlog tops and 4-inch d.o.b. tops is shown in table 20. Table 20 compares the accuracy of volume predictions based on observed and predicted d.i.b. at 4.5 and 17.3 feet for the loblolly pine, yellow-poplar, and white oak validation data. The independent variables measured for the d.b.h. and total height model include d.b.h., height to a sawlog merchantable top, and total height. Height to a 4-inch d.o.b. top was estimated using equation (2). The independent variables measured for the d.b.h. and height to 4-inch top equation include d.b.h., sawlog merchantable height, and height to a 4-inch d.o.b. top. The independent variables measured for the d.b.h. and height to a 9- or 7-inch d.o.b. top equation include d.b.h., sawlog merchantable height, and height to a 9- or 7-inch d.o.b. top. Topwood ratio equation (13) was used to expand volume to a 9- or 7-inch top to volume to a 4-inch top.

Estimating stem d.i.b. by means of equations (9) and (11) rather than measuring it reduces the accuracy of volume estimates by 2 to 4 percent. Differences in accuracy obtained by measuring total height, height to a 4-inch top, and height to a 9- or 7-inch top were less than 1 percent when stemwood volume to a sawlog merchantable top was estimated. For loblolly pine and yellow-poplar, estimates of volume to a 4-inch d.o.b. top obtained by using height to a 9- or 7-inch d.o.b. top and the topwood ratio equation (13) were the most accurate ones. These estimates were only slightly less accurate than estimates of white oak volume to a 4-inch d.o.b. top where height to the 4-inch top was measured.

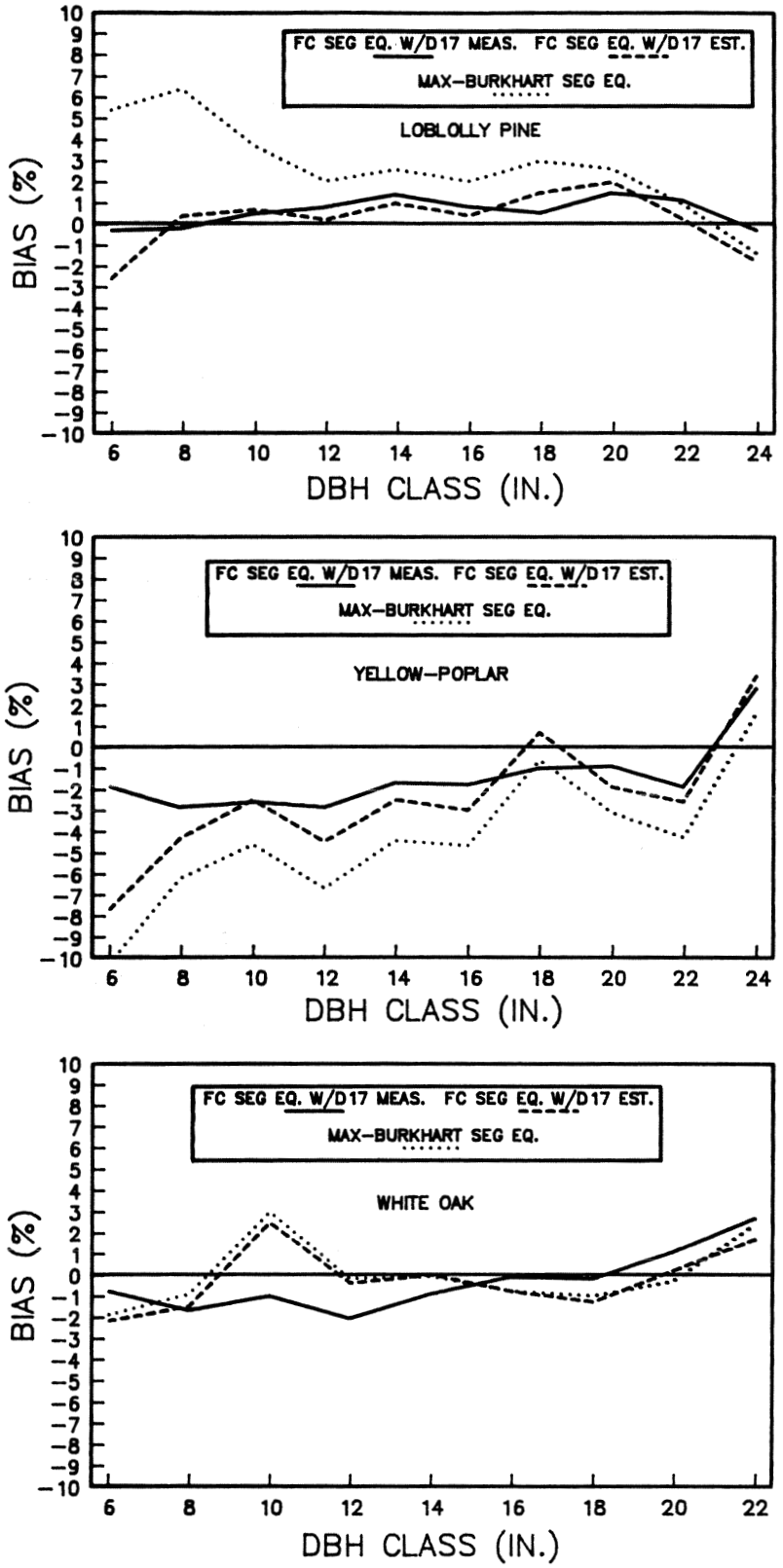

Figure 4.--Bias in estimated stem volume to a 4-inch top for pine, yellow-poplar, and white oak. Volume is estimated by means of (1) the form-class segmented-profile model when diameter at 17.3 feet is measured, (2) the form-class segmented-profile model when diameter at 17.3 feet is estimated from d.b.h. and total height, and (3) the Max-Burkhart equations.

SUMMARY

The USDA Forest Service collected felled-tree taper measurements on over 13,000 trees from natural fully stocked stands across the South. Stem-profile equations that are flexible, accurate, and easy to use with computers were developed from the data collected. The better attributes of Schlaegel's (1983) form-class model and the Max-Burkhart segmented-profile model (1976) were combined in form-class segmented-profile models in which d.b.h., diameter at 17.3 feet, and total height were independent variables.

Form-class segmented-profile equations in which d.b.h. and height to a 9-, 7-, or 4-inch d.o.b. top were predictors were developed. The profile equations based on d.b.h. and height to 4-inch top can be applied to any tree that is $\geq$ 5 inches d.b.h. and has a height to 4-inch d.o.b. top > 17.3 feet. The profile equations based on d.b.h. and height to a 7-inch d.o.b. top were developed for softwoods that are $\geq$ 9.0 inches d.b.h. and have a height to 7-inch d.o.b. top > 17.3 feet. The profile equations based on d.b.h. and height to a 9-inch d.o.b. top were developed for hardwoods that have d.b.h. $\geq$ 11.0 inches and have a height to 9-inch d.o.b. top > 17.3 feet.

The form-class segmented-profile equations predict diameter at any given height, height to a given diameter, or volume between any two heights. A single Southwide equation for each species was acceptable since the profile equation accounts not only for differences in d.b.h. and height but also for differences in stem form as measured by diameter at 17.3 feet.

Southwide inside- and outside-bark form-class segmented-profile coefficients are presented for 58 southern tree species and species groups. Southwide equations for estimating d.i.b. from d.o.b. at 4.5 and 17.3 feet are also listed for each species and species group. Southwide and local regression coefficients for estimating d.i.b. and d.o.b. at 17.3 feet using d.b.h. and total height or height to 4-, 7-, or 9-inch d.o.b. top as independent variables are also presented for each species. Topwood-ratio equations for expanding volume estimates to a 9- or 7-inch top to a 4-inch d.o.b. top are also presented for each species and species group.

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APPENDIX 1--How to use form-class segmented-profile equations (1), (2), and (3)

The following examples show how to use equations (1), (2), and (3) to estimate diameter at a given height, height to a given diameter, and inside-bark volume between two given heights when d.b.h. and total height are known.

Assume that the following measurements are recorded for a loblolly pine sawtimber tree growing in the Deep South subregion:

D = 16.0 inches (d.b.h.)
H = 90 feet (total tree height)

Estimating diameter (d) at a given height (h) using equation (1)

If we want to estimate d inside bark at a height of 50 feet, we first estimate d.i.b. at breast height using equation (7) and coefficients for loblolly pine from table 9.

$$\begin{aligned} DIBD &= a + b(D) \\ &= -0.48140 + 0.91413(16) \\ &= 14.1 \text{ inches} \end{aligned} \qquad (7)$$

Next, we estimate diameter, F, inside bark at 17.3 feet using equation (9) and coefficients for loblolly pine in the Deep South subregion from table 11.

$$\begin{aligned} F &= DIB17 \\ &= D(a + b(17.3/H)^2) \\ &= 16.0(0.87759 + (-1.50283)(17.3/90)^2) \\ &= 13.2 \text{ inches} \end{aligned} \qquad (9)$$

To estimate d inside bark at 50 feet for our sample tree we use equation (1). Since we are solving for diameter inside bark all diameters in equation (1) are inside bark. Thus, the basic symbols are defined as follows:

D = DIBD = 14.1 inches
F = DIB17 = 13.2 inches
H = 90 feet
h = 50 feet
d = estimated d.i.b. at 50 feet

To solve equation (1), first calculate the values of indicator variables based on h = 50 as follows:

I_S = 1 if $h < 4.5$
= 0 otherwise, thus $I_S = 0$

I_B = 1 if $4.5 \leq h \leq 17.3$
= 0 otherwise, thus $I_B = 0$

I_T = 1 if $h > 17.3$
= 0 otherwise, thus $I_T = 1$

I_M = 1 if $h < (17.3 + a(H-17.3))$
= 0 otherwise, thus $I_M = 1$

where a = 0.68464, from table 3 (loblolly pine).

Calculate diameter, d, at 50 feet using equation (1) and the following loblolly pine coefficients from table 3:

r = 31.66250; c = 0.57402; e = 110.96000; p = 8.573; b = 2.36238; a = 0.68464

The estimated diameter, d, inside bark at 50 feet is 9.83 inches.

Estimating height h to a given diameter d using equation (2)

If we want to estimate the height to an inside-bark diameter of 9.83 inches for the above loblolly pine tree, we use the inside-bark values calculated for D and F in the previous example. To solve equation (2), we first determine the values of the indicator variables based on d = 9.83, D = 14.1, and F = 13.2:

I_S = 1 if $d^2 \geq D^2$
= 0 otherwise, thus $I_S = 0$

I_B = 1 if $D^2 > d^2 \geq F^2$
= 0 otherwise, thus $I_B = 0$

I_T = 1 if $F^2 > d^2$
= 0 otherwise, thus $I_T = 1$

I_M = 1 if $d^2 > b(a-1)^2 F^2$
= 0 otherwise, thus $I_M = 1$

where b = 2.36232 and a = 0.68464 (table 3).

Next, we calculate the values of the combined variables G, W, X, Y, Z, T, Q_a, Q_b, and Q_c as defined in the text using the following coefficients from table 3:

r = 31.66250; c = 0.57402; e = 110.96000; p = 8.573; b = 2.36238; a = 0.68464

Thus, G = 0.19709, W = 0.76423, X = 0.64421, Y = 0.16040, Z = 50.78513, T = 166.09391, Q_a = -0.54414, Q_b = -0.74582 and Q_c = 0.44543.

We substitute the appropriate values into equation (2) and calculate h at 9.83 inches d.i.b. The height at which d.i.b. is 9.83 inches is estimated to be 50.0 feet.

Estimating volume between two heights using equation (3) when d.b.h. and total height are known

Assume that we want to estimate stem volume inside bark from a 1-foot stump to a height of 50.0 feet for the loblolly pine described above. The basic symbols for equation (3) are thus defined as follows:

L = 1.0, lower height of interest in feet
U = 50.0, upper height of interest in feet
V = stem volume between L and U in cubic feet

Because we want volume inside bark, we use the inside-bark diameters for D and F already estimated using equations (7) and (11). To solve equation (3) we first calculate the L and U combined variables:

L_1 = maximum of L and 0, thus L_1 = 1.0

U_1 = minimum of U and 4.5, thus U_1 = 4.5

L_2 = maximum of L and 4.5, thus L_2 = 4.5

U_2 = minimum of U and 17.3, thus U_2 = 17.3

L_3 = maximum of L and 17.3, thus L_3 = 17.3

U_3 = minimum of U and H, thus U_3 = 50.0

Next, we find the values of the indicator variables:

I_1 = 1 if L < 4.5
= 0 otherwise, thus I_1 = 1

I_2 = 1 if L < 17.3
= 0 otherwise, thus I_2 = 1

I_3 = 1 if U > 4.5
= 0 otherwise, thus I_3 = 1

I_4 = 1 if U > 17.3
= 0 otherwise, thus I_4 = 1

I_5 = 1 if (L-17.3) < a(H-17.3)
= 0 otherwise, thus I_5 = 1

I_6 = 1 if (U-17.3) < a(H-17.3)
= 0 otherwise, thus I_6 = 1

We must also calculate G, W, Z, and T, which we defined when we discussed equation (2). From table 3, r = 31.66250, c = 0.57402, e = 110.96000, b = 2.36238, and a = 0.68464. Thus, G = 0.19709, W = 0.76423, Z = 50.78513, and T = 166.09391. Finally, the appropriate values are substituted into equation (3) and the estimated volume V of stemwood is calculated. In this instance, V is 41.96 cubic feet.

APPENDIX 2--How to use form-class segmented-profile equations (4), (5), and (6)

Three of the examples that follow show how to use equations (4), (5), and (6) to estimate diameter at a given height, height to a given diameter, and inside-bark volume between two given heights when d.b.h. and height to a given d.o.b. are known. A fourth example shows how to expand estimated volume to volume to a 4-inch top using equation (13).

Assume that the following measurements are recorded for a loblolly pine sawtimber tree growing in the Coastal Plain subregion:

D = 18.0 inches (d.b.h.)
H_x = 60 feet (height to a 7.0-inch d.o.b. top)

MHT = 49.9 feet (merchantable height, three 16.3-foot sawlogs plus 1.0-foot stump)

Estimating diameter (d) at a given height (h) using equation (4)

Assume that we are to estimate d inside bark at a height of 49.9 feet. We first estimate d.i.b. at breast height using equation (7) and coefficients for loblolly pine from table 9.

$$DIBD = a + b(D) \qquad (7)$$
$$= -0.48140 + 0.91413(18.0)$$
$$= 15.97 \text{ inches}$$

Next, we must estimate diameter, F, inside bark at 17.3 feet using equation (11) and coefficients for loblolly pine in the Coastal Plain subregion from table 15.

$$F = DIB17$$
$$= D(a + b(17.3/H_x)^2) \qquad (11)$$
$$= 18.0(0.81309 + (-0.20403)(17.3/60)^2)$$
$$= 14.3 \text{ inches}$$

To estimate d inside bark at 49.9 feet we use equation (4). Since we are solving for diameter inside bark all diameters in equation (4) are inside bark. Thus, the basic symbols are defined as follows:

D = DIBD = 15.97 inches
F = DIB17 = 14.3 inches
H_x = 60.0 feet (height to a 7.0-inch d.o.b. top)

D_x = 6.4 inches (d.i.b. at a d.o.b. of 7.0 inches for loblolly pine, from table 17)
h = 49.9 feet
d = estimated d.i.b at 49.9 feet

To solve equation (4), we first calculate the values of the indicator variables based on h = 49.9 feet as follows:

$I_S = 1$ if $h < 4.5$
$= 0$ otherwise, thus $I_S = 0$

$I_B = 1$ if $4.5 \leq h \leq 17.3$
$= 0$ otherwise, thus $I_B = 0$

$I_T = 1$ if $h > 17.3$
$= 0$ otherwise, thus $I_T = 1$

Next, calculate the diameter, d, at 49.9 feet using equation (4) and the following loblolly pine coefficients from table 7:

r = 15.88358, c = 0.51074, e = 222.76000, p = 5.56549, q = 0.78687

The estimated inside-bark diameter at 49.9 feet is 9.67 inches.

Estimating height (h) to a given diameter (d) using equation (5)

Suppose that we are to estimate the height to the point where the above loblolly pine's d.i.b. is 9.67 inches. Since we want height to an inside-bark diameter we use the values of D and F calculated in the previous example. To solve equation (5), we first determine the values of the indicator variables when d = 9.67, D = 15.97 and F = 14.3:

$I_S = 1$ if $d^2 \geq D^2$
$= 0$ otherwise, thus $I_S = 0$

$I_B = 1$ if $D^2 > d^2 \geq F^2$
$= 0$ otherwise, thus $I_B = 0$

$I_T = 1$ if $F^2 > d^2$
$= 0$ otherwise, thus $I_T = 1$

Next, we calculate the values of the combined variables G, W, X, Y, Z, T, J, R, and N as defined in the text using the following coefficients from table 7:

r = 15.88358; c = 0.51074; e = 222.76000; p = 5.56549; q = 0.78687

Thus, G = 0.28987, W = 079623, X = 0.64798, Y = 0.15061, Z = 101.63661, T = 189.18241, J = 0.76517, R = 213.71582, and N = 40.96.

Finally, substitute the appropriate values into equation (5) and calculate h. In this instance, h is 49.9 feet.

Estimating volume between two heights using equation (6) when d.b.h. and height to a 4.0-, 7.0- or 9.0-inch d.o.b. top are known

Assume that we want to calculate stem volume d.i.b. from a 1-foot stump to a height of 49.9 feet for the loblolly pine tree described above. The basic symbols for equation (6) are defined as follows:

L= 1.0, lower height of interest in feet
U= 49.9, upper height of interest
V= estimated stem volume between L and U in cubic feet

Because we want volume inside bark, we use the inside-bark values of D and F already estimated using equations (7) and (11) and the inside-bark value for D_x from table 17. Values of these variables are:

D = 15.97, d.i.b. at breast height in inches
H_x = 60.0, height to a 7.0-inch d.o.b. top in feet
D_x = 6.4, d.i.b. at the 7.0-inch d.o.b. top in feet
F = 14.3, d.i.b. at 17.3 feet in inches

To solve equation (6) we first calculate the combined L and U variables:

L_1 = maximum of L and 0, thus L_1 = 1

U_1 = minimum of U and 4.5, thus U_1 = 4.5

L_2 = maximum of L and 4.5, thus L_2 = 4.5

U_2 = minimum of U and 17.3, thus U_2 = 17.3

L_3 = maximum of L and 17.3, thus L_3 = 17.3

U_3 = minimum of U and H, thus U_3 = 49.9

Next, we find the values of the indicator variables:

I_1 = 1 if L < 4.5
= 0 otherwise, thus I_1 = 1

I_2 = 1 if L < 17.3
= 0 otherwise, thus I_2 = 1

I_3 = 1 if U > 4.5
= 0 otherwise, thus I_3 = 1

I_4 = 1 if U > 17.3
= 0 otherwise, thus I_4 = 1

We must also calculate G, W, Z, T, R, and N, which we defined when we discussed equation (5). From table 7, r = 15.88358, C = 0.51074, e = 222.760, p = 5.56549, and q = 0.78687. Thus, G = 0.28987, W = 0.79623, Z = 101.63661, T = 189.18241, R = 213.71582, and N = 40.96000. Finally, the appropriate values are substituted into equation (6) and V, the volume of stemwood, is calculated. In this instance, V is 48.33 cubic feet.

Expanding volume to 7.0-inch d.o.b. top to volume to 4.0-inch top

The form-class segmented-profile equation (6) for height to a 7- or 9-inch d.o.b. top cannot provide topwood volume estimates above the 7- or 9-inch top. Thus, ratio equation (13) was developed for expanding estimated volumes to a 4-inch d.o.b. top.

Suppose that we want to estimate the volume of wood between 1.0 foot and a 4.0-inch d.o.b. top for a loblolly pine with d.b.h. = 18.0 inches, H_x = 60, and F = 14.3. First we calculate the volume to a 7-inch d.o.b. top using equation (6) as in the preceding example. We find that the inside-bark volume, V_7, of the stem from 1.0 to 60.0 feet is 52.207 cubic feet. Next, we calculate Y_R, the ratio for expanding volume to a 4-inch top, using equation (13) and the coefficients for loblolly pine (inside bark) from table 18:

$$Y_R = e^{a(DFC)^b(H_x)^c}$$

where F is substituted for DFC since form class was not measured.

$$Y_R = 2.71828^{1253.23(14.3^{-4.39794})(60.0^{0.09080})}$$

$$= 1.0151$$

Volume to a 4-inch d.o.b. top, V_4, is then estimated as:

$$V_4 = VY_R$$

$$= (52.207)(1.0151)$$

$$= 53.00 \text{ cubic feet to 4-inch d.o.b. top}$$

Table 1.--Trees measured for development of stem-profile equations by species and tree size class

Species or species group	Pole timber									Sawtimber								
	Sample trees	D.b.h.		Total height		Form class		Stemwood volume		Sample trees	D.b.h.		Total height		Form class		Stemwood volume	
		Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range		Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range
	Number	Inches		Feet				Cubic feet		Number	Inches		Feet				Cubic feet	
All pines combined	1,030	7.2	5.0- 8.9	56	32- 89	74	41-90	6.3	1.3-17.1	5,066	14.3	9.0-30.6	74	32-150	79	51-93	37.1	5.5-280
Shortleaf pine	222	7.1	5.0- 8.9	56	33- 80	75	56-88	6.3	1.9-13.8	1,353	14.6	9.0-24.2	74	44-111	81	62-91	40.4	8.5-144
Slash pine	127	7.1	5.0- 8.9	57	40- 78	70	54-81	5.8	1.9-11.8	487	13.3	9.0-21.4	75	49-102	78	61-91	29.7	7.9- 95
Longleaf pine	238	7.2	5.0- 8.9	57	33- 81	74	51-86	6.3	1.6-13.9	1,009	13.5	9.0-22.2	70	32- 99	79	61-89	29.5	5.5- 97
Loblolly pine	252	7.2	5.0- 8.9	57	32- 80	72	41-88	6.3	1.3-14.8	1,444	15.2	9.0-29.5	78	45-132	79	51-93	43.6	7.1-245
All major pines combined	839	7.1	5.0- 8.9	56	32- 81	73	41-88	6.2	1.3-14.8	4,293	14.4	9.0-29.5	75	32-132	79	51-93	37.7	5.5-245
Sand pine	44	7.1	5.0- 8.9	54	40- 74	79	65-90	6.7	2.1-14.0	46	11.1	9.0-14.5	59	36- 74	79	62-89	17.4	7.6- 35
Spruce pine	10	7.2	5.1- 8.9	60	51- 73	79	71-89	7.5	3.2-13.9	50	14.4	9.9-22.2	81	62- 99	83	74-89	40.7	13.8-103
Table Mountain pine	0									9	14.2	12.2-16.8	58	45- 69	75	62-83	24.2	12.3 -43
Pitch pine	20	7.1	5.0- 8.7	57	33- 75	69	54-77	5.6	1.4-11.1	96	14.6	9.0-22.2	70	48- 91	77	68-85	35.0	8.6- 85
Pond pine	24	7.5	5.4- 8.8	45	36- 56	69	57-79	5.2	2.5- 9.6	95	12.6	9.0-21.2	60	40- 81	75	63-85	21.3	7.0- 67
White pine	29	7.0	5.1- 8.8	57	37- 76	78	68-85	6.4	2.5-11.5	196	16.5	9.1-30.6	87	51-150	79	69-89	52.7	9.9-280
Virginia pine	64	7.3	5.1- 8.9	59	35- 89	80	68-90	7.8	2.2-17.1	281	12.5	9.0-21.1	71	44-100	81	70-92	26.6	8.6- 76
All other pines combined	191	7.2	5.0- 8.9	55	33- 89	77	54-90	6.8	1.4-17.1	773	13.8	9.0-30.6	73	36-150	79	62-92	33.9	7.0-280
All cypress combined	12	8.1	7.6- 8.7	59	48- 75	65	53-77	7.4	5.1-12.4	101	13.7	9.1-22.9	79	45-106	73	54-86	33.2	7.3-104
Baldcypress	3	8.2	7.8- 8.6	63	55- 75	72	68-77	9.3	6.8-12.4	43	14.8	9.1-21.5	88	68-106	79	57-86	45.1	13.7-104
Pondcypress	9	8.1	7.6- 8.7	58	48- 71	63	53-73	6.8	5.1- 9.1	58	12.9	9.1-22.9	71	45- 91	69	54-85	24.4	7.3-102
Hemlock	35	7.4	5.8- 8.8	56	36- 91	75	64-86	6.6	2.9-13.7	126	16.6	9.1-30.4	86	45-135	79	64-87	53.0	7.5-244
All soft hardwoods combined	764	8.1	5.0-10.9	64	34-103	73	46-88	9.0	2.0-26.5	1,770	16.2	11.0-32.0	88	39-135	78	50-92	47.9	8.3-244
Cherry	9	8.0	5.2-10.9	64	41- 83	77	63-83	9.6	2.5-17.8	8	13.7	11.8-17.1	85	66- 97	82	79-86	34.3	20.3- 49
Red maple	89	8.3	5.0-10.9	66	45- 90	78	60-88	10.1	2.5-21.1	101	15.8	11.0-24.4	81	62-103	80	59-90	40.6	12.7-108
Buckeye	21	8.8	6.2-10.9	61	39- 79	75	56-86	10.2	3.8-19.8	50	16.1	11.3-23.5	80	61-109	80	61-89	43.9	17.4-105

Continued

Table 1.--Trees measured for development of stem-profile equations by species and tree size class--Continued

Species or species group	Pole timber									Sawtimber								
	Sample trees	D.b.h.		Total height		Form class		Stemwood volume		Sample trees	D.b.h.		Total height		Form class		Stemwood volume	
		Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range		Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range
	Number	Inches		Feet				Cubic feet		Number	Inches		Feet				Cubic feet	
Hackberry	15	8.8	7.1-10.6	60	49- 79	72	55-80	8.8	4.9-12.5	88	17.7	11.0-29.0	79	53-106	78	60-88	49.3	14.5-141
Sweetgum	217	7.8	5.0-10.9	64	38-103	70	52-86	8.2	2.1-23.9	411	16.5	11.0-32.0	95	55-128	78	64-91	54.6	14.4-244
Yellow-poplar	98	8.4	5.2-10.9	69	42- 93	76	67-86	10.1	2.4-20.8	399	16.7	11.0-31.3	97	62-135	80	68-91	54.9	15.7-182
Sweetbay	47	8.4	5.5-10.9	62	43- 81	73	61-86	9.2	2.8-20.5	46	14.6	11.1-20.3	74	53- 90	73	60-81	29.5	14.9- 58
Water tupelo	56	7.2	5.1-10.0	58	40- 76	63	53-78	6.0	2.0-12.5	6	14.0	11.0-19.9	71	65- 76	66	50-76	23.5	14.7- 37
Blackgum (Upland)	59	8.7	5.8-10.8	60	38- 75	72	59-84	8.9	3.0-15.0	178	15.7	11.0-28.2	78	57-131	75	61-87	38.5	11.3-133
Blackgum (Lowland)	52	7.9	5.0-10.9	58	34- 82	68	46-88	7.8	2.0-18.8	112	14.9	11.0-23.2	77	50-101	73	55-86	35.5	8.3- 88
Sycamore	32	8.6	5.1-10.9	71	48- 98	78	66-86	11.9	3.0-26.5	94	15.0	11.0-22.8	94	71-124	80	71-92	43.5	18.7- 91
Magnolia	8	9.1	7.5-10.5	64	53- 76	78	75-83	10.8	7.6-16.5	22	13.3	11.0-16.6	69	39- 80	80	74-89	26.9	13.6- 48
Basswood	31	7.7	5.0-10.7	73	51-101	80	68-88	10.0	2.3-22.4	89	16.5	11.0-23.8	93	64-116	83	74-90	54.9	22.2-136
Elm	24	9.3	7.4-10.8	65	46- 77	74	66-81	10.6	5.4-16.0	156	16.4	11.0-28.4	82	54-113	79	60-91	46.8	10.4-160
All hard hardwoods combined	963	8.4	5.0-10.9	64	29-101	74	35-92	9.3	1.6-22.1	3,602	16.1	11.0-36.0	82	49-120	79	57-93	44.2	11.1-304
Beech	29	9.0	6.4-10.8	63	56- 71	79	71-88	10.6	5.1-16.6	79	15.1	11.0-28.3	77	58-105	84	75-91	37.6	15.9-151
Birch	39	8.2	5.5-10.9	73	45- 87	81	66-92	11.1	3.0-21.0	61	14.0	11.0-21.0	83	68-106	80	57-90	31.9	15.0- 63
Hickory	130	8.4	5.1-10.9	66	45- 89	73	58-81	9.0	2.4-18.9	474	15.4	11.0-27.5	84	60-120	79	61-91	40.4	12.1-178
Pecan	10	9.1	7.5-10.7	65	54- 84	72	65-76	9.9	6.8-15.4	84	18.4	11.0-28.0	91	68-113	78	68-89	64.7	14.6-158
White ash	37	8.4	5.0-10.8	67	44- 91	72	56-83	9.2	1.8-20.5	40	14.4	11.0-21.2	84	59-119	77	62-85	34.1	12.1- 88
Green ash	12	9.1	7.3-10.8	67	59- 80	72	63-83	10.1	5.5-17.6	84	19.3	11.0-32.2	89	67-113	67	58-81	53.0	16.0-154
White oak	190	8.3	5.1-10.9	63	43- 93	74	56-86	9.0	2.3-20.1	636	15.8	11.0-26.8	82	52-110	80	58-93	42.5	12.5-135
Overcup oak	15	9.2	7.4-10.5	58	48- 71	69	51-77	9.1	4.5-14.3	106	20.2	11.3-35.1	87	53-117	77	65-92	74.1	13.7-232
Chestnut oak	58	8.4	5.1-10.8	65	29- 89	74	35-80	9.5	1.6-17.8	261	16.4	11.2-29.7	80	56-116	79	64-89	43.2	15.1-154
Post oak	39	9.1	5.8-10.9	57	40- 84	73	60-81	9.5	3.3-16.1	175	14.3	11.0-21.0	70	53- 90	78	67-87	28.4	12.8- 71

Continued

Table 1.--Trees measured for development of stem-profile equations by species and tree size class--Continued

Species or species group	Pole timber									Sawtimber								
	Sample trees	D.b.h.		Total height		Form class		Stemwood volume		Sample trees	D.b.h.		Total height		Form class		Stemwood volume	
		Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range		Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range
	Number	Inches		Feet				Cubic feet		Number	Inches		Feet				Cubic feet	
All white oaks combined	302	8.5	5.1-10.9	62	29- 93	74	35-86	9.2	1.6-20.1	1,178	16.1	11.0-35.1	80	52-117	79	58-93	43.4	12.5-232
Scarlet oak	54	8.2	5.1-10.9	61	36- 76	74	61-82	8.7	2.3-19.3	238	15.7	11.0-30.9	79	53-110	81	68-90	41.5	12.7-179
Southern red oak	57	8.2	5.1-10.9	59	41- 81	69	51-83	8.0	1.9-15.8	281	15.3	11.0-26.0	77	56-102	76	64-88	35.0	13.0-114
Cherrybark oak	9	8.9	7.5-10.6	67	57- 83	73	60-87	9.9	4.6-15.3	37	16.1	11.2-21.4	87	66-107	79	71-85	44.2	19.5- 92
Laurel oak	20	8.0	5.1-10.5	58	37- 78	75	67-82	8.3	2.1-17.6	12	13.8	11.2-17.3	61	49- 90	76	67-80	23.2	11.1- 34
Water oak	46	8.3	5.0-10.9	68	43- 90	78	61-89	10.5	2.4-20.3	185	15.2	11.0-23.6	85	65-106	80	70-91	40.3	14.4-107
Nuttall oak	11	9.2	7.7-10.8	62	37- 80	75	65-80	10.5	5.3-17.8	96	21.5	11.3-36.0	99	72-120	81	71-89	96.4	18.4-304
Willow oak	24	8.8	6.2-10.5	69	52- 83	74	65-80	10.4	4.0-17.7	107	15.3	11.1-23.1	83	63-105	77	68-86	37.5	13.1- 99
Northern red oak	75	8.1	5.1-10.9	65	41-101	76	60-87	9.4	2.0-22.1	275	17.2	11.3-28.2	85	58-118	80	68-90	52.5	18.2-152
Black oak	73	8.4	5.3-10.9	62	40- 77	73	58-86	8.7	1.8-18.1	321	16.3	11.0-28.7	80	54-116	78	66-87	44.3	13.0-151
All red oaks combined	370	8.3	5.0-10-9	63	36-101	74	51-89	9.1	1.8-22.1	1,552	16.3	11.0-36.0	82	49-120	79	64-91	45.8	11.1-304
All oaks combined	672	8.4	5.0-10.9	63	29-101	74	35-89	9.1	1.6-22.1	2,730	16.2	11.0-36.0	82	49-120	79	58-93	44.8	11.1-304
Black locust	25	8.9	6.0-10.7	73	53- 91	74	67-79	10.7	3.7-18.8	50	15.2	11.0-20.5	90	71-110	76	67-84	36.3	16.9- 73
All hardwoods combined	1,727	8.3	5.0-10.9	64	29-103	73	35-92	9.2	1.6-26.3	5,372	16.1	11.0-36.0	84	39-135	79	50-93	45.4	8.3-304

Table 2.--Accuracy of stemwood volume estimates obtained by using Southwide and subregional coefficients and segmented-profile equations

Source of coefficients	Coefficients applied to trees sampled in--	Average absolute difference (observed-predicted) and standard deviation					
		Total stemwood volume	Stemwood volume from stump to--				
			4.5 feet	17.3 feet	Hgt to 9-in d.o.b. top	Hgt to 7-in d.o.b. top	Hgt to 4-in d.o.b. top
		Percent					
LOBLOLLY PINE							
Arkansas area	Arkansas area	3.0 ± 3.2	4.2 ± 3.3	1.8 ± 1.5	2.5 ± 2.5	2.6 ± 2.6	2.9 ± 2.9
Southwide	Arkansas area	3.3 ± 3.0	4.0 ± 2.6	1.5 ± 1.5	2.8 ± 2.3	2.8 ± 2.5	3.1 ± 2.7
Coastal Plain	Coastal Plain	4.0 ± 3.4	4.8 ± 3.9	2.4 ± 2.3	3.2 ± 3.7	3.4 ± 3.4	3.7 ± 3.2
Southwide	Coastal Plain	3.9 ± 3.2	4.9 ± 4.1	2.4 ± 2.4	3.2 ± 3.6	3.5 ± 4.0	3.6 ± 3.0
Deep South	Deep South	4.0 ± 3.8	3.8 ± 3.3	2.2 ± 3.0	3.1 ± 3.8	3.7 ± 3.9	3.8 ± 3.9
Southwide	Deep South	4.1 ± 4.0	4.0 ± 3.6	2.1 ± 2.9	3.1 ± 3.7	3.9 ± 5.0	3.8 ± 4.0
Piedmont	Piedmont	3.6 ± 2.9	4.5 ± 3.4	2.1 ± 1.7	3.0 ± 3.1	3.2 ± 3.7	3.3 ± 2.7
Southwide	Piedmont	3.5 ± 2.8	4.5 ± 3.4	2.1 ± 1.7	3.1 ± 3.2	3.3 ± 4.0	3.3 ± 2.7
Upper Coastal Plain	Upper Coastal Plain	3.6 ± 3.0	4.7 ± 3.9	1.9 ± 1.6	2.5 ± 2.2	2.8 ± 2.4	3.4 ± 2.7
Southwide	Upper Coastal Plain	3.7 ± 3.1	5.3 ± 3.9	2.1 ± 1.6	2.3 ± 2.2	2.7 ± 2.5	3.4 ± 2.8
YELLOW-POPLAR							
Appalachian Mountains	Appalachian Mountains	3.9 ± 3.1	3.9 ± 3.4	2.2 ± 2.0	3.0 ± 3.3	3.4 ± 3.4	3.7 ± 2.8
Southwide	Appalachian Mountains	3.4 ± 2.8	4.6 ± 2.8	1.4 ± 1.2	2.5 ± 2.7	2.8 ± 2.6	3.2 ± 2.6
Coastal Plain	Coastal Plain	3.1 ± 2.2	5.2 ± 5.2	3.2 ± 3.1	2.9 ± 3.2	3.5 ± 3.3	3.0 ± 2.3
Southwide	Coastal Plain	4.3 ± 2.7	8.4 ± 6.5	4.6 ± 3.1	4.1 ± 3.3	4.3 ± 3.0	4.2 ± 2.7
Deep South	Deep South	3.3 ± 2.7	3.7 ± 2.9	2.2 ± 2.2	3.0 ± 3.1	3.3 ± 2.8	3.0 ± 2.4
Southwide	Deep South	3.5 ± 2.5	4.0 ± 3.6	2.0 ± 1.8	3.0 ± 2.7	3.6 ± 2.8	3.2 ± 2.4
Piedmont	Piedmont	3.4 ± 2.4	4.6 ± 3.6	2.4 ± 1.9	2.3 ± 2.1	2.9 ± 2.6	3.0 ± 2.2
Southwide	Piedmont	3.5 ± 2.5	5.2 ± 4.2	2.2 ± 1.7	2.6 ± 2.4	3.4 ± 4.4	3.0 ± 2.5
Upper Coastal Plain	Upper Coastal Plain	3.1 ± 2.3	2.9 ± 2.3	1.8 ± 1.2	2.8 ± 2.0	3.1 ± 2.0	3.2 ± 2.0
Southwide	Upper Coastal Plain	2.9 ± 2.3	4.9 ± 3.1	1.8 ± 1.5	2.5 ± 2.0	2.8 ± 2.0	2.9 ± 2.1

Continued

Table 2.--Accuracy of stemwood volume estimates obtained by using Southwide and subregional coefficients and segmented-profile equations--Continued

Source of coefficients	Coefficients applied to trees sampled in--	Average absolute difference (observed-predicted) and standard deviation					
		Total stemwood volume	Stemwood volume from stump to--				
			4.5 feet	17.3 feet	Hgt to 9-in d.o.b. top	Hgt to 7-in d.o.b. top	Hgt to 4-in d.o.b. top
		Percent					
				WHITE OAK			
Appalachian Mountains	Appalachian Mountains	4.0 ± 3.2	5.6 ± 4.1	2.9 ± 2.7	3.6 ± 3.3	4.6 ± 6.6	3.7 ± 3.0
Southwide	Appalachian Mountains	4.0 ± 3.2	5.9 ± 4.2	2.4 ± 2.3	3.9 ± 3.2	4.6 ± 6.1	3.8 ± 3.0
Arkansas Area	Arkansas Area	4.0 ± 4.2	5.2 ± 3.8	2.0 ± 1.9	2.9 ± 2.5	3.4 ± 2.9	3.4 ± 2.7
Southwide	Arkansas Area	4.0 ± 4.1	5.4 ± 4.6	1.8 ± 1.5	3.2 ± 2.7	3.8 ± 4.5	3.5 ± 2.7
Coastal Plain	Coastal Plain	3.4 ± 2.8	7.1 ± 4.0	1.8 ± 1.4	3.1 ± 5.1	2.7 ± 2.2	3.4 ± 2.7
Southwide	Coastal Plain	3.5 ± 3.1	7.2 ± 4.8	1.9 ± 1.5	2.5 ± 1.8	2.7 ± 2.2	3.4 ± 2.8
Deep South	Deep South	4.2 ± 3.7	5.7 ± 4.6	2.2 ± 1.8	4.1 ± 4.8	3.3 ± 2.9	3.9 ± 3.3
Southwide	Deep South	4.2 ± 3.5	5.6 ± 4.5	2.6 ± 1.9	4.3 ± 4.8	3.6 ± 2.9	4.0 ± 3.2
Delta	Delta	5.1 ± 4.2	5.6 ± 4.1	2.3 ± 1.7	4.2 ± 3.4	4.4 ± 4.1	4.6 ± 3.9
Southwide	Delta	5.2 ± 4.7	5.5 ± 4.0	2.3 ± 1.6	3.7 ± 3.4	4.2 ± 4.2	4.6 ± 4.2
Piedmont	Piedmont	4.7 ± 3.9	6.7 ± 6.1	2.9 ± 3.1	4.8 ± 6.6	5.7 ± 6.8	4.4 ± 3.7
Southwide	Piedmont	4.7 ± 3.9	7.4 ± 7.0	3.0 ± 3.2	5.2 ± 7.5	6.8 ± 9.6	4.3 ± 3.7
Upper Coastal Plain	Upper Coastal Plain	6.4 ± 5.6	5.4 ± 5.4	2.3 ± 1.9	4.5 ± 4.2	5.8 ± 8.0	6.0 ± 4.8
Southwide	Upper Coastal Plain	6.3 ± 5.8	6.4 ± 4.1	2.1 ± 1.9	4.0 ± 2.8	5.0 ± 3.9	6.0 ± 5.0

Table 3.--Inside-bark form-class segmented-profile coefficients for use when total height is known, for southern tree species and species groups[1/]

Species or species group	Stem profile sections											
	Butt (stump to 4.5 ft)					Lower stem (4.5 to 17.3 ft)			Upper stem (above 17.3 ft)			
	Coefficients			Statistics		Coefficient	Statistics		Coefficients		Statistics	
	r	c	e	MSE [2/]	R^2 [3/]	p	MSE [2/]	R^2 [3/]	b	a	MSE [2/]	R^2 [3/]
All pines combined	24.20656	0.46472	72.22792	21.674	0.97	7.15667	5.438	0.99	2.27267	0.66773	10.462	0.98
Shortleaf pine	25.43531	0.45525	28.38927	18.358	0.98	8.21438	4.761	0.99	2.86552	0.72623	9.519	0.98
Slash pine	32.39761	0.77487	-2.25836	18.871	0.96	4.801	3.597	0.99	2.52226	0.73935	6.076	0.98
Longleaf pine	24.40837	0.46799	10.67266	15.087	0.98	3.597	4.340	0.99	2.03709	0.65814	6.952	0.98
Loblolly pine	31.66250	0.57402	110.96000	24.911	0.97	8.573	6.220	0.99	2.36238	0.68464	10.995	0.98
All major pines combined	29.69748	0.55416	44.79679	21.944	0.97	7.03196	5.240	0.99	2.54412	0.70799	10.678	0.97
Sand pine	22.11866	0.24225	30.35804	4.287	0.99	2.39719	2.674	0.99	2.20596	0.67682	4.242	0.97
Spruce pine	30.60204	0.53021	-41.90943	14.106	0.99	4.62512	5.325	0.99	1.89883	0.62823	12.477	0.96
Table Mountain pine	15.05927	0.26895	-4.14299	11.413	0.95	1.85472	6.925	0.97	1.57211	0.55552	10.219	0.95
Pitch pine	2.38073	0.24517	56.21296	15.296	0.98	5.08318	5.848	0.99	2.41963	0.67900	11.711	0.96
Pond pine	14.31325	0.43675	89.93895	14.538	0.96	3.24869	3.953	0.99	2.06410	0.65079	5.276	0.98
White pine	12.19768	0.35840	19.63087	21.448	0.99	10.31373	7.236	0.99	1.74982	0.60458	10.945	0.99
Virginia pine	8.77959	0.30226	27.58681	11.750	0.97	7.18305	3.882	0.99	2.07630	0.61061	6.784	0.97
All other pines combined	2.97297	0.29746	35.05930	16.905	0.98	7.36602	6.020	0.99	1.81562	0.58400	10.300	0.98
All cypress combined	29.85766	2.01552	2467.74000	107.160	0.72	12.19350	7.527	0.99	2.80837	0.76859	6.418	0.98
Baldcypress	54.20738	2.93064	1173.88000	46.074	0.95	14.72859	6.490	0.99	2.87922	0.77001	6.955	0.99
Pondcypress	27.91571	2.66539	2208.19000	120.200	0.59	10.58239	7.810	0.98	2.63530	0.76388	5.686	0.98
Hemlock	22.76763	0.58987	9.28454	39.350	0.97	8.48372	10.543	0.99	1.55322	0.59329	15.848	0.97
All soft hardwoods combined	0.76387	0.66804	62.00767	57.590	0.93	14.04531	10.287	0.99	1.38226	0.43214	15.360	0.96
Cherry	32.34510	0.50231	-11.55418	26.448	0.92	6.51400	2.638	0.99	1.55640	0.52157	7.912	0.96
Red maple	20.22964	0.48000	117.15000	26.937	0.96	7.63003	7.967	0.99	1.12677	0.21122	13.584	0.94
Buckeye	-0.31952	0.56300	-86.84458	53.657	0.92	5.74912	14.024	0.98	1.36316	0.45678	12.673	0.96

Continued

Table 3.--Inside-bark form-class segmented-profile coefficients for use when total height is known, for southern tree species and species groups[1/]--Continued

Species or species group	Stem profile sections											
	Butt (stump to 4.5 ft)					Lower stem (4.5 to 17.3 ft)			Upper stem (above 17.3 ft)			
	Coefficients			Statistics		Coefficient	Statistics		Coefficients		Statistics	
	r	c	e	MSE[2/]	R^2[3/]	p	MSE[2/]	R^2[3/]	b	a	MSE[2/]	R^2[3/]
Hackberry	9.85600	0.83775	39.78865	45.209	0.97	15.24815	17.691	0.98	1.10274	0.18436	21.455	0.93
Sweetgum	39.27999	0.99797	-12.28068	25.450	0.99	18.01587	9.188	0.99	1.50811	0.48173	13.614	0.96
Yellow-poplar	27.29531	0.52621	80.63279	32.570	0.96	12.58635	6.638	0.99	1.37761	0.43356	11.202	0.98
Sweetbay	26.40590	1.43248	-3.16336	41.697	0.91	11.54432	8.765	0.98	1.56727	0.54963	5.962	0.97
Water tupelo	-24.38581	1.27165	28.48718	37.265	0.88	11.73778	4.288	0.98	1.48108	0.73666	3.294	0.94
Blackgum (Upland)	12.27907	0.47988	234.31000	23.309	0.95	14.15661	6.291	0.99	1.58441	0.47041	10.271	0.96
Blackgum (Lowland)	3.85938	1.51531	168.05000	71.666	0.86	16.30110	8.876	0.99	2.12815	0.68482	11.695	0.95
Sycamore	28.54231	0.73200	63.49480	28.377	0.95	13.80676	6.727	0.99	1.59877	0.58084	9.112	0.97
Magnolia	32.65160	0.87127	-117.56000	21.660	0.93	4.14724	3.939	0.99	1.42352	0.40489	8.361	0.96
Basswood	34.92280	0.63078	-112.60000	31.468	0.96	7.65548	6.528	0.99	1.54223	0.51305	14.344	0.96
Elm	0.32727	0.83154	-72.51669	55.778	0.95	19.16713	9.171	0.99	1.20639	0.26369	17.753	0.95
All hard hardwoods combined	16.59025	0.82445	-50.66507	46.213	0.96	12.94614	10.253	0.99	1.25121	0.30693	18.030	0.95
Beech	44.69823	1.23348	53.34998	33.709	0.95	6.76763	7.46	0.99	1.10386	0.13563	14.793	0.94
Birch	51.28318	1.07553	-109.52000	20.017	0.97	9.97617	4.54803	0.99	1.17446	0.22942	8.22	0.96
Hickory	29.12050	0.74397	25.20574	27.693	0.96	16.91338	7.716	0.99	1.30183	0.31675	12.863	0.95
Pecan	15.54633	0.84611	75.40930	44.751	0.97	18.87904	19.445	0.98	1.37417	0.38353	22.432	0.95
White ash	1.21583	0.52363	85.64375	28.912	0.91	9.06721	7.825	0.99	1.38969	0.42542	9.261	0.96
Green ash	6.55702	0.68587	190.64000	45.597	0.98	12.89430	17.427	0.99	1.30346	0.39763	16.615	0.95
White oak	27.18247	0.88257	174.73000	31.61974	0.95	12.99263	8.409	0.99	1.28811	0.29565	13.767	0.95
Overcup oak	13.23593	0.72601	436.83000	52.863	0.98	16.35515	15.549	0.99	1.31793	0.35603	27.071	0.95
Chestnut oak	25.38194	0.52813	126.23000	27.446	0.97	10.28050	9.865	0.99	1.31163	0.35547	14.062	0.96

Continued

Table 3.--Inside-bark form-class segmented-profile coefficients for use when total height is known, for southern tree species and species groups[1/]--Continued

Species or species group	Stem profile sections											
	Butt (stump to 4.5 ft)					Lower stem (4.5 to 17.3 ft)			Upper stem (above 17.3 ft)			
	Coefficients			Statistics		Coefficient	Statistics		Coefficients		Statistics	
	r	c	e	MSE [2/]	R^2 [3/]	p	MSE [2/]	R^2 [3/]	b	a	MSE [2/]	R^2 [3/]
Post oak	34.64245	0.92900	158.65000	19.271	0.95	9.53959	5.741	0.99	1.24843	0.27255	11.524	0.93
All white oaks combined	26.04458	0.74703	209.32000	36.323	0.97	13.249	10.272	0.99	1.24871	0.31537	18.393	0.95
Scarlet oak	47.31765	0.89697	108.22000	27.957	0.96	14.17655	7.698	0.99	1.25713	0.30215	14.773	0.94
Southern red oak	35.42420	0.97958	60.98724	24.567	0.97	12.87467	6.449	0.99	1.33146	0.34634	11.644	0.96
Cherrybark oak	51.63038	1.44613	-221.76000	22.633	0.98	9.84136	8.079	0.99	1.26945	0.29916	11.838	0.96
Laurel oak	33.80548	1.35974	16.61312	21.589	0.95	9.65616	3.286	0.99	1.26017	0.28233	6.622	0.95
Water oak	34.89075	1.05711	19.83006	31.010	0.95	11.33225	7.199	0.99	1.32858	0.36417	10.964	0.96
Nuttall oak	-7.08703	0.91570	-441.90000	80.402	0.97	20.83134	15.647	0.99	1.23544	0.27706	35.209	0.94
Willow oak	36.75301	1.28866	-6.10171	27.537	0.96	11.56397	6.531	0.99	1.20946	0.26427	12.538	0.95
Northern red oak	32.44798	0.84396	12.01150	32.719	0.97	11.66991	6.162	0.99	1.39963	0.38637	17.217	0.96
Black oak	33.04640	0.86211	90.25670	28.895	0.98	12.69298	7.485	0.99	1.34191	0.33751	13.289	0.96
All red oaks combined	16.03176	0.92868	-160.34000	54.036	0.96	14.18646	9.121	0.99	1.24080	0.28549	18.562	0.95
All oaks combined	18.46026	0.85487	-31.64460	49.607	0.96	13.79400	9.619	0.99	1.24408	0.29817	18.488	0.95
Black locust	34.01475	0.47442	-19.13306	17.327	0.97	7.50541	6.037	0.99	1.19776	0.32282	9.915	0.95
All hardwoods combined	5.79579	0.75160	-29.11988	57.897	0.96	13.58742	11.860	0.99	1.25073	0.32213	19.472	0.95

[1/] For use in equations 1, 2, and 3.

[2/] MSE = mean squared error.

[3/] R^2 = coefficient of determination.

Table 4.--Outside-bark form-class segmented-profile coefficients for use when total height is known, for southern tree species and species groups[1/]

Species or species group	Stem profile sections											
	Butt (stump to 4.5 ft)					Lower stem (4.5 to 17.3 ft)			Upper stem (above 17.3 ft)			
	Coefficients			Statistics		Coefficient	Statistics		Coefficients		Statistics	
	r	c	e	MSE[2/]	R^2 [3/]	p	MSE[2/]	R^2 [3/]	b	a	MSE[2/]	R^2 [3/]
All pines combined	21.01306	0.50856	157.11000	27.866	0.97	7.78474	6.828	0.99	2.36095	0.68914	12.332	0.98
Shortleaf pine	24.26750	0.53260	107.65000	23.388	0.97	9.22332	6.235	0.99	3.04710	0.74591	11.424	0.98
Slash pine	27.16454	0.79755	65.52791	24.273	0.96	4.88907	4.364	0.99	2.76770	0.76513	7.488	0.98
Longleaf pine	19.57711	0.54088	22.15904	18.273	0.98	4.34898	5.093	0.99	2.17272	0.68448	8.187	0.98
Loblolly pine	25.29597	0.58370	221.45000	29.825	0.97	8.88273	7.764	0.99	2.39522	0.70372	12.592	0.98
All major pines combined	25.18683	0.59203	119.76000	27.143	0.97	7.84041	6.604	0.99	2.64431	0.72662	12.524	0.97
Sand pine	9.02872	0.25504	60.41609	5.577	0.99	4.16861	2.994	0.99	2.38632	0.70896	4.521	0.98
Spruce pine	31.09115	0.51977	-43.19648	14.016	0.99	3.70448	5.717	0.99	1.96014	0.64781	14.581	0.95
Table Mountain pine	16.73758	0.23255	257.35000	15.422	0.93	2.51066	8.363	0.97	1.68324	0.61762	12.502	0.94
Pitch pine	6.93687	0.26874	96.50804	17.477	0.99	6.15648	6.475	0.99	2.52679	0.69903	15.005	0.96
Pond pine	9.98989	0.40750	126.7800	16.726	0.97	3.90993	4.120	0.99	2.19115	0.67531	6.857	0.98
White pine	10.41255	0.36290	59.64184	23.601	0.99	11.42481	8.285	0.99	1.78758	0.63240	13.220	0.98
Virginia pine	9.17462	0.38821	48.07668	13.985	0.97	9.24015	4.540	0.99	2.11000	0.62645	7.241	0.97
All other pines combined	3.53038	0.31298	85.37754	19.224	0.99	8.40597	7.289	0.99	1.85489	0.60463	12.583	0.98
All cypress combined	25.50343	1.84581	2639.19000	115.870	0.70	12.74249	8.230	0.99	3.10507	0.78995	7.480	0.98
Baldcypress	53.02593	2.80399	1183.93000	46.64043	0.96	15.06926	6.560	0.99	3.20594	0.79079	8.075	0.98
Pondcypress	25.10773	2.23655	2782.32000	130.780	0.58	11.60876	8.921	0.98	2.88567	0.78623	6.533	0.98
Hemlock	21.36317	0.54174	47.97097	41.378	0.98	9.54910	12.680	0.99	1.65131	0.60760	19.830	0.97
All soft hardwoods combined	1.48199	0.63392	97.98536	63.189	0.93	13.13006	10.544	0.99	1.46888	0.46150	18.114	0.96
Cherry	37.12714	0.48776	1.50579	26.363	0.93	6.18866	2.898	0.99	1.64261	0.55071	9.273	0.96
Red maple	22.00135	0.45472	166.10000	29.301	0.96	7.31546	8.164	0.99	1.17064	0.27213	15.646	0.94
Buckeye	3.02215	0.58715	-154.72000	60.018	0.92	5.04720	13.890	0.99	1.45465	0.49221	15.244	0.96

Continued

Table 4.--Outside-bark form-class segmented-profile coefficients for use when total height is known, for southern tree species and species groups[1/]--Continued

Species or species group	Stem profile sections											
	Butt (stump to 4.5 ft)					Lower stem (4.5 to 17.3 ft)			Upper stem (above 17.3 ft)			
	Coefficients			Statistics		Coefficient	Statistics		Coefficients		Statistics	
	r	c	e	MSE[2/]	R^2 [3/]	p	MSE[2/]	R^2 [3/]	b	a	MSE[2/]	R^2 [3/]
Hackberry	7.58001	0.77904	98.86053	49.39851	0.97	14.72719	17.057	0.99	1.13162	0.21363	23.806	0.94
Sweetgum	39.02874	0.92761	8.38221	26.765	0.99	17.80982	9.461	0.99	1.60164	0.49790	16.445	0.96
Yellow-poplar	26.40588	0.51359	118.64000	36.944	0.96	12.35256	7.130	0.99	1.45155	0.45728	13.968	0.98
Sweetbay	23.01219	1.31139	47.93370	48.828	0.91	11.28550	9.310	0.99	1.70245	0.58013	7.146	0.98
Water tupelo	-17.29187	1.39778	-22.59832	34.841	0.91	10.99759	4.610	0.98	1.50338	0.66751	3.995	0.94
Blackgum (Upland)	13.27517	0.43775	357.62000	25.094	0.96	13.62877	6.870	0.99	1.71575	0.51314	12.782	0.97
Blackgum (Lowland)	3.85564	1.45568	230.65000	80.046	0.86	15.92478	9.344	0.99	2.37582	0.69671	14.076	0.95
Sycamore	25.41167	0.72445	58.38711	30.038	0.95	13.54775	7.125	0.99	1.63890	0.59893	9.838	0.97
Magnolia	29.53040	0.84545	-177.27000	22.316	0.94	4.83280	4.851	0.99	1.45934	0.41750	9.767	0.96
Basswood	35.87830	0.61921	-129.42000	33.943	0.96	8.73588	7.284	0.99	1.65110	0.54681	16.090	0.96
Elm	0.81866	0.77141	-51.36724	57.070	0.95	18.74117	9.138	0.99	1.25822	0.29448	20.002	0.95
All hard hardwoods combined	17.37375	0.76817	19.73232	49.587	0.97	12.25625	11.461	0.99	1.29942	0.34212	21.018	0.95
Beech	44.36826	1.22158	79.44636	39.195	0.95	6.36236	7.83	0.99	1.11382	0.14312	15.731	0.94
Birch	49.41385	1.01241	-91.82769	20.954	0.97	11.23179	5.150	0.99	1.19704	0.23928	9.902	0.96
Hickory	26.74384	0.71015	44.42209	30.003	0.96	15.94480	9.075	0.99	1.34232	0.33340	15.827	0.95
Pecan	19.65583	0.76605	156.29000	40.947	0.98	18.71336	19.397	0.99	1.49941	0.44660	26.233	0.95
White ash	0.64600	0.49680	127.87000	34.046	0.91	7.52915	8.425	0.99	1.49287	0.47222	11.775	0.96
Green ash	7.32061	0.61584	288.36000	43.762	0.98	11.17396	19.860	0.99	1.36940	0.43492	19.109	0.96
White oak	26.85889	0.84829	232.96000	34.556	0.96	12.28295	9.366	0.99	1.32630	0.31541	15.741	0.96
Overcup oak	15.45114	0.62728	618.81000	56.454	0.98	14.60416	14.953	0.99	1.35596	0.38248	31.330	0.95
Chestnut oak	22.30226	0.49235	206.69000	31.981	0.97	9.71683	10.346	0.99	1.38908	0.39346	17.614	0.96

Continued

Table 4.--Outside-bark form-class segmented-profile coefficients for use when total height is known, for southern tree species and species groups[1/] --Continued

Species or species group	Stem profile sections											
	Butt (stump to 4.5 ft)					Lower stem (4.5 to 17.3 ft)			Upper stem (above 17.3 ft)			
	Coefficients			Statistics		Coefficient	Statistics		Coefficients		Statistics	
	r	c	e	MSE[2/]	R^2 [3/]	p	MSE[2/]	R^2 [3/]	b	a	MSE[2/]	R^2 [3/]
Post oak	30.82091	0.83441	335.71000	21.435	0.95	10.33370	6.020	0.99	1.29478	0.30931	13.627	0.94
All white oaks combined	23.71110	0.66796	349.50000	41.173	0.97	11.92633	10.702	0.99	1.28727	0.34249	21.440	0.95
Scarlet oak	42.73753	0.86145	214.31000	32.763	0.96	13.53863	8.095	0.99	1.29882	0.33330	17.582	0.94
Southern red oak	31.98221	0.92734	119.69000	29.508	0.96	12.75583	6.898	0.99	1.37269	0.36674	14.270	0.96
Cherrybark	50.51179	1.36917	-215.92000	24.040	0.98	9.30537	8.794	0.99	1.28815	0.31282	13.379	0.97
Laurel oak	34.80988	1.36792	39.52792	25.157	0.95	10.25955	3.677	0.99	1.31060	0.31023	8.061	0.95
Water oak	34.76470	1.08768	-6.46961	34.842	0.95	10.78112	8.175	0.99	1.36987	0.38666	12.605	0.96
Nuttall oak	-5.45119	0.88020	-457.82000	81.811	0.97	21.01569	16.227	0.99	1.28504	0.31629	38.728	0.94
Willow oak	35.40807	1.26850	38.61354	30.555	0.96	11.59408	7.578	0.99	1.23843	0.28533	14.855	0.95
Northern red oak	31.32975	0.81328	78.94096	37.204	0.97	11.45671	6.678	0.99	1.43496	0.39984	19.615	0.96
Black oak	31.60343	0.81484	124.19000	31.542	0.98	12.19245	8.574	0.99	1.39091	0.35814	15.981	0.97
All red oaks combined	18.48034	0.90302	-118.39000	55.972	0.97	14.01655	10.290	0.99	1.28801	0.31908	21.295	0.95
All oaks combined	19.20350	0.80440	55.79724	53.215	0.96	13.13272	10.506	0.99	1.28810	0.32973	21.353	0.95
Black locust	25.57939	0.35922	-8.66136	16.244	0.98	7.02926	5.234	0.99	1.24010	0.35218	12.585	0.96
All hardwoods combined	7.62604	0.70780	19.34425	61.236	0.96	12.85326	12.978	0.99	1.30536	0.35815	22.678	0.95

[1/] For use in equations 1, 2, and 3.

[2/] MSE = mean squared error.

[3/] R^2 = coefficient of determination.

Table 5.--Inside-bark form-class segmented-profile coefficients for use when height to 4-inch d.o.b. top is known, for southern tree species and species groups[1/]

Species or species group	Stem profile sections											
	Butt (stump to 4.5 ft)					Lower stem (4.5 to 17.3 ft)			Upper stem (above 17.3 ft)			
	Coefficients			Statistics		Coefficient	Statistics		Coefficient	Statistics		
	r	c	e	MSE[2/]	R^2 [3/]	p	MSE[2/]	R^2 [3/]	q	MSE[2/]	R^2 [3/]	
All pines combined	19.57453	0.45136	94.08746	21.769	0.97	5.75423	5.597	0.99	0.87838	11.159	0.98	
Shortleaf pine	20.16797	0.45149	19.96681	18.766	0.98	6.77594	4.898	0.99	0.78347	10.507	0.98	
Slash pine	25.11416	0.79979	-22.04987	19.649	0.96	4.14493	3.907	0.99	0.89896	5.820	0.98	
Longleaf pine	19.89731	0.46021	34.37219	16.218	0.97	3.23574	4.022	0.99	0.91527	6.774	0.98	
Loblolly pine	19.16609	0.54668	110.14000	26.325	0.97	6.68944	5.946	0.99	0.85323	11.663	0.98	
All major pines combined	23.47032	0.53227	69.24935	22.073	0.97	5.72081	5.366	0.99	0.84461	11.355	0.97	
Sand pine	14.01730	0.22702	32.18823	4.983	0.99	1.90452	2.547	0.99	0.79851	3.656	0.98	
Spruce pine	23.42265	0.51276	-33.06464	14.219	0.99	3.48541	5.461	0.99	0.95851	11.811	0.96	
Table Mountain pine	13.63629	0.27304	4.50100	11.338	0.95	1.27639	7.007	0.97	0.93012	10.649	0.93	
Pitch pine	1.82766	0.24206	62.44004	15.361	0.98	4.17798	5.953	0.99	0.82003	12.490	0.96	
Pond pine	12.63044	0.42976	108.72000	14.508	0.96	2.50664	4.030	0.99	0.90102	5.621	0.98	
White pine	8.84930	0.35232	22.75990	21.488	0.99	8.58707	7.478	0.99	1.05487	11.044	0.99	
Virginia pine	8.46601	0.34417	8.79772	9.409	0.98	5.45777	4.471	0.99	0.80151	6.611	0.97	
All other pines combined	3.32218	0.29877	37.95592	285.630	0.98	5.84751	6.235	0.99	0.97621	11.732	0.97	
All cypress combined	23.15479	1.87031	2664.92000	106.960	0.72	9.68720	7.809	0.99	0.85436	6.179	0.99	
Baldcypress	44.97219	2.80066	1400.23000	47.212	0.95	12.37375	6.455	0.99	0.85144	6.642	0.99	
Pondcypress	22.62266	2.50092	2541.35000	119.360	0.60	8.08325	8.065	0.98	0.86240	5.652	0.98	
Hemlock	18.47210	0.58220	33.90974	39.352	0.97	6.69498	10.831	0.99	1.11415	15.281	0.98	
All soft hardwoods combined	2.07623	0.67626	63.16373	57.840	0.93	10.83048	10.870	0.99	1.06932	16.935	0.95	
Cherry	36.69403	0.57610	17.67955	27.796	0.90	4.90744	2.791	0.99	0.93003	7.604	0.96	
Red maple	18.50884	0.43793	194.17000	27.005	0.96	8.59395	7.386	0.99	1.25124	14.497	0.94	
Buckeye	6.91120	0.60709	-81.35488	53.575	0.92	4.12073	14.243	0.98	1.01379	12.526	0.97	

Continued

Table 5.--Inside-bark form-class segmented-profile coefficients for use when height to 4-inch d.o.b. top is known, for southern tree species and species groups[1/] --Continued

Species or species group	Stem profile sections										
	Butt (stump to 4.5 ft)					Lower stem (4.5 to 17.3 ft)			Upper stem (above 17.3 ft)		
	Coefficients			Statistics		Coefficient	Statistics		Coefficient	Statistics	
	r	c	e	MSE[2/]	R^2 [3/]	p	MSE[2/]	R^2 [3/]	q	MSE[2/]	R^2 [3/]
Hackberry	9.36889	0.86292	176.99000	44.457	0.97	12.35128	17.134	0.98	1.30637	21.410	0.93
Sweetgum	30.26910	0.97162	27.97553	25.953	0.99	14.25132	9.880	0.99	1.00000	14.861	0.96
Yellow-poplar	14.39865	0.51127	24.47831	33.318	0.96	9.96576	7.130	0.99	1.10228	12.393	0.97
Sweetbay	15.34203	1.28997	24.48406	42.259	0.91	8.72476	9.155	0.98	0.98665	6.975	0.96
Water tupelo	-13.37220	1.28913	26.96067	40.679	0.87	7.58979	5.555	0.96	1.07271	4.816	0.90
Blackgum (Upland)	16.69555	0.59628	211.22000	26.097	0.95	8.80290	7.773	0.99	0.86816	9.890	0.96
Blackgum (Lowland)	1.65312	1.48029	174.46000	71.943	0.86	13.20124	9.507	0.98	0.91073	11.555	0.95
Sycamore	19.16546	0.69450	88.01033	28.737	0.95	10.40165	7.116	0.99	0.98498	9.699	0.96
Magnolia	23.16078	0.82787	-87.83604	21.759	0.93	3.11163	3.989	0.99	0.90353	9.099	0.94
Basswood	31.06399	0.64665	-110.91000	31.421	0.96	6.20686	6.711	0.99	1.01855	15.047	0.95
Elm	7.62297	0.91368	-240.91000	42.184	0.97	14.84517	9.554	0.99	1.14963	19.144	0.94
All hard hardwoods combined	15.32087	0.84179	-24.78451	46.842	0.96	10.85296	10.762	0.99	1.11952	20.609	0.94
Beech	28.35035	1.11249	193.25000	34.376	0.95	4.45848	7.702	0.99	1.11262	17.667	0.92
Birch	31.20891	0.94760	-49.21044	20.816	0.97	7.27450	5.106	0.99	1.00884	8.054	0.96
Hickory	25.05401	0.77669	70.92241	29.268	0.95	12.72475	7.305	0.99	0.98817	14.483	0.94
Pecan	14.09389	0.85160	87.48764	45.065	0.97	15.90593	19.415	0.98	1.09058	24.941	0.94
White ash	3.50540	0.53051	103.36000	28.997	0.91	6.57758	7.947	0.99	0.99593	9.623	0.96
Green ash	5.16768	0.68273	199.85000	45.606	0.98	10.39890	16.952	0.99	1.12269	19.185	0.94
White oak	19.96023	0.84871	199.76000	30.394	0.96	9.78031	6.966	0.99	1.01687	16.630	0.93
Overcup oak	11.98363	0.72520	519.63000	52.729	0.98	13.59938	15.613	0.99	1.13856	31.939	0.94
Chestnut oak	12.36718	0.49047	76.86862	27.422	0.97	6.13653	10.231	0.99	1.10297	15.657	0.95
Post oak	19.27158	0.95880	31.31768	24.283	0.92	5.93130	5.904	0.99	0.99587	12.148	0.92

Continued

Table 5.--Inside-bark form-class segmented-profile coefficients for use when height to 4-inch d.o.b. top is known, for southern tree species and species groups[1/]--Continued

Species or species group	Stem profile sections										
	Butt (stump to 4.5 ft)					Lower stem (4.5 to 17.3 ft)			Upper stem (above 17.3 ft)		
	Coefficients			Statistics		Coefficient	Statistics		Coefficient	Statistics	
	r	c	e	MSE[2/]	R^2 [3/]	p	MSE[2/]	R^2 [3/]	q	MSE[2/]	R^2 [3/]
All white oaks combined	19.78864	0.72426	269.52000	36.418	0.97	10.42000	10.605	0.99	1.13753	21.031	0.94
Scarlet oak	27.54356	0.74944	263.92000	30.058	0.95	9.04254	7.152	0.99	1.02048	15.341	0.94
Southern red oak	22.97463	0.93866	131.18000	25.705	0.96	9.35568	6.160	0.99	0.97967	11.629	0.95
Cherrybark oak	39.22492	1.42308	-165.61000	22.408	0.98	7.12822	8.366	0.99	1.02097	14.102	0.95
Laurel oak	22.87976	1.23888	75.16753	22.374	0.94	7.07049	3.508	0.99	0.96518	8.639	0.92
Water oak	24.68063	1.00719	38.43151	30.150	0.95	8.86923	5.720	0.99	0.99800	12.627	0.94
Nuttall oak	-5.68827	0.91707	-443.84	79.986	0.97	17.23428	15.888	0.99	1.23161	39.764	0.93
Willow oak	24.43783	1.20379	47.53710	28.315	0.96	8.45645	6.604	0.99	1.07274	13.339	0.94
Northern red oak	22.87602	0.74119	114.37000	30.924	0.97	8.61102	7.292	0.99	1.03013	17.456	0.95
Black oak	26.20262	0.82750	76.51710	23.948	0.98	9.77858	7.646	0.99	1.02112	15.941	0.95
All red oaks combined	14.17341	0.94250	-163.27000	54.012	0.96	10.97372	9.522	0.99	1.13660	21.861	0.94
All oaks combined	14.94166	0.85216	-14.39119	49.688	0.96	10.75215	9.982	0.99	1.13698	21.515	0.94
Black locust	27.28041	0.47147	-3.85360	17.289	0.97	5.94068	5.985	0.99	1.20251	11.739	0.93
All hardwoods combined	6.29407	0.76029	-3.87970	56.991	0.95	10.91724	11.725	0.99	1.13731	21.480	0.94

[1/] For use in equations 4, 5, and 6.

[2/] MSE = mean squared error.

[3/] R^2 = coefficient of determination.

Table 6.--Outside-bark form-class segmented-profile coefficients for use when height to 4-inch d.o.b. top is known, for southern tree species and species groups[1/]

Species or species group	Stem profile sections										
	Butt (stump to 4.5 ft)					Lower stem (4.5 to 17.3 ft)			Upper stem (above 17.3 ft)		
	Coefficients			Statistics		Coefficient	Statistics		Coefficient	Statistics	
	r	c	e	MSE[2/]	R^2 [3/]	p	MSE[2/]	R^2 [3/]	q	MSE[2/]	R^2 [3/]
All pines combined	17.03335	0.49585	187.04000	27.973	0.97	6.27498	7.090	0.99	0.88020	12.787	0.98
Shortleaf pine	18.02525	0.52392	99.09490	23.541	0.98	7.35301	6.175	0.99	0.77505	11.953	0.98
Slash pine	20.01213	0.80834	37.23877	24.417	0.96	4.07230	4.329	0.99	0.88453	7.031	0.98
Longleaf pine	15.52918	0.53163	51.56955	20.496	0.97	3.83555	4.855	0.99	0.90616	7.880	0.98
Loblolly pine	16.98388	0.57830	219.23000	32.602	0.97	6.96183	7.240	0.99	0.86827	12.902	0.98
All major pines combined	19.99295	0.57042	161.45000	27.275	0.97	6.37299	6.848	0.99	0.84760	12.970	0.97
Sand pine	6.63555	0.26378	56.40624	5.843	0.99	3.32246	2.999	0.99	0.80428	3.816	0.98
Spruce pine	23.54403	0.50010	-29.21153	14.188	0.99	2.80640	5.834	0.99	0.95645	13.525	0.96
Table Mountain pine	14.76190	0.23248	284.17000	15.288	0.94	1.79905	8.561	0.96	0.92816	13.089	0.93
Pitch pine	5.93734	0.26492	111.31000	17.553	0.99	5.08038	6.623	0.99	0.81543	15.758	0.96
Pond pine	8.34954	0.40133	140.17000	16.723	0.97	3.05483	4.271	0.99	0.88774	7.186	0.98
White pine	7.71486	0.35789	64.49967	23.641	0.99	9.50983	8.659	0.99	1.06666	12.884	0.99
Virginia pine	8.34415	0.41147	37.23535	11.763	0.98	6.82874	5.210	0.99	0.81026	6.866	0.97
All other pines combined	4.05998	0.31481	92.38752	19.212	0.99	6.73109	7.583	0.99	0.98242	13.878	0.97
All cypress combined	18.91994	1.71949	2757.29000	116.080	0.70	10.07695	8.635	0.99	0.83509	6.924	0.98
Baldcypress	43.97643	2.68374	1419.45000	47.816	0.95	12.65276	6.539	0.99	0.82606	7.428	0.99
Pondcypress	19.68886	2.08883	3079.83000	130.300	0.59	8.88798	9.355	0.98	0.85698	6.291	0.98
Hemlock	17.26344	0.53402	80.87129	41.391	0.98	7.549	13.097	0.99	1.06779	19.075	0.98
All soft hardwoods combined	2.57141	0.64085	101.92000	63.452	0.93	10.06803	11.169	0.99	1.01619	19.948	0.95
Cherry	40.31196	0.55528	53.74985	27.629	0.92	4.68815	3.033	0.99	0.90774	8.899	0.96
Red maple	19.70452	0.42526	251.53000	29.172	0.96	8.13298	7.184	0.99	1.20080	16.421	0.94
Buckeye	10.69027	0.64442	-154.67000	59.784	0.92	3.60211	14.086	0.99	0.96773	14.884	0.96

Continued

Table 6.--Outside-bark form-class segmented-profile coefficients for use when height to 4-inch d.o.b. top is known, for southern tree species and species groups[1/] --Continued

Species or species group	Stem profile sections										
	Butt (stump to 4.5 ft)					Lower stem (4.5 to 17.3 ft)			Upper stem (above 17.3 ft)		
	Coefficients			Statistics		Coefficient	Statistics		Coefficient	Statistics	
	r	c	e	MSE[2/]	R^2 [3/]	p	MSE[2/]	R^2 [3/]	q	MSE[2/]	R^2 [3/]
Hackberry	8.59560	0.80638	228.08000	48.354	0.97	11.97301	16.891	0.99	1.26616	24.481	0.93
Sweetgum	29.53672	0.89545	68.16672	27.311	0.99	14.04794	10.243	0.99	0.94866	18.127	0.96
Yellow-poplar	14.80808	0.50061	60.28155	37.041	0.96	9.69008	7.746	0.99	1.05601	14.980	0.97
Sweetbay	13.13011	1.19408	76.12475	49.332	0.90	8.46177	9.795	0.98	0.93539	8.166	0.97
Water tupelo	-9.75790	1.42474	-45.91624	37.941	0.91	6.97370	5.660	0.97	0.98789	5.679	0.91
Blackgum (Upland)	16.10484	0.52007	350.56000	28.068	0.96	8.78543	8.055	0.99	0.81991	12.405	0.97
Blackgum (Lowland)	1.55029	1.41937	240.71000	80.370	0.86	12.86649	10.069	0.99	0.84081	13.759	0.95
Sycamore	16.72042	0.68982	79.52287	30.418	0.95	10.19695	7.571	0.99	0.98453	10.422	0.96
Magnolia	20.80044	0.80718	-147.79000	22.450	0.94	3.57440	4.922	0.99	0.88822	10.450	0.94
Basswood	31.71748	0.63109	-112.07000	33.914	0.96	7.08946	7.497	0.99	0.98108	16.730	0.95
Elm	7.40033	0.84312	-233.82000	42.954	0.97	14.58889	9.731	0.99	1.10244	21.757	0.94
All hard hardwoods combined	14.82198	0.77600	59.81238	50.502	0.96	10.21737	11.951	0.99	1.07939	23.754	0.94
Beech	28.19929	1.10213	239.81000	36.892	0.95	4.19704	8.075	0.99	1.09888	18.984	0.92
Birch	30.50206	0.89241	-14.36625	21.646	0.97	8.15967	5.829	0.99	0.98356	9.705	0.96
Hickory	22.68585	0.74054	81.89285	31.653	0.96	12.25054	8.419	0.99	0.95927	17.456	0.94
Pecan	16.45144	0.76232	162.59000	41.447	0.98	15.75279	19.473	0.99	1.02446	28.961	0.94
White ash	3.90254	0.50601	158.25000	34.131	0.91	5.50088	8.518	0.99	0.95339	11.871	0.96
Green ash	5.50916	0.61123	299.06000	43.793	0.98	9.04727	19.329	0.99	1.08138	22.128	0.94
White oak	19.06854	0.80601	264.73000	33.950	0.96	9.37026	7.314	0.99	0.99073	19.209	0.94
Overcup oak	13.81933	0.62462	738.42000	56.282	0.98	12.13886	15.161	0.99	1.11716	36.799	0.94
Chestnut oak	10.09442	0.45176	169.00000	32.089	0.97	5.81578	10.606	0.99	1.05150	19.136	0.95
Post oak	17.13062	0.85820	188.43000	27.556	0.93	6.69397	7.045	0.99	0.96379	14.195	0.92

Continued

Table 6.--Outside-bark form-class segmented-profile coefficients for use when height to 4-inch d.o.b. top is known, for southern tree species and species groups[1/]--Continued

Species or species group	Stem profile sections										
	Butt (stump to 4.5 ft)					Lower stem (4.5 to 17.3 ft)			Upper stem (above 17.3 ft)		
	Coefficients			Statistics		Coefficient	Statistics		Coefficient	Statistics	
	r	c	e	MSE[2/]	R^2 [3/]	p	MSE[2/]	R^2 [3/]	q	MSE[2/]	R^2 [3/]
All white oaks combined	18.04800	0.64723	429.72000	41.224	0.97	9.32459	11.102	0.99	1.10492	24.373	0.94
Scarlet oak	25.83014	0.74355	416.62000	33.518	0.95	9.00692	8.075	0.99	0.99455	17.817	0.94
Southern red oak	20.55860	0.91342	173.81000	31.793	0.95	9.40211	6.754	0.99	0.95301	13.897	0.95
Cherrybark oak	38.71627	1.35182	-131.91000	23.591	0.98	6.69022	9.101	0.99	1.01239	16.145	0.95
Laurel oak	23.41607	1.23280	120.81000	26.058	0.94	7.50920	3.961	0.99	0.93122	10.398	0.92
Water oak	24.00425	1.02532	26.93172	33.797	0.95	8.75834	6.500	0.99	0.96943	14.235	0.94
Nuttall oak	-4.42173	0.88091	-475.47000	81.521	0.97	17.42864	16.540	0.99	1.18536	43.966	0.93
Willow oak	23.52217	1.18570	111.48000	31.445	0.96	8.46337	7.657	0.99	1.04376	15.704	0.94
Northern red oak	21.92788	0.71984	212.38000	35.820	0.97	8.58138	7.931	0.99	1.00149	20.189	0.95
Black oak	24.70984	0.78767	116.49000	26.763	0.98	9.32619	8.388	0.99	0.97788	19.586	0.95
All red oaks combined	15.30089	0.90603	-106.35000	55.996	0.97	10.78307	10.738	0.99	1.09010	25.015	0.94
All oaks combined	15.06454	0.79552	90.30362	53.354	0.96	10.17330	10.919	0.99	1.09623	24.749	0.94
Black locust	19.01854	0.35102	3.70515	16.273	0.98	5.50360	5.212	0.99	1.16389	14.910	0.94
All hardwoods combined	6.73383	0.71024	55.86839	60.987	0.96	10.31848	12.720	0.99	1.09029	24.792	0.94

[1/] For use in equations 4, 5, and 6.

[2/] MSE = mean squared error.

[3/] R^2 = coefficient of determination.

Table 7.--Inside-bark form-class segmented-profile coefficients for use when height to 7-inch d.o.b. top (southern softwood species) or 9-inch d.o.b. top (southern hardwood species) is known[1/]

Species or species group	Stem profile sections											
	Butt (stump to 4.5 ft)					Lower stem (4.5 to 17.3 ft)			Upper stem (above 17.3 ft)			
	Coefficients			Statistics		Coefficient	Statistics		Coefficient	Statistics		
	r	c	e	MSE[2/]	R^2 [3/]	p	MSE[2/]	R^2 [3/]	q	MSE[2/]	R^2 [3/]	
All pines combined	17.52141	0.42085	212.30000	23.221	0.97	4.62902	6.211	0.99	0.80018	10.470	0.98	
Shortleaf pine	17.05141	0.43650	51.21248	20.032	0.97	5.75237	5.300	0.99	0.71945	9.343	0.98	
Slash pine	19.65766	0.80263	-56.75203	21.637	0.94	3.19922	4.440	0.99	0.84606	5.755	0.98	
Longleaf pine	16.90410	0.43537	98.61610	17.606	0.96	2.69963	4.373	0.99	0.84133	6.443	0.98	
Loblolly pine	15.88358	0.51074	222.76000	28.170	0.96	5.56549	6.516	0.99	0.78687	11.167	0.98	
All major pines combined	19.67352	0.49948	158.64000	23.834	0.96	4.62589	5.972	0.99	0.77183	10.934	0.97	
Sand pine	10.68723	0.17796	93.82565	5.943	0.98	1.70062	2.926	0.99	0.85324	3.259	0.98	
Spruce pine	19.30980	0.50996	-43.34937	15.263	0.98	2.89792	5.827	0.99	0.85346	9.871	0.97	
Table Mountain pine	10.42064	0.26006	23.97904	11.337	0.95	0.85155	7.010	0.97	0.80446	9.845	0.92	
Pitch pine	2.236309	0.22531	125.40000	16.338	0.98	3.29779	6.663	0.99	0.73752	12.648	0.96	
Pond pine	9.60731	0.35444	226.99000	15.266	0.95	1.87862	4.449	0.99	0.81246	5.452	0.98	
White pine	7.38775	0.34603	51.29501	22.777	0.99	7.24845	8.231	0.99	0.96549	10.802	0.99	
Virginia pine	6.45340	0.33177	26.01610	10.171	0.98	4.41421	4.815	0.99	0.74619	5.852	0.97	
All other pines combined	5.55021	0.31155	87.18491	18.889	0.98	5.14703	6.718	0.99	0.89565	10.833	0.98	
All cypress combined	18.08213	1.33436	4291.41000	108.090	0.70	7.43469	8.735	0.99	0.85548	6.022	0.99	
Baldcypress	39.05969	2.41213	2893.88000	49.480	0.94	10.43738	6.883	0.99	0.85367	6.288	0.99	
Pondcypress	21.21374	1.19920	6242.22000	119.270	0.58	5.91880	8.958	0.97	0.86106	5.646	0.98	
Hemlock	16.76497	0.57427	124.66000	43.636	0.97	5.68176	12.234	0.99	1.01169	14.596	0.98	
All soft hardwoods combined	-3.38842	0.63527	35.64541	65.653	0.90	8.64166	13.190	0.99	0.84805	16.752	0.96	
Red maple	5.08903	0.35892	397.93000	33.240	0.94	3.36726	11.143	0.99	0.81660	18.914	0.92	
Buckeye	8.11618	0.65081	-186.60000	62.015	0.89	2.42080	17.322	0.97	0.85800	12.098	0.97	

Continued

Table 7.--Inside-bark form-class segmented-profile coefficients for use when height to 7-inch d.o.b. top (southern softwood species) or 9-inch d.o.b. top (southern hardwood species) is known[1/]--Continued

Species or species group	Stem profile sections										
	Butt (stump to 4.5 ft)					Lower stem (4.5 to 17.3 ft)			Upper stem (above 17.3 ft)		
	Coefficients			Statistics		Coefficient	Statistics		Coefficient	Statistics	
	r	c	e	MSE[2/]	R^2 [3/]	p	MSE[2/]	R^2 [3/]	q	MSE[2/]	R^2 [3/]
Hackberry	5.18978	0.81944	291.32000	49.379	0.96	8.92998	19.696	0.97	0.86631	23.159	0.92
Sweetgum	19.20174	0.88488	227.60000	32.336	0.98	10.86478	12.950	0.99	0.77359	15.084	0.96
Yellow-poplar	11.43042	0.49799	107.56000	37.051	0.94	7.11898	8.458	0.99	0.89475	13.158	0.97
Sweetbay	2.59433	1.18333	-306.80000	54.995	0.84	5.97795	11.969	0.96	0.85325	8.289	0.94
Blackgum (Upland)	8.25373	0.52928	270.28000	29.553	0.92	6.43568	9.310	0.98	0.77604	9.869	0.95
Blackgum (Lowland)	-2.71851	1.38885	97.84611	88.253	0.78	8.39752	14.318	0.95	0.84134	11.426	0.93
Sycamore	12.96010	0.66258	191.64000	32.670	0.91	7.11830	8.338	0.98	0.94439	9.043	0.94
Magnolia	13.14198	0.79169	-119.21000	24.537	0.87	1.87158	4.833	0.98	0.64756	6.984	0.96
Basswood	21.68899	0.63425	-132.52000	35.689	0.93	4.60915	7.702	0.99	0.78797	12.467	0.96
Elm	-0.44140	0.94606	-513.62000	57.424	0.95	11.10968	14.224	0.99	0.80767	19.782	0.94
All hard hardwoods combined	7.60744	0.80668	-135.64000	51.822	0.96	8.13717	12.666	0.99	0.82778	20.602	0.95
Beech	21.59996	1.03168	698.22000	37.963	0.93	2.93435	9.027	0.99	0.76075	17.389	0.92
Birch	21.35601	1.00420	-171.83000	23.934	0.95	4.30630	5.201	0.99	0.82470	8.989	0.94
Hickory	15.08240	0.74606	-10.47815	33.448	0.93	9.35044	8.838	0.98	0.71776	13.948	0.94
Pecan	10.43971	0.81311	364.38000	46.592	0.96	13.40870	19.725	0.98	0.82007	24.951	0.93
White ash	6.47354	0.38099	563.99000	33.488	0.85	2.59500	10.328	0.97	0.76787	9.817	0.95
Green ash	4.99216	0.66430	414.55000	47.289	0.97	7.22585	19.562	0.98	0.83080	20.170	0.92
White oak	14.81018	0.75907	561.93000	32.982	0.93	6.95857	8.076	0.99	0.67254	14.660	0.94
Overcup oak	10.15596	0.69455	950.57000	56.115	0.97	10.74129	16.969	0.99	0.81700	34.139	0.93
Chestnut oak	12.42912	0.46087	329.68000	29.428	0.96	4.41306	11.449	0.99	0.81073	16.501	0.94
Post oak	12.86349	0.94766	-35.35108	26.226	0.90	4.51201	6.298	0.98	0.57498	8.404	0.94
All white oaks combined	14.52198	0.66306	607.65000	40.178	0.96	7.90665	12.152	0.99	0.83351	21.782	0.94

Continued

Table 7.--Inside-bark form-class segmented-profile coefficients for use when height to 7-inch d.o.b. top (southern softwood species) or 9-inch d.o.b. top (southern hardwood species) is known[1/] --Continued

Species or species group	Stem profile sections										
	Butt (stump to 4.5 ft)					Lower stem (4.5 to 17.3 ft)			Upper stem (above 17.3 ft)		
	Coefficients			Statistics		Coefficient	Statistics		Coefficient	Statistics	
	r	c	e	MSE[2/]	R^2 [3/]	p	MSE[2/]	R^2 [3/]	q	MSE[2/]	R^2 [3/]
Scarlet oak	18.30355	0.60872	689.33000	33.485	0.92	6.33216	8.530	0.98	0.71691	13.008	0.95
Southern red oak	15.60123	0.85057	330.49000	28.150	0.94	6.44760	7.442	0.99	0.74774	11.706	0.94
Cherrybark oak	25.85612	1.30682	18.28815	25.574	0.97	5.44066	9.015	0.98	0.68075	12.522	0.94
Water oak	19.34362	0.97238	312.28000	32.371	0.93	6.17519	6.777	0.99	0.70453	9.720	0.95
Nuttall oak	-6.10108	0.91746	-715.31000	81.970	0.97	13.63445	16.843	0.99	0.86288	39.101	0.93
Willow oak	12.19866	1.06860	82.03535	32.315	0.94	5.51792	7.571	0.99	0.72478	10.528	0.95
Northern red oak	19.27614	0.71461	395.04000	33.326	0.96	6.19723	8.424	0.99	0.76292	14.575	0.96
Black oak	16.94705	0.76609	154.47000	26.986	0.98	7.35601	8.735	0.99	0.73888	13.214	0.96
All red oaks combined	4.78943	0.90327	-456.56000	57.856	0.96	8.15359	11.373	0.99	0.84437	20.426	0.95
All oaks combined	6.82692	0.81097	-138.20000	54.439	0.95	8.05425	11.707	0.99	0.83987	20.988	0.95
Black locust	21.74255	0.43665	191.42000	20.470	0.95	3.85237	7.397	0.98	0.90554	13.751	0.89
All hardwoods combined	1.23461	0.73829	-103.39000	65.643	0.94	7.86939	14.699	0.99	0.85016	22.418	0.95

[1/] For use in equations 4, 5, and 6.

[2/] MSE = mean squared error.

[3/] R^2 = coefficient of determination.

Table 8.--Outside-bark form-class segmented-profile coefficients for use when height to 7-inch d.o.b. top (southern softwood species) or 9-inch d.o.b. top (southern hardwood species) is known[1/]

Species or species group	Stem profile sections										
	Butt (stump to 4.5 ft)					Lower stem (4.5 to 17.3 ft)			Upper stem (above 17.3 ft)		
	Coefficients			Statistics		Coefficient	Statistics		Coefficient	Statistics	
	r	c	e	MSE[2/]	R^2 [3/]	p	MSE[2/]	R^2 [3/]	q	MSE[2/]	R^2 [3/]
All pines combined	15.47887	0.45692	399.42000	29.704	0.96	5.11517	7.918	0.99	0.80988	11.936	0.98
Shortleaf pine	15.14298	0.49814	185.44000	25.094	0.97	6.23138	6.732	0.99	0.71935	10.598	0.98
Slash pine	15.86071	0.79879	32.01650	26.918	0.94	3.10595	4.899	0.99	0.84105	6.895	0.98
Longleaf pine	13.19894	0.50431	148.23000	22.085	0.96	3.15791	5.330	0.99	0.83838	7.325	0.98
Loblolly pine	13.91481	0.53603	408.96000	34.485	0.96	5.75992	8.105	0.99	0.80830	12.232	0.98
All major pines combined	16.87203	0.52890	334.25000	29.284	0.96	5.21364	7.709	0.99	0.78227	12.426	0.98
Sand pine	5.82114	0.20544	150.96000	6.690	0.98	2.47016	3.499	0.99	0.88019	3.248	0.98
Spruce pine	18.61713	0.48793	-24.79783	15.355	0.99	2.35354	6.207	0.99	0.85707	10.822	0.97
Table Mountain pine	11.59543	0.21424	334.83000	15.213	0.94	1.18296	8.768	0.96	0.81719	11.888	0.92
Pitch pine	6.19294	0.24259	236.19000	18.515	0.98	4.09038	7.583	0.99	0.74272	16.195	0.95
Pond pine	5.62236	0.34069	271.80000	17.839	0.95	2.32202	4.777	0.99	0.80551	6.920	0.98
White pine	6.87136	0.35027	128.13000	24.970	0.99	8.04857	9.657	0.99	0.98099	12.758	0.99
Virginia pine	6.42581	0.39525	67.30745	12.714	0.97	5.47021	5.689	0.99	0.76552	6.162	0.97
All other pines combined	4.24213	0.32140	165.92000	21.796	0.98	5.82466	7.971	0.99	0.90111	12.744	0.98
All cypress combined	14.46137	1.30587	4176.51000	119.330	0.67	7.72422	9.656	0.98	0.85148	6.732	0.98
Baldcypress	38.11305	2.32065	2979.96000	50.189	0.95	10.64254	7.169	0.99	0.84240	7.039	0.99
Pondcypress	18.43097	1.05331	6907.79000	132.390	0.56	6.55066	10.377	0.97	0.87742	6.226	0.98
Hemlock	16.02743	0.52446	229.35000	45.852	0.97	6.40943	14.836	0.99	0.96871	18.100	0.98
All soft hardwoods combined	-3.11908	0.59242	114.36000	70.831	0.90	8.13933	13.744	0.99	0.81529	19.198	0.96
Red maple	5.91760	0.32164	568.68000	35.553	0.94	3.17514	11.462	0.99	0.79510	21.340	0.93
Buckeye	10.57327	0.70093	-375.74000	68.873	0.89	2.08424	16.969	0.97	0.82886	13.506	0.97

Continued

Table 8.--Outside-bark form-class segmented-profile coefficients for use when height to 7-inch d.o.b. top (southern softwood species) or 9-inch d.o.b. top (southern hardwood species) is known[1/] --Continued

Species or species group	Stem profile sections											
	Butt (stump to 4.5 ft)					Lower stem (4.5 to 17.3 ft)			Upper stem (above 17.3 ft)			
	Coefficients			Statistics		Coefficient	Statistics		Coefficient	Statistics		
	r	c	e	MSE[2/]	R^2 [3/]	p	MSE[2/]	R^2 [3/]	q	MSE[2/]	R^2 [3/]	
Hackberry	5.11805	0.76070	462.92000	53.252	0.96	8.67683	19.705	0.98	0.85915	26.056	0.92	
Sweetgum	18.76491	0.80100	409.53000	33.825	0.98	10.83377	13.363	0.99	0.73494	18.175	0.96	
Yellow-poplar	11.95090	0.48169	213.85000	41.037	0.94	6.90029	9.213	0.99	0.86465	15.428	0.97	
Sweetbay	1.65489	1.12189	-372.80000	63.461	0.84	5.85242	12.779	0.97	0.83858	9.907	0.94	
Blackgum (Upland)	9.24963	0.44002	583.55000	31.481	0.93	6.48446	9.533	0.98	0.73330	11.692	0.96	
Blackgum (Lowland)	-2.69457	1.31881	173.96000	99.449	0.78	7.93153	15.011	0.96	0.76625	13.249	0.94	
Sycamore	11.15930	0.67195	131.17000	34.589	0.91	6.98201	8.931	0.98	0.95483	9.556	0.94	
Magnolia	9.75014	0.81264	-383.90000	25.167	0.89	2.09642	5.782	0.98	0.64955	7.685	0.96	
Basswood	22.22606	0.60818	-72.20484	38.580	0.94	5.26971	8.653	0.99	0.77524	13.726	0.96	
Elm	-0.32957	0.86669	-528.83000	57.347	0.96	10.58539	15.561	0.99	0.78728	21.891	0.94	
All hard hardwoods combined	8.01998	0.73791	42.19479	55.842	0.96	7.62666	14.014	0.99	0.81262	23.159	0.95	
Beech	21.73515	1.02323	828.44000	40.637	0.93	2.74241	9.481	0.99	0.75919	18.606	0.92	
Birch	20.99633	0.92591	-59.88405	25.160	0.96	4.96963	6.237	0.99	0.80917	10.872	0.94	
Hickory	12.67390	0.70780	-34.39883	35.971	0.94	9.04503	10.237	0.98	0.70579	16.355	0.94	
Pecan	11.83493	0.71599	505.21000	43.734	0.97	12.47009	20.392	0.98	0.79263	28.435	0.93	
White ash	7.23990	0.32334	920.05000	39.317	0.84	2.02236	10.802	0.98	0.74620	12.751	0.94	
Green ash	5.49448	0.58683	628.41000	46.151	0.98	6.41434	20.991	0.99	0.82710	22.939	0.93	
White oak	14.13459	0.71661	715.33000	36.764	0.93	6.69348	8.444	0.99	0.66489	16.283	0.94	
Overcup oak	10.88840	0.58882	1246.82000	59.870	0.97	9.60102	16.325	0.99	0.81278	39.410	0.93	
Chestnut oak	11.39883	0.40675	632.96000	33.906	0.96	4.12953	11.936	0.99	0.78383	19.781	0.95	
Post oak	11.75093	0.83101	182.95000	29.111	0.91	4.75212	7.645	0.98	0.58504	9.727	0.95	

Continued

Table 8.--Outside-bark form-class segmented-profile coefficients for use when height to 7-inch d.o.b. top (southern softwood species) or 9-inch d.o.b. top (southern hardwood species) is known[1]--Continued

Species or species group	Stem profile sections										
	Butt (stump to 4.5 ft)					Lower stem (4.5 to 17.3 ft)			Upper stem (above 17.3 ft)		
	Coefficients			Statistics		Coefficient	Statistics		Coefficient	Statistics	
	r	c	e	MSE[2]	R^2 [3]	p	MSE[2]	R^2 [3]	q	MSE[2]	R^2 [3]
All white oaks combined	13.91640	0.58215	963.71000	44.756	0.96	7.04293	12.692	0.99	0.82616	24.515	0.95
Scarlet oak	16.44524	0.57534	1035.09000	36.510	0.93	6.28220	9.681	0.98	0.70493	14.638	0.95
Southern red oak	13.60924	0.82728	420.35000	34.706	0.94	6.37541	8.512	0.99	0.74081	13.534	0.94
Cherrybark oak	24.95933	1.22038	120.96000	27.740	0.97	5.21492	9.754	0.99	0.68417	13.901	0.95
Water oak	18.24345	0.98079	345.89000	36.429	0.93	6.04975	7.729	0.99	0.69141	10.899	0.95
Nuttall oak	-4.97844	0.88006	-739.03000	83.756	0.97	13.79754	17.467	0.99	0.84317	42.863	0.93
Willow oak	11.99847	1.04563	231.41000	35.895	0.94	5.52944	8.627	0.99	0.71851	12.133	0.96
Northern red oak	18.60082	0.68041	664.10000	38.363	0.96	6.18733	9.243	0.99	0.74709	16.487	0.96
Black oak	15.94679	0.73065	213.62000	29.948	0.98	7.04140	9.499	0.99	0.71335	15.566	0.96
All red oaks combined	6.20263	0.86079	-356.31000	60.283	0.96	7.97778	12.758	0.99	0.82102	22.864	0.95
All oaks combined	7.80341	0.75012	72.13668	58.452	0.95	7.59305	12.757	0.99	0.82304	23.546	0.95
Black locust	15.13623	0.31591	229.66000	19.169	0.97	3.55627	6.413	0.99	0.88818	17.125	0.91
All hardwoods combined	2.24727	0.68306	20.11288	69.215	0.95	7.42340	15.997	0.99	0.82862	25.302	0.95

[1] For use in equations 4, 5, and 6.

[2] MSE = mean squared error.

[3] R^2 = coefficient of determination.

Table 9.--Regression coefficients for estimating d.i.b. at 4.5 feet from d.b.h, for southern tree species and species groups[1/]

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
All pines combined	-0.38344	0.91915	0.351	0.99	2.98
Shortleaf pine	-0.44121	0.93045	0.331	0.99	2.74
Slash pine	-0.55073	0.91887	0.291	0.99	2.79
Longleaf pine	-0.45903	0.92746	0.300	0.99	2.74
Loblolly pine	-0.48140	0.91413	0.378	0.99	3.08
All major pines combined	-0.45691	0.92059	0.369	0.99	3.13
Sand pine	-0.39956	0.95183	0.148	0.99	1.77
Spruce pine	-0.13301	0.93755	0.205	0.99	1.67
Table Mountain pine	0.05119	0.89372	0.284	0.97	2.23
Pitch pine	-0.58808	0.91852	0.259	0.99	2.20
Pond pine	-0.51271	0.90245	0.315	0.98	3.15
White pine	-0.31608	0.92054	0.312	0.99	2.27
Virginia pine	-0.31137	0.95011	0.204	0.99	1.92
All other pines combined	-0.17289	0.91572	0.391	0.99	3.40
All cypress combined	-1.14836	1.00761	0.530	0.98	4.40
Baldcypress	-0.27012	0.97546	0.145	0.99	1.06
Pondcypress	-0.94204	0.96735	0.484	0.97	4.44
Hemlock	-0.04931	0.92272	0.231	0.99	1.70
All soft hardwoods combined	-0.25063	0.94349	0.352	0.99	2.73
Cherry	-0.12958	0.94152	0.100	0.99	1.01
Red maple	-0.09800	0.94646	0.164	0.99	1.42
Buckeye	-0.35332	0.95955	0.217	0.99	1.66
Hackberry	-0.18338	0.95768	0.285	0.99	1.76
Sweetgum	-0.39271	0.95997	0.222	0.99	1.78
Yellow-poplar	-0.22976	0.92408	0.274	0.99	2.01
Sweetbay	-0.17978	0.92381	0.258	0.99	2.48
Water tupelo	-0.38140	0.97327	0.218	0.99	3.02
Blackgum (Upland)	0.19899	0.88941	0.354	0.99	2.86
Blackgum (Lowland)	-0.15231	0.93442	0.268	0.99	2.27
Sycamore	-0.09192	0.96411	0.160	0.99	1.25
Magnolia	-0.21114	0.94461	0.158	0.99	1.40

Continued

Table 9.--Regression coefficients for estimating d.i.b. at 4.5 feet from d.b.h, for southern tree species and species groups[1/]--Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Basswood	-0.35979	0.95322	0.253	0.99	1.93
Elm	-0.42027	0.96305	0.169	0.99	1.16
All hard hardwoods combined	-0.42001	0.94264	0.360	0.99	2.67
Beech	-0.13040	0.97071	0.142	0.99	1.10
Birch	0.21790	0.92290	0.194	0.99	1.75
Hickory	-0.60912	0.94347	0.282	0.99	2.28
Pecan	-0.52196	0.95283	0.355	0.99	2.19
White ash	-0.48735	0.93847	0.346	0.99	3.36
Green ash	-0.34316	0.93964	0.216	0.99	1.31
White oak	-0.24096	0.93789	0.263	0.99	2.02
Overcup oak	-0.37973	0.94380	0.369	0.99	2.12
Chestnut oak	-0.43197	0.92120	0.269	0.99	2.03
Post oak	-0.26493	0.91899	0.338	0.98	2.82
All white oaks combined	-0.34255	0.93494	0.339	0.99	2.50
Scarlet oak	-0.40860	0.94613	0.191	0.99	1.47
Southern red oak	-0.42141	0.93008	0.286	0.99	2.25
Cherrybark oak	-0.21801	0.93540	0.321	0.99	2.38
Laurel oak	-0.04612	0.93127	0.134	0.99	1.42
Water oak	-0.30330	0.95826	0.204	0.99	1.59
Nuttall oak	-0.34588	0.97000	0.171	0.99	0.88
Willow oak	-0.39728	0.94781	0.233	0.99	1.79
Northern red oak	-0.52266	0.95215	0.215	0.99	1.54
Black oak	-0.70754	0.94821	0.281	0.99	2.10
All red oaks combined	-0.61021	0.95803	0.338	0.99	2.45
All oaks combined	-0.49699	0.94832	0.345	0.99	2.52
Black locust	-0.37166	0.89193	0.319	0.99	2.83
All hardwoods combined	-0.33014	0.94215	0.377	0.99	2.77

[1/] DIBD = a + b (D)

where: DIBD = diameter inside bark at 4.5 feet

D = diameter outside bark at 4.5 feet

a and b = regression coefficients.

Table 10.--Regression coefficients for estimating d.i.b. at 17.3 feet from d.o.b. at 17.3 feet, for southern tree species and species groups[1/]

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
All pines combined	-0.29571	0.93417	0.275	0.99	2.63
Shortleaf pine	-0.26604	0.93598	0.242	0.99	2.21
Slash pine	-0.45544	0.93017	0.207	0.99	2.25
Longleaf pine	-0.37553	0.93761	0.229	0.99	2.38
Loblolly pine	-0.23631	0.92735	0.242	0.99	2.21
All major pines combined	-0.32395	0.93418	0.252	0.99	2.40
Sand pine	-0.14558	0.95183	0.110	0.99	1.52
Spruce pine	-0.14467	0.94027	0.150	0.99	1.37
Table Mountain pine	-0.53167	0.95057	0.232	0.99	2.18
Pitch pine	-0.45647	0.92238	0.200	0.99	1.93
Pond pine	-0.43779	0.90799	0.275	0.99	3.16
White pine	-0.14677	0.93025	0.241	0.99	2.01
Virginia pine	-0.21141	0.97267	0.124	0.99	1.33
All other pines combined	-0.07550	0.92512	0.387	0.99	3.84
All cypress combined	-0.88710	1.00538	0.361	0.99	3.76
Baldcypress	-0.34570	0.97943	0.093	0.99	0.82
Pondcypress	-0.71435	0.97004	0.374	0.98	4.45
Hemlock	-0.06858	0.91972	0.188	0.99	1.61
All soft hardwoods combined	-0.20059	0.92968	0.327	0.99	3.04
Cherry	-0.06283	0.92535	0.138	0.99	1.61
Red maple	-0.02454	0.93138	0.150	0.99	1.54
Buckeye	-0.19778	0.93880	0.227	0.99	2.06
Hackberry	-0.31197	0.95608	0.216	0.99	1.63
Sweetgum	-0.32168	0.93805	0.217	0.99	2.12
Yellow-poplar	-0.14213	0.91431	0.231	0.99	1.94
Sweetbay	-0.09170	0.90690	0.263	0.99	3.13
Water tupelo	-0.12842	0.92600	0.062	0.99	1.25
Blackgum (Upland)	0.02598	0.87980	0.297	0.99	2.89
Blackgum (Lowland)	-0.19064	0.91987	0.235	0.99	2.51
Sycamore	-0.11098	0.96899	0.135	0.99	1.26
Magnolia	-0.11323	0.93421	0.147	0.99	1.51

Continued

Table 10.--Regression coefficients for estimating d.i.b. at 17.3 feet from d.o.b. at 17.3 feet, for southern tree species and species groups[1/]--Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Basswood	-0.32506	0.95323	0.175	0.99	1.50
Elm	-0.46442	0.95512	0.204	0.99	1.67
All hard hardwoods combined	-0.35866	0.93619	0.322	0.99	2.80
Beech	-0.15005	0.96797	0.129	0.99	1.15
Birch	0.22282	0.91325	0.188	0.99	1.99
Hickory	-0.42376	0.92901	0.245	0.99	2.27
Pecan	-0.55539	0.95085	0.251	0.99	1.82
White ash	-0.44794	0.92092	0.365	0.99	4.20
Green ash	-0.42359	0.92974	0.256	0.99	2.12
White oak	-0.23229	0.93013	0.214	0.99	1.91
Overcup oak	-0.40015	0.94034	0.331	0.99	2.29
Chestnut oak	-0.27912	0.90638	0.223	0.99	1.91
Post oak	-0.19992	0.91679	0.226	0.99	2.19
All white oaks combined	-0.31276	0.92904	0.282	0.99	2.41
Scarlet oak	-0.26056	0.93886	0.177	0.99	1.55
Southern red oak	-0.19806	0.91242	0.243	0.99	2.27
Cherrybark oak	-0.37257	0.94226	0.212	0.99	1.84
Laurel oak	-0.03007	0.92124	0.140	0.99	1.83
Water oak	-0.16271	0.94463	0.142	0.99	1.30
Nuttall oak	-0.55940	0.97077	0.196	0.99	1.19
Willow oak	-0.36361	0.94087	0.177	0.99	1.63
Northern red oak	-0.39178	0.94604	0.206	0.99	1.69
Black oak	-0.49171	0.93021	0.235	0.99	2.04
All red oaks combined	-0.43232	0.94535	0.288	0.99	2.43
All oaks combined	-0.38071	0.93839	0.291	0.99	2.47
Black locust	-0.04833	0.86758	0.227	0.99	2.29
All hardwoods combined	-0.29487	0.93464	0.338	0.99	2.94

[1/] DIB17 = a + b (F)

where: DIB17 = diameter inside bark at 17.3 feet

F = diameter outside bark at 17.3 feet

a and b = regression coefficients.

Table 11.--Regression coefficients for estimating d.i.b. at 17.3 feet from d.b.h. and total height, for species and species groups across the South and in seven subregions[1/]

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
		SOUTHWIDE			
All pines combined	0.85435	-1.01846	0.581	0.99	5.55
Shortleaf pine	0.88563	-1.20730	0.555	0.99	5.07
Slash pine	0.85411	-1.34827	0.459	0.99	4.99
Longleaf pine	0.85759	-1.05479	0.477	0.99	4.94
Loblolly pine	0.85561	-1.31295	0.552	0.99	5.06
All major pines combined	0.85944	-1.13131	0.575	0.99	5.49
Sand pine	0.90095	-1.12377	0.330	0.99	4.53
Spruce pine	0.88631	-1.16238	0.378	0.99	3.45
Table Mountain pine	0.94135	-2.09975	0.427	0.99	4.02
Pitch pine	0.84422	-1.09157	0.456	0.99	4.41
Pond pine	0.82199	-0.76690	0.429	0.99	4.92
White pine	0.81014	-0.57310	0.535	0.99	4.46
Virginia pine	0.84779	-0.57823	0.370	0.99	4.00
All other pines combined	0.83703	-0.77470	0.572	0.99	5.67
All cypress combined	0.86379	-2.34185	0.872	0.99	9.09
Baldcypress	0.85709	-1.51481	0.728	0.99	6.41
Pondcypress	0.79384	-1.62356	0.819	0.99	9.76
Hemlock	0.81151	-0.53500	0.563	0.99	4.82
All soft hardwoods combined	0.83714	-1.37220	0.709	0.99	6.59
Cherry	0.85449	-0.90888	0.306	0.99	3.58
Red maple	0.88007	-1.61935	0.556	0.99	5.74
Buckeye	0.88025	-1.70436	0.678	0.99	6.15
Hackberry	0.82556	-1.04218	0.840	0.99	6.61
Sweetgum	0.83039	-1.47259	0.578	0.99	5.65
Yellow-poplar	0.84884	-1.60124	0.532	0.99	4.47
Sweetbay	0.76372	-0.50453	0.707	0.99	8.42
Water tupelo	0.69162	-0.71437	0.547	0.99	10.98
Blackgum (Upland)	0.79039	-0.78551	0.544	0.99	5.28
Blackgum (Lowland)	0.79883	-1.16431	0.730	0.99	7.80
Sycamore	0.84386	-1.17967	0.522	0.99	4.87

Continued

Table 11.--Regression coefficients for estimating d.i.b. at 17.3 feet from d.b.h. and total height, for species and species groups across the South and in seven subregions[1/] --Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Magnolia	0.83468	-0.51887	0.503	0.99	5.16
Basswood	0.84116	-0.49826	0.510	0.99	4.38
Elm	0.81020	-0.47383	0.754	0.99	6.17
All hard hardwoods combined	0.81479	-0.65727	0.806	0.99	6.99
Beech	0.88340	-0.86345	0.508	0.99	4.53
Birch	0.80280	-0.06620	0.697	0.99	7.39
Hickory	0.83602	-1.08572	0.618	0.99	5.72
Pecan	0.83058	-1.21315	0.902	0.99	6.55
White ash	0.84140	-1.57471	0.594	0.99	6.84
Green Ash	0.84047	-1.71696	0.874	0.99	7.24
White oak	0.87104	-1.53124	0.560	0.99	5.01
Overcup oak	0.80073	-0.81188	0.866	0.99	6.00
Chestnut oak	0.81297	-0.55468	0.569	0.99	4.87
Post oak	0.80909	-0.55189	0.522	0.99	5.08
All white oaks combined	0.81948	-0.62789	0.660	0.99	5.64
Scarlet oak	0.86515	-1.12761	0.419	0.99	3.70
Southern red oak	0.83258	-1.41913	0.480	0.99	4.53
Cherrybark oak	0.86843	-1.94723	0.511	0.99	4.44
Laurel oak	0.80897	-0.59108	0.374	0.99	4.88
Water oak	0.82379	-0.59447	0.443	0.99	4.06
Nuttall oak	0.83420	-0.88657	0.848	0.99	5.16
Willow oak	0.82093	-1.02266	0.517	0.99	4.75
Northern red oak	0.83307	-0.81521	0.538	0.99	4.45
Black oak	0.82617	-0.88969	0.486	0.99	4.22
All red oaks combined	0.83439	-0.94555	0.619	0.99	5.22
All oaks combined	0.82857	-0.81753	0.637	0.99	5.41
Black locust	0.80385	-1.12726	0.449	0.99	4.53
All hardwoods combined	0.82131	-0.94452	0.851	0.99	7.42
GULF AND ATLANTIC COASTAL PLAIN					
All pines combined	0.83618	-0.91452	0.536	0.99	5.64
Slash pine	0.85504	-1.52260	0.488	0.99	5.43

Continued

Table 11.--Regression coefficients for estimating d.i.b. at 17.3 feet from d.b.h. and total height, for species and species groups across the South and in seven subregions[1/] --Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Longleaf pine	0.84822	-0.94775	0.462	0.99	4.86
Loblolly pine	0.84885	-1.30374	0.599	0.99	5.76
All major pines combined	0.84156	-1.04168	0.547	0.99	5.63
Sand pine	0.90095	-1.12377	0.330	0.99	4.53
Pond pine	0.82199	-0.76690	0.429	0.99	4.92
All cypress combined	0.86379	-2.34185	0.872	0.99	9.09
Baldcypress	0.85709	-1.51481	0.728	0.99	6.41
Pondcypress	0.79384	-1.62356	0.819	0.99	9.76
All soft hardwoods combined	0.81339	-1.35403	0.716	0.99	8.87
Sweetgum	0.82664	-1.08149	0.446	0.99	5.19
Yellow-poplar	0.83933	-1.23564	0.445	0.99	4.50
Sweetbay	0.70806	-0.04295	0.699	0.99	8.52
Blackgum (Lowland)	0.79883	-1.16431	0.730	0.99	7.80
Red maple	0.89814	-1.64805	0.293	0.99	4.29
Water tupelo	0.69162	-0.71437	0.547	0.99	10.98
All hard hardwoods combined	0.83043	-0.95711	0.652	0.99	5.81
White oak	0.87104	-1.53124	0.560	0.99	5.01
Laurel oak	0.80897	-0.59108	0.374	0.99	4.88
Water oak	0.80876	-0.50661	0.579	0.99	4.37
Willow oak	0.84765	-1.96750	0.557	0.99	4.68
All red oaks combined	0.79440	-0.49418	0.527	0.99	4.79
All oaks combined	0.83006	-0.90255	0.652	0.99	5.75
All hardwoods combined	0.82643	-1.36470	0.741	0.99	8.11
		PIEDMONT			
All pines combined	0.84935	-1.01837	0.573	0.99	5.66
Shortleaf pine	0.87910	-1.30480	0.513	0.99	5.22
Longleaf pine	0.86684	-1.17085	0.422	0.99	3.77
Loblolly pine	0.84322	-1.14334	0.563	0.99	5.42
All major pines combined	0.85206	-1.10383	0.559	0.99	5.46
Virginia pine	0.84549	-0.53918	0.447	0.99	4.95
All soft hardwoods combined	0.83790	-1.50180	0.564	0.99	5.78

Continued

Table 11.--Regression coefficients for estimating d.i.b. at 17.3 feet from d.b.h. and total height, for species and species groups across the South and in seven subregions[1/] --Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Red maple	0.75662	0.01564	0.348	0.99	4.83
Sweetgum	0.84185	-1.81811	0.544	0.99	6.18
Yellow-poplar	0.82792	-1.25025	0.441	0.99	4.10
Sycamore	0.84403	-1.16307	0.587	0.99	5.16
Elm	0.86488	-1.59558	0.767	0.99	7.38
All hard hardwoods combined	0.86025	-1.32287	0.558	0.99	5.52
Hickory	0.83736	-0.83608	0.631	0.99	6.07
White oak	0.87668	-1.61701	0.530	0.99	5.22
Chestnut oak	0.87906	-1.34978	0.467	0.99	4.22
Post oak	0.79081	-0.34721	0.486	0.99	4.92
All white oaks combined	0.87557	-1.52320	0.513	0.99	4.91
Scarlet oak	0.86356	-0.94497	0.569	0.99	5.18
Southern red oak	0.83560	-1.39597	0.512	0.99	5.13
Water oak	0.87003	-1.39341	0.368	0.99	3.75
Black oak	0.83478	-1.15638	0.496	0.99	5.05
All red oaks combined	0.85797	-1.39149	0.547	0.99	5.40
All oaks combined	0.86172	-1.34644	0.549	0.99	5.39
All hardwoods combined	0.83911	-1.15690	0.592	0.99	5.92
APPALACHIAN MOUNTAINS					
All pines	0.83153	-0.59760	0.560	0.99	5.20
Shortleaf pine	0.89145	-1.23279	0.407	0.99	3.76
Table Mountain pine	0.94135	-2.09975	0.427	0.99	4.02
Pitch pine	0.84422	-1.09157	0.456	0.99	4.41
Virginia pine	0.84378	-0.35007	0.393	0.99	4.12
All yellow pines combined	0.86999	-1.02577	0.502	0.99	4.90
White pine	0.81014	-0.57310	0.535	0.99	4.46
Hemlock	0.81151	-0.53500	0.563	0.99	4.82
All soft hardwoods combined	0.84509	-1.15525	0.641	0.99	5.47
Red maple	0.86689	-1.36809	0.476	0.99	4.32
Buckeye	0.88025	-1.70436	0.678	0.99	6.15
Yellow-poplar	0.86519	-2.04685	0.523	0.99	3.88

Continued

Table 11.--Regression coefficients for estimating d.i.b. at 17.3 feet from d.b.h. and total height, for species and species groups across the South and in seven subregions[1/] --Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Blackgum (Upland)	0.78470	-0.65579	0.802	0.99	6.85
Basswood	0.84116	-0.49826	0.510	0.99	4.38
All hard hardwoods combined	0.82671	-0.84167	0.738	0.99	7.11
Birch	0.80280	-0.06620	0.697	0.99	7.39
Hickory	0.83626	-1.07179	0.673	0.99	5.82
Beech	0.85250	-0.62346	0.341	0.99	2.91
White ash	0.83090	-1.18637	0.433	0.99	4.93
White oak	0.81142	-0.56323	0.735	0.99	6.36
Chestnut oak	0.79580	-0.45995	0.664	0.99	5.53
All white oaks combined	0.81548	-0.67382	0.672	0.99	5.62
Scarlet oak	0.87070	-1.22351	0.511	0.99	4.30
Southern red oak	0.82778	-1.31455	0.690	0.99	6.62
Northern red oak	0.84559	-1.13114	0.550	0.99	4.22
Black oak	0.82254	-0.78424	0.429	0.99	3.49
All red oaks combined	0.83966	-0.97461	0.548	0.99	4.46
All oaks combined	0.82813	-0.84795	0.636	0.99	5.25
Black locust	0.80385	-1.12726	0.449	0.99	4.53
All hardwoods combined	0.83678	-1.03135	0.645	0.99	5.55
UPPER COASTAL PLAIN					
All pines combined	0.85116	-0.91480	0.624	0.99	5.49
Shortleaf pine	0.88173	-1.10050	0.375	0.99	3.37
Loblolly pine	0.81431	-0.64282	0.711	0.99	5.73
All major pines combined	0.85228	-0.94008	0.630	0.99	5.4
Virginia pine	0.80326	0.01326	0.359	0.99	3.6
All soft hardwoods combined	0.83340	-1.30335	0.587	0.99	4.90
Sweetgum	0.80754	-0.89435	0.629	0.99	5.81
Yellow-poplar	0.84339	-1.14478	0.374	0.99	2.65
All hard hardwoods combined	0.85893	-1.29695	0.576	0.99	4.93
Hickory	0.87616	-1.52452	0.523	0.99	4.52
White oak	0.88140	-1.43660	0.540	0.99	4.45
Chestnut oak	0.81972	-0.53303	0.354	0.99	2.95

Continued

Table 11.--Regression coefficients for estimating d.i.b. at 17.3 feet from d.b.h. and total height, for species and species groups across the South and in seven subregions[1/] --Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Post oak	0.79353	-0.29955	0.55	0.99	5.76
All white oaks combined	0.86600	-1.32802	0.537	0.99	4.70
Scarlet oak	0.79932	-0.04135	0.739	0.99	5.85
Southern red oak	0.82383	-1.13440	0.305	0.99	2.63
All red oaks combined	0.82231	-0.74373	0.630	0.99	5.19
All oaks combined	0.85175	-1.18487	0.590	0.99	5.03
All hardwoods combined	0.84184	-1.03862	0.612	0.99	5.20
		DEEP SOUTH			
All pines combined	0.87543	-1.30832	0.533	0.99	4.99
Shortleaf pine	0.88398	-1.31215	0.568	0.99	5.50
Slash pine	0.84805	-1.20946	0.477	0.99	4.84
Spruce pine	0.88631	-1.16238	0.378	0.99	3.45
Longleaf pine	0.89579	-1.48645	0.409	0.99	4.16
Loblolly pine	0.87759	-1.50283	0.535	0.99	4.44
All major pines combined	0.87535	-1.32793	0.527	0.99	4.94
All soft hardwoods combined	0.83316	-0.96759	0.567	0.99	5.71
Red maple	0.86263	-1.48044	0.629	0.99	6.36
Sweetgum	0.85619	-1.82974	0.476	0.99	4.53
Yellow-poplar	0.83482	-0.77222	0.505	0.99	4.62
Magnolia	0.83468	-0.51887	0.503	0.99	5.16
Sweetbay	0.83164	-0.95206	0.363	0.99	4.20
Blackgum (Upland)	0.80203	-0.86517	0.472	0.99	5.03
Sycamore	0.84479	-1.23611	0.477	0.99	4.78
Elm	0.93595	-2.15166	0.566	0.99	5.30
All hard hardwoods combined	0.85487	-1.30362	0.660	0.99	6.25
Hickory	0.90918	-2.81354	0.547	0.99	5.30
Beech	0.87673	-0.65131	0.501	0.99	4.50
Green ash	0.84047	-1.71696	0.771	0.99	9.01
White oak	0.88643	-1.90252	0.613	0.99	5.65
Post oak	0.83044	-0.86119	0.597	0.99	6.00
All white oaks combined	0.84877	-1.10681	0.623	0.99	6.00

Continued

Table 11.--Regression coefficients for estimating d.i.b. at 17.3 feet from d.b.h. and total height, for species and species groups across the South and in seven subregions[1/] --Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Southern red oak	0.86068	-1.86990	0.577	0.99	5.34
Cherrybark oak	0.86843	-1.94723	0.511	0.99	4.44
Water oak	0.82815	-0.48062	0.544	0.99	4.77
Willow oak	0.83930	-1.18982	0.455	0.99	4.60
All red oaks combined	0.83556	-1.07456	0.546	0.99	5.00
All oaks combined	0.84913	-1.26366	0.584	0.99	5.47
All hardwoods combined	0.84708	-1.17930	0.619	0.99	5.97
ARKANSAS AREA					
All pines combined	0.85116	-0.59055	0.610	0.99	4.78
Shortleaf pine	0.87049	-0.84867	0.578	0.99	4.67
Loblolly pine	0.84240	-0.98577	0.541	0.99	3.87
Blackgum (Upland)	0.80936	-1.10476	0.530	0.99	5.04
All hard hardwoods combined	0.83614	-1.05156	0.531	0.99	4.70
Hickory	0.86611	-1.67304	0.528	0.99	4.79
White oak	0.85632	-1.30848	0.524	0.99	4.59
Post oak	0.80519	-0.69129	0.466	0.99	4.11
All white oaks combined	0.85264	-1.31605	0.527	0.99	4.61
Southern red oak	0.83613	-1.81272	0.484	0.99	4.27
Northern red oak	0.82932	-0.68467	0.494	0.99	4.40
Black oak	0.82214	-0.90267	0.498	0.99	4.39
All red oaks combined	0.82755	-0.82252	0.531	0.99	4.64
All oaks combined	0.82981	-0.93016	0.530	0.99	4.70
All hardwoods combined	0.84055	-1.18410	0.560	0.99	4.98
DELTA AREA					
All soft hardwoods combined	0.83389	-1.25757	0.728	0.99	5.18
Hackberry	0.82055	-0.88550	0.801	0.99	6.02
Sweetgum	0.83039	-1.47259	0.578	0.99	5.65
Yellow-poplar	0.84957	-1.68268	0.468	0.99	3.45
Elm	0.84108	-1.49121	0.768	0.99	5.65
All hard hardwoods combined	0.79268	-0.49207	1.178	0.99	8.97
Hickory	0.85869	-1.64459	0.448	0.99	4.35

Continued

Table 11.--Regression coefficients for estimating d.i.b. at 17.3 feet from d.b.h. and total height, for species and species groups across the South and in seven subregions[1/] --Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Pecan	0.83058	-1.21315	0.902	0.99	6.55
Green ash	0.84047	-1.71696	0.874	0.99	7.24
White oak	0.88648	-1.41252	0.726	0.99	5.95
Post oak	0.85734	-0.76557	0.543	0.99	4.90
Overcup oak	0.80595	-0.92699	0.940	0.99	6.19
All white oaks combined	0.79655	-0.29663	0.924	0.99	6.75
Southern red oak	0.91091	-2.64940	0.654	0.99	5.40
Nuttall oak	0.83420	-0.88657	0.848	0.99	5.16
Black oak	0.82015	-0.80806	0.676	0.99	5.66
All red oaks combined	0.84475	-1.23740	0.790	0.99	5.40
All oaks combined	0.82476	-0.78786	0.872	0.99	6.32
All hardwoods combined	0.81055	-0.94783	1.060	0.99	7.82

[1/] $DIB17 = D(a + b(17.3/H)^2)$

where: DIB17 = d.i.b. at 17.3 feet in inches

D = d.b.h. in inches

H = tree total height in feet

a and b = regression coefficients

Table 12.--Regression coefficients for estimating d.o.b. at 17.3 feet from d.b.h. and total height, for species and species groups across the South and in seven subregions[1/]

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
		SOUTHWIDE			
All pines combined	0.91750	-0.75389	0.538	0.99	4.67
Shortleaf pine	0.93394	-0.71880	0.499	0.99	4.13
Slash pine	0.93461	-1.09653	0.427	0.99	4.09
Longleaf pine	0.92898	-1.06670	0.422	0.99	3.94
Loblolly pine	0.92022	-1.04015	0.528	0.99	4.37
All major pines combined	0.92527	-0.87746	0.521	0.99	4.50
Sand pine	0.94744	-1.02854	0.315	0.99	4.04
Spruce pine	0.93707	-0.88937	0.368	0.99	3.11
Table Mountain pine	1.00657	-1.95639	0.428	0.99	3.65
Pitch pine	0.91948	-0.70394	0.449	0.99	3.84
Pond pine	0.90932	-0.44463	0.368	0.99	3.65
White pine	0.87525	-0.49510	0.516	0.99	3.95
Virginia pine	0.88560	-0.55140	0.367	0.99	3.78
All other pines combined	0.89173	-0.51199	0.516	0.99	4.70
All cypress combined	0.88531	-1.59535	0.722	0.99	6.92
Baldcypress	0.88774	-1.27408	0.682	0.99	5.71
Pondcypress	0.84368	-1.16304	0.695	0.99	7.40
Hemlock	0.88233	-0.47214	0.566	0.99	4.43
All soft hardwoods combined	0.90245	-1.20221	0.731	0.99	6.20
Cherry	0.92487	-0.89867	0.366	0.99	3.92
Red maple	0.93991	-1.62226	0.574	0.99	5.51
Buckeye	0.95219	-1.83725	0.709	0.99	5.93
Hackberry	0.86910	-0.81196	0.842	0.99	6.18
Sweetgum	0.89123	-1.14145	0.631	0.99	5.61
Yellow-poplar	0.92919	-1.47777	0.528	0.99	4.01
Sweetbay	0.82921	-0.21525	0.695	0.99	7.43
Water tupelo	0.74608	-0.55725	0.598	0.99	10.83
Blackgum (Upland)	0.88830	-0.76044	0.587	0.99	5.03
Blackgum (Lowland)	0.86770	-0.99155	0.756	0.99	7.28
Sycamore	0.87174	-1.02304	0.528	0.99	4.73

Continued

Table 12.--Regression coefficients for estimating d.o.b. at 17.3 feet from d.b.h. and total height, for species and species groups across the South and in seven subregions[1/] --Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Magnolia	0.89035	-0.36485	0.547	0.99	5.19
Basswood	0.87854	0.18247	0.510	0.99	4.06
Elm	0.83337	0.41856	0.765	0.99	5.80
All hard hardwoods combined	0.87243	-0.23513	0.809	0.99	6.37
Beech	0.91141	-0.66730	0.525	0.99	4.47
Birch	0.85516	-0.00134	0.667	0.99	6.61
Hickory	0.89772	-0.39920	0.641	0.99	5.29
Pecan	0.87734	-0.53003	0.907	0.99	6.02
White ash	0.91531	-0.96788	0.618	0.99	6.23
Green ash	0.94193	-1.49985	0.940	0.99	6.99
White oak	0.93266	-1.23167	0.590	0.99	4.81
Overcup oak	0.85146	-0.33596	0.827	0.99	5.25
Chestnut oak	0.89280	-0.08423	0.579	0.99	4.37
Post oak	0.87574	-0.24370	0.497	0.99	4.35
All white oaks combined	0.87759	-0.15654	0.681	0.99	5.26
Scarlet oak	0.92204	-0.83926	0.467	0.99	3.78
Southern red oak	0.89375	-0.94777	0.549	0.99	4.65
Cherrybark oak	0.91590	-1.31763	0.577	0.99	4.58
Laurel oak	0.84882	-0.29314	0.400	0.99	4.79
Water oak	0.86881	-0.29747	0.452	0.99	3.86
Nuttall oak	0.86807	-0.36240	0.860	0.99	4.92
Willow oak	0.87548	-0.57500	0.513	0.99	4.29
Northern red oak	0.88329	-0.32529	0.517	0.99	3.91
Black oak	0.88567	-0.21760	0.528	0.99	4.08
All red oaks combined	0.88290	-0.40049	0.639	0.99	4.92
All oaks combined	0.88047	-0.29054	0.658	0.99	5.08
Black locust	0.92160	-1.07997	0.537	0.99	4.68
All hardwoods combined	0.88067	-0.62804	0.876	0.99	6.96
GULF AND ATLANTIC COASTAL PLAIN					
All pines combined	0.90439	-0.64356	0.493	0.99	4.67
Slash pine	0.92729	-1.05973	0.465	0.99	4.57

Continued

Table 12.--Regression coefficients for estimating d.o.b. at 17.3 feet from d.b.h. and total height, for species and species groups across the South and in seven subregions[1/] --Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Longleaf pine	0.91386	-0.69511	0.431	0.99	4.09
Loblolly pine	0.91127	-1.03660	0.560	0.99	4.90
All major pines combined	0.90275	-0.68762	0.518	0.99	4.82
Sand pine	0.94744	-1.02854	0.315	0.99	4.04
Pond pine	0.90932	-0.44463	0.368	0.99	3.65
All cypress combined	0.88531	-1.59535	0.722	0.99	6.92
Baldcypress	0.88774	-1.27408	0.682	0.99	5.71
Pondcypress	0.84368	-1.16304	0.695	0.99	7.40
All soft hardwoods combined	0.87823	-1.15187	0.741	0.99	8.30
Sweetgum	0.87883	-0.71205	0.479	0.99	5.06
Yellow-poplar	0.90225	-0.99104	0.484	0.99	4.47
Sweetbay	0.78644	-0.12807	0.759	0.99	8.20
Blackgum (Lowland)	0.86770	-0.99155	0.756	0.99	7.28
Red maple	0.93051	-1.38937	0.319	0.99	4.40
Water tupelo	0.74608	-0.55725	0.598	0.99	10.83
All hard hardwoods combined	0.90227	-0.83316	0.649	0.99	5.32
White oak	0.93266	-1.23167	0.590	0.99	4.81
Laurel oak	0.84882	-0.29314	0.400	0.99	4.79
Water oak	0.84687	-0.17495	0.589	0.99	4.16
Willow oak	0.88293	-1.08120	0.528	0.99	4.05
All red oaks	0.84974	-0.31186	0.521	0.99	4.37
All oaks combined	0.88839	-0.72850	0.647	0.99	5.24
All hardwoods combined	0.88948	-1.17512	0.741	0.99	7.37
		PIEDMONT			
All pines combined	0.92346	-0.96754	0.540	0.99	4.86
Shortleaf pine	0.93925	-1.03904	0.494	0.99	4.57
Longleaf pine	0.94949	-1.11778	0.361	0.99	2.91
Loblolly pine	0.91747	-1.04471	0.552	0.99	4.81
All major pines combined	0.92308	-0.96128	0.538	0.99	4.76
Virginia pine	0.87949	-0.43848	0.406	0.99	4.27
All soft hardwoods combined	0.90585	-1.33900	0.602	0.99	5.63

Continued

Table 14.--Regression coefficients for estimating d.o.b. at 17.3 feet from d.b.h. and height to 4-inch d.o.b. top, for species and species groups across the South and in seven subregions[1/] -- Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Magnolia	0.89693	-0.25550	0.534	0.99	5.07
Basswood	0.88197	0.05921	0.507	0.99	4.01
Elm	0.84680	0.07349	0.769	0.99	5.83
All hard hardwoods combined	0.87101	-0.10646	0.766	0.99	5.99
Beech	0.90273	-0.23267	0.514	0.99	4.38
Birch	0.86814	-0.16330	0.732	0.99	7.28
Hickory	0.89612	-0.19676	0.634	0.99	5.22
Pecan	0.87073	-0.23244	0.913	0.99	6.06
White ash	0.90149	-0.36118	0.614	0.99	6.14
Green ash	0.93950	-0.78803	0.810	0.99	8.17
White oak	0.90583	-0.35564	0.588	0.99	4.79
Overcup oak	0.84975	-0.18153	0.818	0.99	5.19
Chestnut oak	0.88974	-0.01272	0.576	0.99	4.34
Post oak	0.87920	-0.16042	0.490	0.99	4.29
All white oaks combined	0.87926	-0.10932	0.679	0.99	5.24
Scarlet oak	0.90833	-0.30703	0.456	0.99	3.66
Southern red oak	0.87043	-0.27635	0.544	0.99	4.55
Cherrybark oak	0.89719	-0.46761	0.553	0.99	4.39
Laurel oak	0.83095	-0.04946	0.414	0.99	4.88
Water oak	0.86046	-0.05366	0.441	0.99	3.73
Nuttall oak	0.86627	-0.16938	0.862	0.99	4.93
Willow oak	0.87070	-0.24999	0.504	0.99	4.22
Northern red oak	0.87556	-0.08069	0.510	0.99	3.84
Black oak	0.88643	-0.12938	0.511	0.99	3.93
All red oaks combined	0.87843	-0.17067	0.631	0.99	4.84
All oaks combined	0.87861	-0.14191	0.652	0.99	5.02
Black locust	0.89903	-0.28617	0.545	0.99	4.75
All hardwoods combined	0.87189	-0.19623	0.840	0.99	6.63
GULF AND ATLANTIC COASTAL PLAIN					
All pines combined	0.89655	-0.27541	0.442	0.99	4.10
Slash pine	0.90820	-0.33588	0.388	0.99	3.75

Continued

Table 14.--Regression coefficients for estimating d.o.b. at 17.3 feet from d.b.h. and height to 4-inch d.o.b. top, for species and species groups across the South and in seven subregions[1/] -- Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Longleaf pine	0.90652	-0.30980	0.371	0.99	3.42
Loblolly pine	0.89380	-0.39562	0.538	0.99	4.43
All major pines combined	0.89848	-0.30721	0.453	0.99	4.06
Sand pine	0.89177	-0.23376	0.380	0.99	4.84
Pond pine	0.90114	-0.22623	0.351	0.99	3.49
All other pines	0.89918	-0.24201	0.369	0.99	4.13
All cypress	0.85891	-0.68793	0.724	0.99	6.95
Baldcypress	0.86620	-0.50806	0.676	0.99	5.66
Pondcypress	0.82401	-0.51290	0.687	0.99	7.32
All soft hardwoods	0.84196	-0.25298	0.754	0.99	8.19
Sweetgum	0.86712	-0.26051	0.455	0.99	4.70
Yellow-poplar	0.87799	-0.20585	0.495	0.99	4.57
Sweetbay	0.80326	-0.07172	0.756	0.99	8.16
Blackgum (Lowland)	0.83849	-0.27067	0.767	0.99	7.26
Red maple	0.87223	-0.14734	0.343	0.99	4.66
Water tupelo	0.67498	-0.06215	0.592	0.99	10.58
All hard hardwoods combined	0.87589	-0.26303	0.644	0.99	5.21
White oak	0.90583	-0.35564	0.588	0.99	4.79
Laurel oak	0.83095	-0.04946	0.414	0.99	4.88
Water oak	0.84028	-0.01205	0.590	0.99	4.16
Willow oak	0.88751	-0.65710	0.509	0.99	3.90
All red oaks combined	0.84678	-0.11646	0.508	0.99	4.24
All oaks combined	0.87558	-0.26361	0.650	0.99	5.27
All hardwoods combined	0.85637	-0.28475	0.781	0.99	7.67
		PIEDMONT			
All pines combined	0.90891	-0.37140	0.472	0.99	3.95
Shortleaf pine	0.91520	-0.28596	0.387	0.99	3.26
Longleaf pine	0.94237	-0.68607	0.355	0.99	2.86
Loblolly pine	0.90655	-0.41558	0.522	0.99	4.11
All major pines combined	0.90963	-0.35629	0.477	0.99	3.85
Virginia pine	0.87457	-0.21645	0.394	0.99	4.12

Continued

Table 12.--Regression coefficients for estimating d.o.b. at 17.3 feet from d.b.h. and total height, for species and species groups across the South and in seven subregions[1/] --Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Red maple	0.78534	0.32305	0.361	0.99	4.70
Sweetgum	0.90716	-1.58897	0.597	0.99	6.17
Yellow-poplar	0.91158	-1.14432	0.433	0.99	3.62
Sycamore	0.87537	-1.22361	0.595	0.99	5.04
Elm	0.93432	-1.51214	0.757	0.99	6.66
All hard hardwoods combined	0.92492	-0.96243	0.612	0.99	5.46
Hickory	0.91940	-0.69950	0.659	0.99	5.69
White oak	0.93949	-1.33686	0.618	0.99	5.53
Chestnut oak	0.97530	-1.16493	0.430	0.99	3.42
Post oak	0.85762	-0.05520	0.491	0.99	4.46
All white oaks combined	0.94716	-1.22230	0.597	0.99	5.14
Scarlet oak	0.93148	-0.81537	0.580	0.99	4.83
Southern red oak	0.89310	-0.85748	0.617	0.99	5.54
Water oak	0.92112	-1.18873	0.380	0.99	3.60
Black oak	0.92716	-0.99562	0.554	0.99	4.97
All red oaks combined	0.91384	-0.92692	0.565	0.99	5.05
All oaks combined	0.92305	-0.93937	0.605	0.99	5.36
All hardwoods combined	0.90281	-0.80783	0.645	0.99	5.85
APPALACHIAN MOUNTAINS					
All pines and hemlock combined	0.89200	-0.43162	0.528	0.99	4.516
Shortleaf pine	0.94609	-0.86655	0.402	0.99	3.39
Table Mountain pine	1.00657	-1.95639	0.428	0.99	3.65
Pitch pine	0.91948	-0.70394	0.449	0.99	3.84
Virginia pine	0.87457	-0.22573	0.406	0.99	4.06
All yellow pines combined	0.92528	-0.77946	0.472	0.99	4.25
White pine	0.87525	-0.49510	0.516	0.99	3.95
Hemlock	0.88233	-0.47214	0.566	0.99	4.43
All soft hardwoods combined	0.92008	-1.10972	0.591	0.99	4.59
Red maple	0.92495	-1.23198	0.458	0.99	3.84
Buckeye	0.95219	-1.83725	0.709	0.99	5.93
Yellow-poplar	0.92431	-1.19955	0.521	0.99	3.50

Continued

Table 12.--Regression coefficients for estimating d.o.b. at 17.3 feet from d.b.h. and total height, for species and species groups across the South and in seven subregions[1/] --Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Blackgum (Upland)	0.90024	-0.74702	0.826	0.99	6.14
Basswood	0.87854	-0.18247	0.510	0.99	4.06
All hard hardwoods combined	0.88636	-0.34851	0.640	0.99	5.02
Birch	0.85516	-0.00134	0.738	0.99	7.11
Hickory	0.90046	-0.48444	0.697	0.99	5.41
Beech	0.88404	-0.50032	0.387	0.99	3.16
White ash	0.89948	-0.53103	0.374	0.99	3.77
White oak	0.86488	-0.12071	0.785	0.99	6.21
Chestnut oak	0.86544	0.16634	0.694	0.99	5.13
All white oaks combined	0.88037	-0.18030	0.683	0.99	5.14
Scarlet oak	0.91090	-0.61067	0.572	0.99	4.43
Southern red oak	0.89986	-0.83810	0.702	0.99	5.95
Northern red oak	0.88453	-0.44088	0.554	0.99	3.92
Black oak	0.88139	-0.09673	0.499	0.99	3.64
All red oaks combined	0.88785	-0.36663	0.555	0.99	4.12
All oaks combined	0.87967	-0.19478	0.644	0.99	4.82
Black locust	0.92160	-1.07997	0.537	0.99	4.68
All hardwoods combined	0.90085	-0.67373	0.633	0.99	4.93
UPPER COASTAL PLAIN					
All pines combined	0.92503	-0.76642	0.546	0.99	4.36
Shortleaf pine	0.93193	-0.55548	0.339	0.99	2.78
Loblolly pine	0.89604	-0.45007	0.623	0.99	4.49
All major pines combined	0.91629	-0.53803	0.524	0.99	4.07
Virginia pine	0.84114	0.10523	0.389	0.99	3.77
All soft hardwoods combined	0.91264	-0.88947	0.581	0.99	4.33
Sweetgum	0.88671	-0.54030	0.598	0.99	4.93
Yellow-poplar	0.90533	-0.02909	0.370	0.99	2.35
All hard hardwoods combined	0.92820	-0.90130	0.566	0.99	4.35
Hickory	0.92886	-0.60142	0.491	0.99	3.79
White oak	0.95156	-1.38428	0.560	0.99	4.24
Chestnut oak	0.89084	0.25894	0.349	0.99	2.56

Continued

Table 12.--Regression coefficients for estimating d.o.b. at 17.3 feet from d.b.h. and total height, for species and species groups across the South and in seven subregions[1/] --Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Post oak	0.86909	-0.03502	0.487	0.99	4.56
All white oaks combined	0.93382	-0.95965	0.527	0.99	4.17
Scarlet oak	0.86030	0.55111	0.683	0.99	4.88
Southern red oak	0.92595	-1.37014	0.410	0.99	3.17
All red oaks combined	0.90158	-0.57238	0.616	0.99	4.56
All oaks combined	0.92319	-0.87283	0.575	0.99	4.41
All hardwoods combined	0.92231	-0.83441	0.581	0.99	4.43
		DEEP SOUTH			
All pines combined	0.93529	-1.00727	0.465	0.99	3.97
Shortleaf pine	0.94050	-1.08472	0.485	0.99	4.32
Slash pine	0.92169	-0.77285	0.380	0.99	3.43
Spruce pine	0.93707	-0.88937	0.368	0.99	3.11
Longleaf pine	0.94888	-1.04845	0.363	0.99	3.35
Loblolly pine	0.94170	-1.30697	0.500	0.99	3.80
All major pines combined	0.93669	-1.03986	0.459	0.99	3.92
All soft hardwoods combined	0.88924	-0.71157	0.589	0.99	5.45
Red maple	0.91519	-1.35881	0.708	0.99	6.66
Sweetgum	0.91639	-1.37787	0.525	0.99	4.52
Yellow-poplar	0.90054	-0.48677	0.495	0.99	4.13
Magnolia	0.89035	-0.36485	0.547	0.99	5.19
Sweetbay	0.88032	-0.52239	0.358	0.99	3.76
Blackgum (Upland)	0.86742	-0.60898	0.526	0.99	5.06
Sycamore	0.86572	-0.82194	0.474	0.99	4.53
Elm	0.97716	-1.62397	0.523	0.99	4.49
All hard hardwoods combined	0.90731	-0.84995	0.600	0.99	5.18
Hickory	0.97486	-2.23035	0.528	0.99	4.56
Beech	0.90180	-0.40063	0.504	0.99	4.32
Green ash	0.94193	-1.49985	0.864	0.99	8.72
White oak	0.95112	-1.65318	0.593	0.99	4.98
Post oak	0.90539	-0.59791	0.652	0.99	5.84
All white oaks combined	0.91135	-0.72173	0.653	0.99	5.67

Continued

Table 12.--Regression coefficients for estimating d.o.b. at 17.3 feet from d.b.h. and total height, for species and species groups across the South and in seven subregions[1/] --Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Southern red oak	0.91177	-1.28107	0.586	0.99	4.90
Cherrybark oak	0.91590	-1.31763	0.577	0.99	4.58
Water oak	0.88197	-0.36159	0.512	0.99	4.19
Willow oak	0.89840	-0.82396	0.458	0.99	4.20
All red oaks combined	0.88522	-0.60736	0.537	0.99	4.50
All oaks combined	0.89921	-0.74529	0.583	0.99	4.98
All hardwoods combined	0.90302	-0.83634	0.594	0.99	5.24
ARKANSAS AREA					
All pines combined	0.91758	-0.36350	0.524	0.99	3.79
Shortleaf pine	0.93359	-0.58351	0.505	0.99	3.72
Loblolly pine	0.91383	-0.70493	0.495	0.99	3.20
Blackgum (Upland)	0.90991	-1.07520	0.513	0.99	4.29
All hard hardwoods combined	0.90495	-0.65860	0.539	0.99	4.28
Hickory	0.91347	-0.51377	0.544	0.99	4.37
White oak	0.91385	-0.84192	0.564	0.99	4.48
Post oak	0.87051	-0.35511	0.496	0.99	3.93
All white oaks combined	0.91336	-0.91297	0.558	0.99	4.43
Southern red oak	0.90567	-1.30454	0.425	0.99	3.33
Northern red oak	0.89194	-0.39776	0.440	0.99	3.57
Black oak	0.90773	-0.66191	0.540	0.99	4.22
All red oaks combined	0.89547	-0.44289	0.473	0.99	3.71
All oaks combined	0.89856	-0.60157	0.524	0.99	4.15
All hardwoods combined	0.91237	-0.83578	0.550	0.99	4.39
DELTA AREA					
All soft hardwoods combined	0.89425	-1.20721	0.754	0.99	4.95
Hackberry	0.86310	-0.66456	0.815	0.99	5.72
Sweetgum	0.89123	-1.14145	0.631	0.99	5.61
Yellow-poplar	0.94313	-2.04733	0.472	0.99	3.16
Elm	0.88576	-1.02602	0.807	0.99	5.48
All hard hardwoods combined	0.83619	-0.14761	1.137	0.99	7.92
Hickory	0.91934	-1.07190	0.475	0.99	4.13

Continued

Table 12.--Regression coefficients for estimating d.o.b. at 17.3 feet from d.b.h. and total height, for species and species groups across the South and in seven subregions[1/] --Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Pecan	0.87734	-0.53003	0.907	0.99	6.02
Green ash	0.94193	-1.49985	0.940	0.99	6.99
White oak	0.93445	-0.98809	0.722	0.99	5.44
Post oak	0.91368	-0.42442	0.535	0.99	4.41
Overcup oak	0.86189	-0.56356	0.842	0.99	5.07
All white oaks combined	0.85329	0.01954	0.861	0.99	5.76
Southern red oak	0.96685	-2.21395	0.604	0.99	4.51
Nuttall oak	0.86807	-0.36240	0.860	0.99	4.92
Black oak	0.87599	-0.26989	0.721	0.99	5.44
All red oaks combined	0.87316	-0.40855	0.796	0.99	5.03
All oaks combined	0.86473	-0.15548	0.831	0.99	5.54
All hardwoods combined	0.85791	-0.44828	1.053	0.99	7.12

[1/] $DOB17 = D(a + b(17.3/H)^2)$

where: DOB17 = d.o.b. at 17.3 feet, in inches

D = d.b.h. in inches

H = tree total height in feet

a and b = regression coefficients

Table 13.--Regression coefficients for estimating d.i.b. at 17.3 feet from d.b.h. and height to 4-inch d.o.b. top, for species and species groups across the South and in seven subregions[1/]

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
		SOUTHWIDE			
All pines combined	0.83108	-0.38934	0.573	0.99	5.45
Shortleaf pine	0.85410	-0.44197	0.535	0.99	4.84
Slash pine	0.82151	-0.50122	0.474	0.99	5.08
Longleaf pine	0.83481	-0.44264	0.473	0.99	4.85
Loblolly pine	0.82759	-0.47347	0.569	0.99	5.15
All major pines combined	0.83419	-0.44607	0.566	0.99	5.36
Sand pine	0.84209	-0.26820	0.394	0.99	5.37
Spruce pine	0.85655	-0.33446	0.380	0.99	3.47
Table Mountain pine	0.87420	-0.83950	0.499	0.99	4.70
Pitch pine	0.81607	-0.42143	0.460	0.99	4.40
Pond pine	0.80098	-0.33912	0.426	0.99	4.89
White pine	0.79885	-0.18446	0.542	0.99	4.52
Virginia pine	0.83116	-0.19186	0.370	0.99	3.98
All other pines	0.81943	-0.29093	0.589	0.99	5.83
All cypress combined	0.82401	-0.80721	0.885	0.99	9.22
Baldcypress	0.83365	-0.64227	0.717	0.99	6.31
Pondcypress	0.76531	-0.70573	0.811	0.99	9.67
Hemlock	0.80393	-0.20634	0.560	0.99	4.80
All soft hardwoods combined	0.80643	-0.35639	0.729	0.99	6.71
Cherry	0.82585	-0.14592	0.283	0.99	3.19
Red maple	0.82806	-0.26620	0.579	0.99	5.94
Buckeye	0.83213	-0.40672	0.706	0.99	6.40
Hackberry	0.80606	-0.36290	0.834	0.99	6.57
Sweetgum	0.80005	-0.34564	0.603	0.99	5.76
Yellow-poplar	0.79795	-0.26821	0.473	0.99	4.40
Sweetbay	0.75393	-0.18697	0.699	0.99	8.32
Water tupelo	0.64308	-0.01464	0.601	0.99	11.23
Blackgum (Upland)	0.77185	-0.24686	0.548	0.99	5.31
Blackgum (Lowland)	0.76269	-0.29903	0.755	0.99	7.96
Sycamore	0.82402	-0.36098	0.531	0.99	4.94

Continued

Table 13.--Regression coefficients for estimating d.i.b. at 17.3 feet from d.b.h. and height to 4-inch d.o.b. top, for species and species groups across the South and in seven subregions[1/] -- Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Magnolia	0.83991	-0.32901	0.484	0.99	4.97
Basswood	0.83021	-0.11653	0.509	0.99	4.33
Elm	0.80227	-0.21286	0.741	0.99	6.12
All hard hardwoods combined	0.80367	-0.22663	0.757	0.99	6.52
Beech	0.86948	-0.27754	0.495	0.99	4.42
Birch	0.80779	-0.14043	0.754	0.99	8.03
Hickory	0.81426	-0.32340	0.615	0.99	5.68
Pecan	0.81449	-0.50486	0.909	0.99	6.60
White ash	0.81619	-0.55831	0.589	0.99	6.72
Green ash	0.83445	-0.87195	0.701	0.99	8.19
White oak	0.83573	-0.41990	0.568	0.99	5.07
Overcup oak	0.78991	-0.32951	0.851	0.99	5.90
Chestnut oak	0.80184	-0.18959	0.572	0.99	4.89
Post oak	0.80255	-0.24130	0.514	0.99	5.01
All white oaks combined	0.80968	-0.23903	0.658	0.99	5.61
Scarlet oak	0.84486	-0.39323	0.410	0.99	3.59
Southern red oak	0.79565	-0.39576	0.498	0.99	4.64
Cherrybark oak	0.83299	-0.58875	0.501	0.99	4.36
Laurel oak	0.77759	-0.12847	0.418	0.99	5.36
Water oak	0.80804	-0.12146	0.433	0.99	3.93
Nuttall oak	0.82553	-0.37213	0.839	0.99	5.11
Willow oak	0.80844	-0.39672	0.501	0.99	4.59
Northern red oak	0.81783	-0.26276	0.533	0.99	4.38
Black oak	0.81231	-0.34214	0.467	0.99	4.03
All red oaks combined	0.81869	-0.33826	0.616	0.99	5.18
All oaks combined	0.81486	-0.29437	0.634	0.99	5.37
Black locust	0.77932	-0.28470	0.461	0.99	4.66
All hardwoods combined	0.80505	-0.28467	0.820	0.99	7.11
GULF AND ATLANTIC COASTAL PLAIN					
All pines combined	0.82213	-0.36900	0.492	0.99	5.07
Slash pine	0.82191	-0.50291	0.423	0.99	4.64

Continued

Table 13.--Regression coefficients for estimating d.i.b. at 17.3 feet from d.b.h. and height to 4-inch d.o.b. top, for species and species groups across the South and in seven subregions[1/] -- Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Yellow-poplar	0.79795	-0.26821	0.473	0.99	4.40
Blackgum (Upland)	0.77401	-0.24304	0.792	0.99	6.76
Cherry	0.82895	-0.17806	0.266	0.99	2.80
Basswood	0.83021	-0.11653	0.509	0.99	4.33
All hard hardwoods combined	0.81266	-0.29879	0.641	0.99	5.56
Birch	0.80779	-0.14043	0.760	0.99	7.84
Hickory	0.81935	-0.35210	0.665	0.99	5.75
Beech	0.83854	-0.16697	0.333	0.99	2.84
White ash	0.80889	-0.34290	0.429	0.99	4.82
White oak	0.80572	-0.24512	0.729	0.99	6.31
Chestnut oak	0.78944	-0.18561	0.662	0.99	5.52
All white oaks combined	0.79582	-0.20703	0.696	0.99	5.90
Scarlet oak	0.84862	-0.41564	0.501	0.99	4.18
Southern red oak	0.79825	-0.41735	0.702	0.99	6.73
Northern red oak	0.82708	-0.39037	0.555	0.99	4.26
Black oak	0.81626	-0.37848	0.412	0.99	3.36
All red oaks combined	0.82862	-0.40352	0.551	0.99	4.47
All oaks combined	0.81592	-0.32782	0.633	0.99	5.22
Black locust	0.77932	-0.28470	0.461	0.99	4.66
All hardwoods combined	0.81711	-0.32020	0.649	0.99	5.58
UPPER COASTAL PLAIN					
All pines combined	0.83901	-0.46136	0.588	0.99	5.20
Shortleaf pine	0.86365	-0.52919	0.385	0.99	3.46
Loblolly pine	0.81181	-0.41128	0.707	0.99	5.70
All major pines combined	0.84320	-0.53546	0.626	0.99	5.38
Virginia pine	0.80850	-0.04927	0.359	0.99	3.67
All soft hardwoods combined	0.81964	-0.54616	0.586	0.99	4.89
Sweetgum	0.79764	-0.37185	0.626	0.99	5.78
Yellow-poplar	0.79795	-0.26821	0.473	0.99	4.40
All hard hardwoods combined	0.82844	-0.36415	0.588	0.99	5.02
Hickory	0.84656	-0.48309	0.538	0.99	4.65

Continued

Table 13.--Regression coefficients for estimating d.i.b. at 17.3 feet from d.b.h. and height to 4-inch d.o.b. top, for species and species groups across the South and in seven subregions[1/] -- Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
All soft hardwoods combined	0.80135	-0.28241	0.595	0.99	5.96
Red maple	0.76088	-0.02176	0.347	0.99	4.81
Sweetgum	0.79404	-0.29582	0.603	0.99	6.57
Yellow-poplar	0.79795	-0.26821	0.473	0.99	4.40
Sycamore	0.82402	-0.36098	0.531	0.99	4.94
Elm	0.81801	-0.35727	0.789	0.99	7.59
All hard hardwoods combined	0.82246	-0.32572	0.563	0.99	5.48
Hickory	0.82272	-0.27878	0.624	0.99	5.95
White oak	0.83294	-0.39064	0.534	0.99	5.21
Chestnut oak	0.83804	-0.34737	0.466	0.99	4.20
All white oaks combined	0.83077	-0.37490	0.520	0.99	5.02
Scarlet oak	0.83707	-0.24400	0.568	0.99	5.17
Southern red oak	0.79422	-0.34224	0.516	0.99	5.03
Water oak	0.83137	-0.27040	0.378	0.99	3.79
Northern red oak	0.78729	-0.15744	0.481	0.99	4.87
Black oak	0.79703	-0.27153	0.498	0.99	5.06
All red oaks combined	0.81678	-0.31038	0.582	0.99	5.68
All oaks combined	0.82317	-0.33846	0.556	0.99	5.39
All hardwoods combined	0.81039	-0.27780	0.579	0.99	5.71
APPALACHIAN MOUNTAINS					
All pines combined	0.81997	-0.24009	0.568	0.99	5.27
Shortleaf pine	0.86103	-0.45015	0.413	0.99	3.82
Table Mountain pine	0.87420	-0.83950	0.499	0.99	4.70
Pitch pine	0.81607	-0.42143	0.460	0.99	4.40
Virginia pine	0.83736	-0.15014	0.390	0.99	4.08
All other pines	0.80747	-0.18020	0.558	0.99	5.18
White pine	0.79885	-0.18446	0.542	0.99	4.52
Hemlock	0.80393	-0.20634	0.560	0.99	4.80
All soft hardwood	0.82452	-0.35624	0.651	0.99	5.54
Red maple	0.83293	-0.33088	0.492	0.99	4.46
Buckeye	0.83213	-0.40672	0.706	0.99	6.40

Continued

Table 13.--Regression coefficients for estimating d.i.b. at 17.3 feet from d.b.h. and height to 4-inch d.o.b. top, for species and species groups across the South and in seven subregions[1/] -- Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Longleaf pine	0.83716	-0.43037	0.409	0.99	4.17
Loblolly pine	0.82579	-0.48589	0.576	0.99	5.20
All major pines combined	0.82716	-0.43011	0.486	0.99	4.83
Sand pine	0.84209	-0.26820	0.394	0.99	5.37
Pond pine	0.80098	-0.33912	0.426	0.99	4.89
All other pines	0.80795	-0.24140	0.490	0.99	6.13
All cypress	0.82401	-0.80721	0.885	0.99	9.22
Baldcypress	0.83365	-0.64227	0.717	0.99	6.31
Pondcypress	0.76531	-0.70573	0.811	0.99	9.67
All soft hardwoods	0.76784	-0.27534	0.751	0.99	9.02
Sweetgum	0.80359	-0.34931	0.446	0.99	5.07
Yellow-poplar	0.80944	-0.26168	0.461	0.99	4.65
Sweetbay	0.71778	-0.10240	0.691	0.99	8.42
Blackgum (Lowland)	0.76480	-0.32463	0.749	0.99	7.86
Red maple	0.82961	-0.17844	0.321	0.99	4.63
Water tupelo	0.61447	-0.04333	0.527	0.99	10.41
All hard hardwoods combined	0.81250	-0.31397	0.654	0.99	5.75
White oak	0.83573	-0.41990	0.568	0.99	5.07
Laurel oak	0.77759	-0.12847	0.418	0.99	5.36
Water oak	0.79881	-0.15360	0.583	0.99	4.39
Willow oak	0.83545	-0.92328	0.534	0.99	4.49
All red oaks combined	0.78883	-0.18673	0.544	0.99	4.92
All oaks combined	0.81338	-0.31532	0.660	0.99	5.82
All hardwoods combined	0.78728	-0.31656	0.789	0.99	8.52
		PIEDMONT			
All pines combined	0.83235	-0.37233	0.51948	0.99	4.76
Shortleaf pine	0.85136	-0.43591	0.455	0.99	4.21
Longleaf pine	0.86170	-0.74616	0.409	0.99	3.65
Loblolly pine	0.82861	-0.46704	0.546	0.99	4.74
All major pines combined	0.83522	-0.43888	0.523	0.99	4.65
Virginia pine	0.83928	-0.26470	0.429	0.99	4.72

Continued

Table 13.--Regression coefficients for estimating d.i.b. at 17.3 feet from d.b.h. and height to 4-inch d.o.b. top, for species and species groups across the South and in seven subregions[1/] -- Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
White oak	0.85458	-0.45955	0.550	0.99	4.54
Chestnut oak	0.79611	-0.02255	0.359	0.99	2.99
Post oak	0.79057	-0.13141	0.544	0.99	5.70
All white oaks combined	0.83284	-0.34247	0.552	0.99	4.84
Scarlet oak	0.81672	-0.18849	0.737	0.99	5.83
Southern red oak	0.79565	-0.39576	0.498	0.99	4.64
All red oaks combined	0.81348	-0.32460	0.628	0.99	5.17
All oaks combined	0.82311	-0.32800	0.599	0.99	5.10
All hardwoods combined	0.81842	-0.29001	0.616	0.99	5.25
		DEEP SOUTH			
All pines combined	0.84611	-0.46240	0.531	0.99	4.95
Shortleaf pine	0.84964	-0.40684	0.602	0.99	5.81
Slash pine	0.81806	-0.38227	0.479	0.99	4.86
Spruce pine	0.85655	-0.33446	0.380	0.99	3.47
Longleaf pine	0.85675	-0.51987	0.418	0.99	4.25
Loblolly pine	0.84880	-0.57194	0.534	0.99	4.42
All major pines combined	0.84503	-0.46694	0.535	0.99	5.0
All soft hardwoods combined	0.82190	-0.39781	0.552	0.99	5.56
Red maple	0.82205	-0.33919	0.636	0.99	6.43
Sweetgum	0.82302	-0.54749	0.458	0.99	4.35
Yellow-poplar	0.81706	-0.15831	0.514	0.99	4.69
Magnolia	0.83991	-0.32901	0.484	0.99	4.97
Sweetbay	0.80446	-0.28561	0.381	0.99	4.40
Blackgum (Upland)	0.79381	-0.39408	0.462	0.99	4.92
Sycamore	0.81232	-0.24913	0.486	0.99	4.87
Elm	0.88261	-0.64730	0.516	0.99	4.84
All hard hardwoods combined	0.83150	-0.43213	0.664	0.99	6.28
Hickory	0.83791	-0.65863	0.598	0.99	5.80
Beech	0.87219	-0.25684	0.489	0.99	4.39
Green ash	0.83445	-0.87195	0.701	0.99	8.19
White oak	0.85658	-0.65725	0.608	0.99	5.61

Continued

Table 13.--Regression coefficients for estimating d.i.b. at 17.3 feet from d.b.h. and height to 4-inch d.o.b. top, for species and species groups across the South and in seven subregions[1/] -- Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Post oak	0.81913	-0.37839	0.589	0.99	5.92
All white oaks combined	0.84205	-0.52448	0.612	0.99	5.94
Southern red oak	0.81840	-0.54761	0.592	0.99	5.48
Cherrybark oak	0.83299	-0.58875	0.501	0.99	4.36
Water oak	0.82093	-0.16835	0.542	0.99	4.76
Laurel oak	0.82230	-0.42645	0.428	0.99	4.32
All red oaks combined	0.82808	-0.47482	0.553	0.99	5.09
All oaks combined	0.83119	-0.47740	0.576	0.99	5.40
All hardwoods combined	0.82866	-0.41870	0.638	0.99	6.15
ARKANSAS AREA					
All pines combined	0.84550	-0.39221	0.598	0.99	4.72
Shortleaf pine	0.85803	-0.46706	0.569	0.99	4.60
Loblolly pine	0.83497	-0.59369	0.531	0.99	3.80
Blackgum (Upland)	0.78080	-0.33884	0.536	0.99	5.10
All hard hardwoods combined	0.81306	-0.32461	0.532	0.99	4.70
Hickory	0.83323	-0.51691	0.530	0.99	4.81
White oak	0.81903	-0.30306	0.534	0.99	4.68
Post oak	0.80359	-0.37703	0.460	0.99	4.06
All white oaks combined	0.81737	-0.34736	0.532	0.99	4.67
Southern red oak	0.81980	-0.87641	0.476	0.99	4.19
Northern red oak	0.81423	-0.20944	0.495	0.99	4.41
Black oak	0.80919	-0.37194	0.476	0.99	4.17
All red oaks combined	0.80408	-0.25516	0.529	0.99	4.64
All oaks combined	0.80882	-0.28623	0.531	0.99	4.66
All hardwoods combined	0.81554	-0.37660	0.574	0.99	5.11
DELTA AREA					
All soft hardwoods combined	0.81807	-0.50597	0.731	0.99	5.20
Hackberry	0.80719	-0.35631	0.790	0.99	5.94
Sweetgum	0.80005	-0.34564	0.603	0.99	5.76
Yellow-poplar	0.79795	-0.26821	0.473	0.99	4.40
Elm	0.81067	-0.43674	0.794	0.99	5.84

Continued

Table 13.--Regression coefficients for estimating d.i.b. at 17.3 feet from d.b.h. and height to 4-inch d.o.b. top, for species and species groups across the South and in seven subregions[1/] -- Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
All hard hardwoods combined	0.78845	-0.22744	1.170	0.99	8.92
Hickory	0.81486	-0.35768	0.466	0.99	4.52
Pecan	0.81348	-0.47848	0.904	0.99	6.57
Green ash	0.83445	-0.87195	0.701	0.99	8.19
White oak	0.85127	-0.37082	0.730	0.99	5.98
Post oak	0.84363	-0.27550	0.535	0.99	4.83
Overcup oak	0.79375	-0.37802	0.915	0.99	0.602
All white oaks combined	0.79991	-0.14132	0.922	0.99	6.89
Southern red oak	0.82427	-0.55528	0.738	0.99	6.09
Nuttall oak	0.82546	-0.38706	0.842	0.99	5.13
Black oak	0.80242	-0.24741	0.664	0.99	5.56
All red oaks combined	0.82526	-0.45706	0.780	0.99	5.48
All oaks combined	0.81303	-0.29398	0.865	0.99	6.27
All hardwoods combined	0.79830	-0.34324	1.103	0.99	8.07

[1/] $DIB17 = D(a + b(17.3/H_x)^2)$

where: DIB17 = d.i.b. at 17.3 feet, in inches

D = d.b.h. in inches

H_x = tree height to a 4-inch d.o.b. top, in feet

a and b = regression coefficients

Table 14.--Regression coefficients for estimating d.o.b. at 17.3 feet from d.b.h. and height to 4-inch d.o.b. top, for species and species groups across the South and in seven subregions[1/]

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
		SOUTHWIDE			
All pines combined	0.90115	-0.29846	0.527	0.99	4.55
Shortleaf pine	0.91951	-0.31586	0.488	0.99	4.03
Slash pine	0.90083	-0.31088	0.437	0.99	4.16
Longleaf pine	0.90651	-0.33021	0.421	0.99	3.90
Loblolly pine	0.89715	-0.37501	0.539	0.99	4.43
All major pines combined	0.90503	-0.33669	0.507	0.99	4.36
Sand pine	0.89177	-0.23376	0.380	0.99	4.84
Spruce pine	0.91467	-0.26088	0.367	0.99	3.11
Table Mountain pine	0.95104	-0.83029	0.414	0.99	3.53
Pitch pine	0.90039	-0.26152	0.452	0.99	3.83
Pond pine	0.90114	-0.22623	0.351	0.99	3.49
White pine	0.86485	-0.14838	0.523	0.99	4.01
Virginia pine	0.86643	-0.15143	0.375	0.99	3.84
All other pines	0.88178	-0.20939	0.519	0.99	4.72
All cypress combined	0.85891	-0.68793	0.724	0.99	6.95
Baldcypress	0.86620	-0.50806	0.676	0.99	5.66
Pondcypress	0.82401	-0.51290	0.687	0.99	7.32
Hemlock	0.87492	-0.17137	0.567	0.99	4.44
All soft hardwoods combined	0.87610	-0.31864	0.743	0.99	6.25
Cherry	0.89526	-0.12702	0.329	0.99	3.41
Red maple	0.88660	-0.25260	0.597	0.99	5.70
Buckeye	0.89854	-0.41934	0.751	0.99	6.28
Hackberry	0.85588	-0.30582	0.833	0.99	6.12
Sweetgum	0.86870	-0.28063	0.636	0.99	5.53
Yellow-poplar	0.88410	-0.24477	0.460	0.99	3.85
Sweetbay	0.83052	-0.12753	0.689	0.99	7.35
Water tupelo	0.70560	0.00033	0.654	0.99	11.05
Blackgum (Upland)	0.87118	-0.24815	0.587	0.99	5.03
Blackgum (Lowland)	0.83650	-0.24649	0.772	0.99	7.34
Sycamore	0.85423	-0.30796	0.536	0.99	4.78

Continued

Table 14.--Regression coefficients for estimating d.o.b. at 17.3 feet from d.b.h. and height to 4-inch d.o.b. top, for species and species groups across the South and in seven subregions[1/] -- Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
All soft hardwoods combined	0.87085	-0.24940	0.617	0.99	5.66
Red maple	0.80259	0.01580	0.364	0.99	4.74
Sweetgum	0.86593	-0.26212	0.633	0.99	6.27
Yellow-poplar	0.88410	-0.24477	0.460	0.99	3.85
Sycamore	0.85423	-0.30796	0.536	0.99	4.78
Elm	0.88873	-0.32550	0.778	0.99	6.85
All hard hardwoods combined	0.90119	-0.27094	0.596	0.99	5.25
Hickory	0.90767	-0.23831	0.653	0.99	5.59
White oak	0.90681	-0.35780	0.603	0.99	5.36
Chestnut oak	0.93531	-0.25518	0.402	0.99	3.19
All white oaks combined	0.91220	-0.31989	0.594	0.99	5.15
Scarlet oak	0.91002	-0.22317	0.576	0.99	4.80
Southern red oak	0.87039	-0.23205	0.603	0.99	5.27
Water oak	0.88885	-0.23849	0.381	0.99	3.55
Northern red oak	0.86470	-0.08375	0.489	0.99	4.44
Black oak	0.90118	-0.28972	0.536	0.99	4.81
All red oaks combined	0.88976	-0.23482	0.570	0.99	5.04
All oaks combined	0.90002	-0.27095	0.589	0.99	5.16
All hardwoods combined	0.88546	-0.22257	0.617	0.99	5.51
APPALACHIAN MOUNTAINS					
All pines combined	0.88433	-0.17985	0.536	0.99	4.57
Shortleaf pine	0.92530	-0.32414	0.401	0.99	3.39
Table Mountain pine	0.95104	-0.83029	0.414	0.99	3.53
Pitch pine	0.90039	-0.26152	0.452	0.99	3.83
Virginia pine	0.87027	-0.09512	0.405	0.99	4.05
All other pines	0.87173	-0.13924	0.498	0.99	4.26
White pine	0.86485	-0.14838	0.523	0.99	4.01
Hemlock	0.87492	-0.17137	0.567	0.99	4.44
All soft hardwood	0.90078	-0.34955	0.598	0.99	4.64
Red maple	0.89551	-0.31198	0.468	0.99	3.93
Buckeye	0.89854	-0.41934	0.751	0.99	6.28

Continued

Table 14.--Regression coefficients for estimating d.o.b. at 17.3 feet from d.b.h. and height to 4-inch d.o.b. top, for species and species groups across the South and in seven subregions[1/] -- Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Yellow-poplar	0.88410	-0.24477	0.460	0.99	3.85
Blackgum (Upland)	0.88792	-0.27491	0.814	0.99	6.05
Cherry	0.89576	-0.12522	0.313	0.99	3.03
Basswood	0.88197	0.05921	0.507	0.99	4.01
All hard hardwoods combined	0.88389	-0.15720	0.636	0.99	4.98
Birch	0.86814	-0.16330	0.737	0.99	7.11
Hickory	0.89648	-0.21224	0.684	0.99	5.31
Beech	0.87570	-0.16248	0.366	0.99	2.99
White ash	0.88884	-0.14231	0.373	0.99	3.70
White oak	0.86737	-0.10314	0.783	0.99	6.19
Chestnut oak	0.87030	-0.03047	0.695	0.99	5.14
All white oaks combined	0.87024	-0.04145	0.73923	0.99	5.62
Scarlet oak	0.90270	-0.24293	0.562	0.99	4.32
Southern red oak	0.88348	-0.29111	0.699	0.99	5.92
Northern red oak	0.87549	-0.12313	0.556	0.99	3.93
Black oak	0.88525	-0.11175	0.494	0.99	3.60
All red oaks combined	0.88601	-0.16586	0.563	0.99	4.16
All oaks combined	0.87989	-0.11767	0.642	0.99	4.79
Black locust	0.89903	-0.28617	0.545	0.99	4.75
All hardwoods combined	0.89144	-0.24651	0.634	0.99	4.94
UPPER COASTAL PLAIN					
All pines combined	0.91350	-0.40479	0.528	0.99	4.26
Shortleaf pine	0.92447	-0.29106	0.338	0.99	2.77
Loblolly pine	0.89386	-0.28198	0.621	0.99	4.48
All major pines combined	0.91237	-0.32438	0.520	0.99	4.04
Virginia pine	0.84520	0.02140	0.389	0.99	3.77
All soft hardwoods combined	0.90301	-0.36782	0.581	0.99	4.33
Sweetgum	0.88191	-0.24681	0.595	0.99	4.90
Yellow-poplar	0.88410	-0.24477	0.460	0.99	3.85
All hard hardwoods combined	0.90743	-0.25817	0.571	0.99	4.39
Hickory	0.92025	-0.22967	0.490	0.99	3.79

Continued

Table 14.--Regression coefficients for estimating d.o.b. at 17.3 feet from d.b.h. and height to 4-inch d.o.b. top, for species and species groups across the South and in seven subregions[1/] -- Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
White oak	0.92513	-0.43556	0.571	0.99	4.32
Chestnut oak	0.88140	0.25520	0.340	0.99	2.49
Post oak	0.87277	-0.05668	0.485	0.99	4.54
All white oaks combined	0.90968	-0.24542	0.536	0.99	4.24
Scarlet oak	0.88562	0.00829	0.687	0.99	4.91
Southern red oak	0.87043	-0.27635	0.544	0.99	4.55
All red oaks combined	0.89666	-0.27248	0.614	0.99	4.54
All oaks combined	0.90215	-0.24233	0.580	0.99	4.45
All hardwoods combined	0.90377	-0.23880	0.594	0.99	4.54
		DEEP SOUTH			
All pines combined	0.91282	-0.35460	0.454	0.99	3.86
Shortleaf pine	0.91139	-0.32727	0.517	0.99	4.59
Slash pine	0.90310	-0.25196	0.378	0.99	3.41
Spruce pine	0.91467	-0.26088	0.367	0.99	3.11
Longleaf pine	0.92233	-0.37719	0.361	0.99	3.33
Loblolly pine	0.91583	-0.48282	0.488	0.99	3.69
All major pines combined	0.91247	-0.35825	0.458	0.99	3.90
All soft hardwoods combined	0.88282	-0.31332	0.577	0.99	5.34
Red maple	0.87682	-0.30052	0.715	0.99	6.72
Sweetgum	0.89307	-0.43436	0.507	0.99	4.37
Yellow-poplar	0.88848	-0.08612	0.499	0.99	4.16
Magnolia	0.89693	-0.25550	0.534	0.99	5.07
Sweetbay	0.86431	-0.14620	0.364	0.99	3.84
Blackgum (Upland)	0.86680	-0.32828	0.516	0.99	4.96
Sycamore	0.84091	-0.12366	0.480	0.99	4.58
Elm	0.93523	-0.47202	0.500	0.99	4.30
All hard hardwoods combined	0.89698	-0.33350	0.589	0.99	5.08
Hickory	0.92184	-0.56013	0.538	0.99	4.64
Beech	0.90179	-0.18137	0.497	0.99	4.26
Green ash	0.93950	-0.78803	0.810	0.99	8.17
White oak	0.92612	-0.58248	0.586	0.99	4.92

Continued

Table 14.--Regression coefficients for estimating d.o.b. at 17.3 feet from d.b.h. and height to 4-inch d.o.b. top, for species and species groups across the South and in seven subregions[1/] -- Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Post oak	0.89951	-0.27801	0.646	0.99	5.78
All white oaks combined	0.91018	-0.37932	0.621	0.99	5.44
Southern red oak	0.88772	-0.42860	0.572	0.99	4.78
Cherrybark oak	0.89719	-0.46761	0.553	0.99	4.39
Water oak	0.87722	-0.13560	0.510	0.99	4.17
Laurel oak	0.88665	-0.29555	0.445	0.99	4.08
All red oaks combined	0.88839	-0.34417	0.523	0.99	4.41
All oaks combined	0.89237	-0.32263	0.571	0.99	4.87
All hardwoods combined	0.89351	-0.33442	0.592	0.99	5.23
ARKANSAS AREA					
All pines combined	0.91574	-0.26570	0.520	0.99	3.74
Shortleaf pine	0.92503	-0.32127	0.501	0.99	3.68
Loblolly pine	0.90788	-0.41433	0.490	0.99	3.17
Blackgum (Upland)	0.88203	-0.32886	0.519	0.99	4.34
All hard hardwoods combined	0.89107	-0.20963	0.538	0.99	4.27
Hickory	0.91212	-0.26360	0.535	0.99	4.30
White oak	0.89087	-0.20648	0.566	0.99	4.50
Post oak	0.86589	-0.15412	0.496	0.99	3.93
All white oaks combined	0.88885	-0.23758	0.560	0.99	4.45
Southern red oak	0.88918	-0.56646	0.424	0.99	3.32
Northern red oak	0.88395	-0.13060	0.439	0.99	3.56
Black oak	0.89865	-0.27623	0.525	0.99	4.08
All red oaks combined	0.88415	-0.16870	0.496	0.99	3.91
All oaks combined	0.88590	-0.19545	0.522	0.99	4.13
All hardwoods combined	0.89435	-0.25317	0.551	0.99	4.39
DELTA AREA					
All soft hardwoods combined	0.87817	-0.47022	0.760	0.99	5.00
Hackberry	0.85463	-0.28625	0.805	0.99	5.66
Sweetgum	0.86870	-0.28063	0.636	0.99	5.53
Yellow-poplar	0.88410	-0.24477	0.460	0.99	3.85
Elm	0.86202	-0.25791	0.824	0.99	5.59

Continued

Table 14.--Regression coefficients for estimating d.o.b. at 17.3 feet from d.b.h. and height to 4-inch d.o.b. top, for species and species groups across the South and in seven subregions[1/] -- Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
All hard hardwoods combined	0.84513	-0.04682	1.137	0.99	7.92
Hickory	0.89262	-0.25316	0.472	0.99	4.11
Pecan	0.86873	-0.18837	0.908	0.99	6.03
Green ash	0.93950	-0.78803	0.810	0.99	8.17
White oak	0.91037	-0.26571	0.722	0.99	5.44
Post oak	0.91323	-0.21297	0.525	0.99	4.32
Overcup oak	0.85699	-0.27388	0.822	0.99	4.95
All white oaks combined	0.86263	-0.04456	0.867	0.99	5.94
Southern red oak	0.89534	-0.47366	0.664	0.99	4.96
Nuttall oak	0.86588	-0.18799	0.857	0.99	4.90
Black oak	0.87434	-0.13207	0.712	0.99	5.37
All red oaks combined	0.87056	-0.20507	0.778	0.99	5.05
All oaks combined	0.86639	-0.11704	0.826	0.99	5.51
All hardwoods combined	0.85041	-0.18337	1.083	0.99	7.27

[1/] $DOB17 = D(a + b(17.3/H_x)^2)$

where: DOB17 = d.o.b. at 17.3 feet, in inches

D = d.b.h. in inches

H_x = tree height to a 4-inch d.o.b. top, in feet

a and b = regression coefficients

Table 15.--Regression coefficients for estimating d.i.b. at 17.3 feet from d.b.h. and height to 7-inch d.o.b. top (softwoods) and height to 9-inch d.o.b. top (hardwoods), for species and species groups across the South and in seven subregions[1/]

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
		SOUTHWIDE			
All pines combined	0.82334	-0.18672	0.588	0.99	5.18
Shortleaf pine	0.84372	-0.20802	0.556	0.99	4.72
Slash pine	0.80563	-0.17112	0.507	0.99	4.94
Longleaf pine	0.81819	-0.16107	0.494	0.99	4.68
Loblolly pine	0.81617	-0.20697	0.603	0.99	5.08
All major pines combined	0.82344	-0.19550	0.594	0.99	5.21
Sand pine	0.84672	-0.15633	0.413	0.99	4.81
Spruce pine	0.84946	-0.15396	0.391	0.99	3.34
Table Mountain pine	0.82541	-0.30158	0.563	0.99	5.31
Pitch pine	0.80459	-0.17945	0.463	0.99	4.09
Pond pine	0.78560	-0.11806	0.443	0.99	4.74
White pine	0.79877	-0.12387	0.556	0.99	4.34
Virginia pine	0.82668	-0.08604	0.397	0.99	4.00
All other pines	0.81174	-0.12246	0.561	0.99	5.12
All cypress combined	0.79484	-0.33559	0.983	0.99	9.55
Baldcypress	0.82002	-0.25531	0.713	0.99	6.08
Pondcypress	0.73701	-0.20278	0.946	0.99	10.34
Hemlock	0.79732	-0.06334	0.607	0.99	4.65
All soft hardwoods combined	0.80062	-0.09707	0.797	0.99	6.28
Red maple	0.82135	-0.07850	0.679	0.99	5.58
Buckeye	0.82222	-0.12441	0.778	0.99	6.07
Hackberry	0.78676	-0.04422	0.855	0.99	6.08
Sweetgum	0.79733	-0.10884	0.663	0.99	5.23
Yellow-poplar	0.80972	-0.11396	0.615	0.99	4.71
Sweetbay	0.74016	-0.02301	0.855	0.99	8.05
Blackgum (Upland)	0.76453	-0.07778	0.590	0.99	5.10
Blackgum (Lowland)	0.75778	-0.06987	0.796	0.99	7.04
Sycamore	0.80927	-0.04091	0.601	0.99	4.97
Magnolia	0.83467	-0.10291	0.522	0.99	4.87
Basswood	0.81984	0.04156	0.554	0.99	4.11

Continued

Table 15.--Regression coefficients for estimating d.i.b. at 17.3 feet from d.b.h. and height to 7-inch d.o.b. top (softwoods) and height to 9-inch d.o.b. top (hardwoods), for species and species groups across the South and in seven subregions[1/] --Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Elm	0.79755	-0.05318	0.831	0.99	6.38
All hard hardwoods combined	0.79646	-0.05063	0.805	0.99	6.21
Beech	0.85139	-0.03113	0.476	0.99	3.77
Birch	0.79552	0.03199	0.659	0.99	5.92
Hickory	0.80719	-0.08518	0.632	0.99	5.23
Pecan	0.79328	-0.08161	0.880	0.99	6.02
White ash	0.80060	-0.08996	0.488	0.99	4.42
Green ash	0.65576	0.06129	0.863	0.99	6.59
White oak	0.82274	-0.11024	0.596	0.99	4.72
Overcup oak	0.77729	-0.04719	0.890	0.99	5.66
Chestnut oak	0.79633	-0.05454	0.608	0.99	4.75
Post oak	0.79173	-0.05179	0.506	0.99	4.56
All white oaks combined	0.79921	-0.03611	0.680	0.99	5.20
Scarlet oak	0.83047	-0.10105	0.421	0.99	3.36
Southern red oak	0.78385	-0.11649	0.506	0.99	4.37
Cherrybark oak	0.81509	-0.15310	0.444	0.99	3.50
Water oak	0.79576	0.00843	0.467	0.99	3.89
Nuttall oak	0.81161	-0.02696	0.877	0.99	5.08
Willow oak	0.79847	-0.11006	0.520	0.99	4.39
Northern red oak	0.80887	-0.06456	0.565	0.99	4.18
Black oak	0.80091	-0.09622	0.482	0.99	3.78
All red oaks combined	0.81135	-0.11809	0.662	0.99	5.04
All oaks combined	0.80569	-0.07819	0.673	0.99	5.14
Black locust	0.76080	0.01117	0.541	0.99	4.73
All hardwoods combined	0.79554	-0.07264	0.922	0.99	7.03
GULF AND ATLANTIC COASTAL PLAIN					
All pines combined	0.80945	-0.17312	0.619	0.99	5.97
Slash pine	0.80669	-0.19519	0.463	0.99	4.81
Longleaf pine	0.82079	-0.16556	0.432	0.99	4.18
Loblolly pine	0.81309	-0.20403	0.621	0.99	5.28
All major pines combined	0.81428	-0.17615	0.516	0.99	4.85

Continued

Table 15.--Regression coefficients for estimating d.i.b. at 17.3 feet from d.b.h. and height to 7-inch d.o.b. top (softwoods) and height to 9-inch d.o.b. top (hardwoods), for species and species groups across the South and in seven subregions[1/] --Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Sand pine	0.84672	-0.15633	0.413	0.99	4.81
Pond pine	0.78560	-0.11806	0.443	0.99	4.74
All other pines	0.80058	-0.10647	0.516	0.99	5.72
All cypress	0.79484	-0.33559	0.983	0.99	9.55
Baldcypress	0.82002	-0.25531	0.713	0.99	6.08
Pondcypress	0.73701	-0.20278	0.946	0.99	10.34
All soft hardwoods	0.76721	-0.09136	0.925	0.99	8.09
Sweetgum	0.80376	-0.17661	0.569	0.99	4.72
Yellow-poplar	0.79330	0.01789	0.539	0.99	4.44
Sweetbay	0.71521	-0.02270	0.910	0.99	8.27
Blackgum (Lowland)	0.75827	-0.06817	0.784	0.99	6.89
Red maple	0.78263	0.08191	0.215	0.99	2.18
All hard hardwoods combined	0.81690	-0.15813	0.669	0.99	5.46
White oak	0.85422	-0.18705	0.626	0.99	5.05
Water oak	0.79760	-0.06817	0.573	0.99	4.32
Willow oak	0.80203	-0.19061	0.496	0.99	4.16
All red oaks combined	0.79707	-0.12657	0.561	0.99	4.60
All oaks combined	0.81804	-0.15922	0.677	0.99	5.52
All hardwoods combined	0.78817	-0.11981	0.893	0.99	7.57
		PIEDMONT			
All pines combined	0.82494	-0.18125	0.521	0.99	4.65
Shortleaf pine	0.84357	-0.22704	0.448	0.99	4.05
Longleaf pine	0.82731	-0.22503	0.443	0.99	3.96
Loblolly pine	0.82026	-0.23215	0.553	0.99	4.66
All major pines combined	0.82671	-0.21755	0.524	0.99	4.56
Virginia pine	0.83953	-0.14852	0.407	0.99	4.27
All soft hardwoods combined	0.80026	-0.09307	0.659	0.99	5.52
Red maple	0.71808	0.08634	0.449	0.99	4.46
Sweetgum	0.79685	-0.10475	0.687	0.99	5.78
Yellow-poplar	0.79759	-0.11434	0.517	0.99	4.21
Sycamore	0.80326	0.06190	0.633	0.99	4.98

Continued

Table 15.--Regression coefficients for estimating d.i.b. at 17.3 feet from d.b.h. and height to 7-inch d.o.b. top (softwoods) and height to 9-inch d.o.b. top (hardwoods), for species and species groups across the South and in seven subregions[1/] --Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Elm	0.82105	-0.12649	0.774	0.99	7.24
All hard hardwoods combined	0.81862	-0.11491	0.575	0.99	5.02
Hickory	0.82244	-0.08677	0.556	0.99	4.85
White oak	0.83220	-0.16781	0.556	0.99	4.53
Chestnut oak	0.83786	-0.16357	0.457	0.99	3.90
All white oaks combined	0.82678	-0.13958	0.519	0.99	4.46
Scarlet oak	0.81892	-0.01249	0.543	0.99	4.55
Southern red oak	0.78722	-0.11730	0.522	0.99	4.67
Water oak	0.82227	-0.06274	0.393	0.99	3.47
Northern red oak	0.79068	-0.05985	0.470	0.99	4.52
Black oak	0.80128	-0.14328	0.595	0.99	5.53
All red oaks combined	0.80976	-0.09912	0.618	0.99	5.46
All oaks combined	0.81846	-0.12074	0.576	0.99	5.02
All hardwoods combined	0.80782	-0.09134	0.607	0.99	5.19
APPALACHIAN MOUNTAINS					
All pines combined	0.81681	-0.12555	0.586	0.99	5.05
Shortleaf pine	0.85177	-0.21342	0.415	0.99	3.61
Table Mountain pine	0.82541	-0.30158	0.563	0.99	5.31
Pitch pine	0.80459	-0.17945	0.463	0.99	4.09
Virginia pine	0.83240	-0.05362	0.416	0.99	3.98
All other pines	0.80539	-0.09665	0.578	0.99	4.97
White pine	0.79877	-0.12387	0.556	0.99	4.34
Hemlock	0.79732	-0.06334	0.607	0.99	4.65
All soft hardwood	0.81483	-0.07660	0.729	0.99	5.44
Red maple	0.82568	-0.08486	0.677	0.99	5.24
Buckeye	0.82222	-0.12441	0.778	0.99	6.07
Yellow-poplar	0.81884	-0.08312	0.585	0.99	4.08
Blackgum (Upland)	0.77242	-0.10132	0.879	0.99	6.36
Basswood	0.81984	0.04156	0.554	0.99	4.11
All hard hardwoods combined	0.80386	-0.06102	0.685	0.99	5.22
Birch	0.79552	0.03199	0.659	0.99	5.92

Continued

Table 15.--Regression coefficients for estimating d.i.b. at 17.3 feet from d.b.h. and height to 7-inch d.o.b. top (softwoods) and height to 9-inch d.o.b. top (hardwoods), for species and species groups across the South and in seven subregions[1/] --Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Hickory	0.81587	-0.13035	0.706	0.99	5.26
Beech	0.83653	-0.05309	0.298	0.99	1.95
White ash	0.80168	-0.08207	0.485	0.99	4.20
White oak	0.79654	-0.03390	0.776	0.99	6.07
Chestnut oak	0.78196	-0.02968	0.740	0.99	5.42
All white oaks combined	0.78718	-0.02618	0.762	0.99	5.74
Scarlet oak	0.83386	-0.08845	0.523	0.99	3.79
Southern red oak	0.80239	-0.18378	0.684	0.99	5.94
Northern red oak	0.81436	-0.09273	0.606	0.99	4.20
Black oak	0.80107	-0.06891	0.429	0.99	3.24
All red oaks combined	0.81611	-0.10063	0.584	0.99	4.26
All oaks combined	0.80475	-0.06985	0.681	0.99	5.03
Black locust	0.76080	0.01117	0.567	0.99	5.02
All hardwoods combined	0.80765	-0.06992	0.693	0.99	5.23
UPPER COASTAL PLAIN					
All pines combined	0.82365	-0.17541	0.601	0.99	5.27
Shortleaf pine	0.84961	-0.22576	0.390	0.99	3.44
Loblolly pine	0.80195	-0.20471	0.711	0.99	5.74
All major pines combined	0.82639	-0.21460	0.642	0.99	5.45
Virginia pine	0.81207	-0.05218	0.357	0.99	3.65
All soft hardwoods combined	0.81966	-0.25560	0.576	0.99	4.60
Sweetgum	0.79853	-0.15781	0.648	0.99	5.62
Yellow-poplar	0.83275	-0.28089	0.349	0.99	2.48
All hard hardwoods combined	0.81658	-0.10507	0.606	0.99	4.97
Hickory	0.83178	-0.13781	0.544	0.99	4.59
White oak	0.84067	-0.12739	0.572	0.99	4.51
Chestnut oak	0.79432	-0.00082	0.359	0.99	2.99
Post oak	0.79696	-0.08845	0.630	0.99	5.55
All white oaks combined	0.82467	-0.11145	0.578	0.99	4.73
Scarlet oak	0.81930	-0.11323	0.724	0.99	5.73
Southern red oak	0.79028	-0.14065	0.317	0.99	2.62

Continued

Table 15.--Regression coefficients for estimating d.i.b. at 17.3 feet from d.b.h. and height to 7-inch d.o.b. top (softwoods) and height to 9-inch d.o.b. top (hardwoods), for species and species groups across the South and in seven subregions[1/] --Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
All red oaks combined	0.80309	-0.10160	0.632	0.99	5.10
All oaks combined	0.81281	-0.09826	0.620	0.99	5.04
All hardwoods combined	0.81619	-0.12316	0.617	0.99	5.03
DEEP SOUTH					
All pines combined	0.83489	-0.19106	0.553	0.99	4.69
Shortleaf pine	0.84696	-0.23884	0.635	0.99	5.47
Slash pine	0.80941	-0.14487	0.508	0.99	4.64
Longleaf pine	0.83704	-0.17066	0.452	0.99	4.14
Loblolly pine	0.83472	-0.23878	0.547	0.99	4.21
All major pines	0.83379	-0.19353	0.558	0.99	4.74
Spruce pine	0.84946	-0.15396	0.391	0.99	3.34
All soft hardwoods combined	0.80954	-0.08664	0.597	0.99	5.33
Red maple	0.81392	-0.07028	0.693	0.99	6.43
Sweetgum	0.80395	-0.09150	0.475	0.99	4.04
Yellow-poplar	0.81094	-0.01441	0.571	0.99	4.67
Magnolia	0.83467	-0.10291	0.522	0.99	4.87
Sweetbay	0.80216	-0.09731	0.395	0.99	3.88
Blackgum (Upland)	0.77399	-0.06841	0.494	0.99	4.68
Sycamore	0.80482	-0.05756	0.556	0.99	4.96
Elm	0.85455	-0.14785	0.526	0.99	4.51
All hard hardwoods combined	0.81457	-0.07227	0.673	0.99	5.58
Hickory	0.81988	-0.17712	0.661	0.99	5.51
Beech	0.85640	-0.03975	0.477	0.99	3.86
Green ash	0.79615	-0.08898	0.518	0.99	4.99
White oak	0.83600	-0.16679	0.611	0.99	4.86
Post oak	0.78523	-0.02867	0.618	0.99	5.47
All white oaks combined	0.82335	-0.12871	0.638	0.99	5.31
Southern red oak	0.79782	-0.13424	0.635	0.99	5.25
Cherrybark oak	0.81509	-0.15310	0.444	0.99	3.50
Water oak	0.81407	-0.01661	0.567	0.99	4.58
All red oaks combined	0.80853	-0.09030	0.584	0.99	4.80

Continued

Table 15.--Regression coefficients for estimating d.i.b. at 17.3 feet from d.b.h. and height to 7-inch d.o.b. top (softwoods) and height to 9-inch d.o.b. top (hardwoods), for species and species groups across the South and in seven subregions[1/] --Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
All oaks combined	0.81354	-0.10294	0.607	0.99	5.01
All hardwoods combined	0.81426	-0.08142	0.660	0.99	5.62
ARKANSAS AREA					
All pines combined	0.83613	-0.19899	0.605	0.99	4.63
Shortleaf pine	0.84498	-0.22485	0.584	0.99	4.54
Loblolly pine	0.81877	-0.24766	0.538	0.99	3.85
Blackgum (Upland)	0.76239	-0.06223	0.607	0.99	5.23
All hard hardwoods combined	0.80274	-0.09801	0.554	0.99	4.53
Hickory	0.81715	-0.15325	0.569	0.99	4.75
White oak	0.80516	-0.06241	0.564	0.99	4.53
Post oak	0.78341	-0.08154	0.466	0.99	4.10
All white oaks combined	0.80438	-0.09662	0.559	0.99	4.61
Southern red oak	0.78291	-0.18002	0.476	0.99	4.19
Northern red oak	0.80755	-0.06502	0.535	0.99	4.28
Black oak	0.79292	-0.08013	0.473	0.99	3.75
All red oaks combined	0.79694	-0.08248	0.541	0.99	4.36
All oaks combined	0.79940	-0.08506	0.54879	0.99	4.46
All hardwoods combined	0.80140	-0.10500	0.618	0.99	5.08
DELTA AREA					
All soft hardwoods combined	0.79890	-0.09210	0.807	0.99	5.45
Hackberry	0.78860	-0.05862	0.862	0.99	6.06
Sweetgum	0.80912	-0.14822	0.784	0.99	4.85
Yellow-poplar	0.81305	-0.14414	0.455	0.99	3.36
Elm	0.78568	-0.03019	0.860	0.99	5.84
All hard hardwoods combined	0.77736	-0.06088	1.292	0.99	9.00
Hickory	0.80907	-0.11432	0.501	0.99	4.29
Pecan	0.79347	-0.08167	0.885	0.99	6.02
Green ash	0.65576	0.06129	0.863	0.99	6.59
White oak	0.83861	-0.08590	0.749	0.99	5.36
Post oak	0.85427	-0.15238	0.438	0.99	3.72
Overcup oak	0.78018	-0.06228	0.944	0.99	5.81

Continued

Table 15.--Regression coefficients for estimating d.i.b. at 17.3 feet from d.b.h. and height to 7-inch d.o.b. top (softwoods) and height to 9-inch d.o.b. top (hardwoods), for species and species groups across the South and in seven subregions[1/] --Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
All white oaks combined	0.78992	0.02085	0.937	0.99	6.38
Southern red oak	0.81186	-0.20515	0.730	0.99	5.46
Nuttall oak	0.81110	-0.03014	0.883	0.99	5.11
Black oak	0.80142	-0.12838	0.998	0.99	5.11
All red oaks combined	0.81430	-0.14532	0.841	0.99	5.42
All oaks combined	0.80397	-0.07025	0.906	0.99	6.00
All hardwoods combined	0.78401	-0.07594	1.206	0.99	8.21

[1/] $DIB17 = D(a + b(17.3/H_x)^2)$

where: DIB17 = d.i.b. at 17.3 feet, in inches

D = d.b.h. in inches

H_x = tree height to a 7-inch d.o.b. top (softwoods) or 9-inch d.o.b. top (hardwoods), in feet

a and b = regression coefficients

Table 16.--Regression coefficients for estimating d.o.b. at 17.3 feet from d.b.h. and height to 7-inch d.o.b. top (softwoods) and height to 9-inch d.o.b. top (hardwoods), for species and species groups sampled across the South and in seven subregions[1/]

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
		SOUTHWIDE			
All pines combined	0.89450	-0.13734	0.550	0.99	4.41
Shortleaf pine	0.91170	-0.14394	0.503	0.99	3.91
Slash pine	0.89181	-0.10985	0.470	0.99	4.09
Longleaf pine	0.89228	-0.10923	0.446	0.99	3.82
Loblolly pine	0.88841	-0.16621	0.568	0.99	4.35
All major pines combined	0.89626	-0.14084	0.530	0.99	4.22
Sand pine	0.89851	-0.14541	0.387	0.99	4.21
Spruce pine	0.90721	-0.10376	0.386	0.99	3.06
Table Mountain pine	0.90043	-0.28868	0.523	0.99	4.46
Pitch pine	0.89487	-0.12543	0.465	0.99	3.64
Pond pine	0.88667	-0.05766	0.351	0.99	3.26
White pine	0.86316	-0.08326	0.542	0.99	3.90
Virginia pine	0.86170	-0.06188	0.408	0.99	3.91
All other pines	0.87515	-0.09063	0.492	0.99	4.14
All cypress combined	0.83857	-0.23071	0.793	0.99	7.12
Baldcypress	0.85699	-0.22206	0.678	0.99	5.50
Pondcypress	0.80248	-0.14398	0.783	0.99	7.69
Hemlock	0.86920	-0.05278	0.609	0.99	4.27
All soft hardwoods combined	0.87204	-0.08541	0.798	0.99	5.75
Red maple	0.88457	-0.08811	0.707	0.99	5.41
Buckeye	0.88433	-0.10564	0.837	0.99	6.03
Hackberry	0.83523	-0.00811	0.852	0.99	5.66
Sweetgum	0.86188	-0.05282	0.692	0.99	4.99
Yellow-poplar	0.89307	-0.10528	0.600	0.99	4.15
Sweetbay	0.81989	-0.01149	0.841	0.99	7.12
Blackgum (Upland)	0.86133	-0.06247	0.651	0.99	4.97
Blackgum (Lowland)	0.83228	-0.04333	0.807	0.99	6.44
Sycamore	0.84073	-0.03094	0.590	0.99	4.69
Magnolia	0.90273	-0.11105	0.556	0.99	4.80
Basswood	0.87850	0.06035	0.565	0.99	3.90

Continued

Table 16.--Regression coefficients for estimating d.o.b. at 17.3 feet from d.b.h. and height to 7-inch d.o.b. top (softwoods) and height to 9-inch d.o.b. top (hardwoods), for species and species groups sampled across the South and in seven subregions[1/] --Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Elm	0.85687	-0.01844	0.856	0.99	6.05
All hard hardwoods combined	0.86593	-0.00701	0.809	0.99	5.68
Beech	0.88813	-0.02679	0.498	0.99	3.78
Birch	0.86178	-0.00272	0.598	0.99	5.03
Hickory	0.88968	-0.03612	0.670	0.99	4.96
Pecan	0.85541	0.01049	0.911	0.99	5.70
White ash	0.89433	-0.05869	0.484	0.99	3.87
Green ash	0.72220	0.10776	0.947	0.99	6.51
White oak	0.89391	-0.08706	0.616	0.99	4.46
Overcup oak	0.84039	-0.00116	0.852	0.99	4.97
Chestnut oak	0.89338	-0.02394	0.620	0.99	4.28
Post oak	0.87437	-0.03572	0.476	0.99	3.86
All white oaks combined	0.87242	0.00488	0.694	0.99	4.81
Scarlet oak	0.89526	-0.06894	0.475	0.99	3.48
Southern red oak	0.86485	-0.08856	0.544	0.99	4.21
Cherrybark oak	0.87570	-0.07148	0.484	0.99	3.48
Water oak	0.84769	0.04176	0.467	0.99	3.62
Nuttall oak	0.85618	0.03525	0.884	0.99	4.81
Willow oak	0.86700	-0.08414	0.527	0.99	4.07
Northern red oak	0.87259	-0.01653	0.546	0.99	3.71
Black oak	0.87871	-0.00548	0.521	0.99	3.66
All hardwoods combined	0.86260	-0.03694	0.934	0.99	6.51
All red oaks combined	0.87427	-0.05445	0.671	0.99	4.67
All oaks combined	0.87280	-0.02381	0.685	0.99	4.76
Black locust	0.88246	-0.00358	0.637	0.99	4.82
GULF AND ATLANTIC COASTAL PLAIN					
All pines combined	0.88235	-0.11920	0.589	0.99	5.13
Slash pine	0.89933	-0.14045	4.411	0.99	3.77
Longleaf pine	0.89352	-0.11290	0.394	0.99	3.45
Loblolly pine	0.88325	-0.16476	0.580	0.99	4.50
All major pines combined	0.88870	-0.12254	0.480	0.99	4.07

Continued

Table 16.--Regression coefficients for estimating d.o.b. at 17.3 feet from d.b.h. and height to 7-inch d.o.b. top (softwoods) and height to 9-inch d.o.b. top (hardwoods), for species and species groups sampled across the South and in seven subregions[1/] --Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Sand pine	0.89851	-0.14541	0.387	0.99	4.21
Pond pine	0.88667	-0.05766	0.351	0.99	3.26
All other pines	0.89193	-0.39891	0.380	0.99	3.77
All cypress	0.83857	-0.23071	0.793	0.99	7.12
Baldcypress	0.85699	-0.22206	0.678	0.99	5.50
Pondcypress	0.80248	-0.14398	0.783	0.99	7.69
All soft hardwoods	0.83971	-0.07101	0.930	0.99	7.37
Sweetgum	0.86387	-0.11257	0.547	0.99	4.15
Yellow-poplar	0.86336	0.02849	0.579	0.99	4.37
Sweetbay	0.80066	-0.01027	0.989	0.99	7.99
Blackgum (Lowland)	0.83116	-0.03911	0.806	0.99	6.40
Red maple	0.82155	0.09517	0.228	0.99	2.19
All hard hardwoods combined	0.87905	-0.12827	0.668	0.99	5.02
White oak	0.92439	-0.17938	0.541	0.99	4.01
Water oak	0.84268	-0.02141	0.589	0.99	4.15
Willow oak	0.86692	-0.15255	0.476	0.99	3.65
All red oaks combined	0.85195	-0.07781	0.538	0.99	4.06
All oaks combined	0.87884	-0.12857	0.677	0.99	5.08
All hardwoods combined	0.85591	-0.09500	0.882	0.99	6.82
		PIEDMONT			
All pines combined	0.90147	-0.18000	0.470	0.99	3.83
Shortleaf pine	0.91030	-0.15030	0.382	0.99	3.16
Longleaf pine	0.91100	-0.20890	0.388	0.99	3.13
Loblolly pine	0.89893	-0.20427	0.528	0.99	4.03
All major pines combined	0.90269	-0.17589	0.477	0.99	3.77
Virginia pine	0.87348	-0.11701	0.378	0.99	3.77
All soft hardwoods combined	0.86837	-0.07123	0.682	0.99	5.23
Red maple	0.76189	0.08898	0.455	0.99	4.27
Sweetgum	0.86397	-0.06534	0.730	0.99	5.60
Yellow-poplar	0.88411	-0.10933	0.505	0.99	3.69
Sycamore	0.83300	0.06161	0.638	0.99	4.85

Continued

Table 16.--Regression coefficients for estimating d.o.b. at 17.3 feet from d.b.h. and height to 7-inch d.o.b. top (softwoods) and height to 9-inch d.o.b. top (hardwoods), for species and species groups sampled across the South and in seven subregions[1/] --Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Elm	0.89612	-0.13051	0.757	0.99	6.47
All hard hardwoods combined	0.89780	-0.08898	0.605	0.99	4.77
Hickory	0.90907	-0.07630	0.586	0.99	4.60
White oak	0.90319	-0.13027	0.646	0.99	4.80
Chestnut oak	0.92890	-0.08733	0.387	0.99	2.91
All white oaks combined	0.90754	-0.10717	0.600	0.99	4.63
Scarlet oak	0.89178	-0.00164	0.549	0.99	4.22
Southern red oak	0.86621	-0.07982	0.605	0.99	4.85
Water oak	0.87956	-0.04742	0.394	0.99	3.24
Northern red oak	0.86968	0.03886	0.494	0.99	4.27
Black oak	0.90804	-0.16066	0.600	0.99	4.91
All red oaks combined	0.88441	-0.07032	0.591	0.99	4.73
All oaks combined	0.89602	-0.08999	0.605	0.99	4.76
All hardwoods combined	0.88199	-0.05926	0.646	0.99	5.00
APPALACHIAN MOUNTAINS					
All pines combined	0.88205	-0.09587	0.560	0.99	4.44
Shortleaf pine	0.91722	-0.14075	0.417	0.99	3.32
Table Mountain pine	0.90043	-0.28868	0.523	0.99	4.46
Pitch pine	0.89487	-0.12543	0.465	0.99	3.64
Virginia pine	0.86754	-0.03855	0.428	0.99	3.93
All other pines	0.87039	-0.07864	0.521	0.99	4.13
White pine	0.86316	-0.08326	0.542	0.99	3.90
Hemlock	0.86920	-0.05278	0.609	0.99	4.27
All soft hardwood	0.89060	-0.07892	0.678	0.99	4.62
Red maple	0.88908	-0.08554	0.671	0.99	4.82
Buckeye	0.88433	-0.10564	0.837	0.99	6.03
Yellow-poplar	0.89576	-0.03363	0.561	0.99	3.55
Blackgum (Upland)	0.88526	-0.11044	0.903	0.99	5.70
Basswood	0.87850	0.06035	0.565	0.99	3.90
All hard hardwoods combined	0.87848	-0.03133	0.676	0.99	4.68
Birch	0.86178	-0.00272	0.598	0.99	5.03

Continued

Table 16.--Regression coefficients for estimating d.o.b. at 17.3 feet from d.b.h. and height to 7-inch d.o.b. top (softwoods) and height to 9-inch d.o.b. top (hardwoods), for species and species groups sampled across the South and in seven subregions[1/] --Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
Hickory	0.89438	-0.07682	0.732	0.99	4.91
Beech	0.87258	-0.04166	0.337	0.99	2.11
White ash	0.88792	-0.05736	0.436	0.99	3.39
White oak	0.86182	0.00130	0.835	0.99	5.99
Chestnut oak	0.87228	0.00296	0.780	0.99	5.08
All white oaks combined	0.86856	-0.00185	0.806	0.99	5.48
Scarlet oak	0.89258	-0.03707	0.601	0.99	4.03
Southern red oak	0.88786	-0.12622	0.686	0.99	5.27
Northern red oak	0.87199	-0.03632	0.601	0.99	3.85
Black oak	0.88108	-0.01948	0.508	0.99	3.45
All red oaks combined	0.88037	-0.03450	0.594	0.99	3.96
All oaks combined	0.87571	-0.02091	0.687	0.99	4.62
Black locust	0.88246	-0.00358	0.644	0.99	4.93
All hardwoods combined	0.88324	-0.05057	0.674	0.99	4.63
UPPER COASTAL PLAIN					
All pines combined	0.90157	-0.16773	0.536	0.99	4.29
Shortleaf pine	0.91688	-0.12348	0.341	0.99	2.74
Loblolly pine	0.88459	-0.11500	0.626	0.99	4.52
All major pines combined	0.90103	-0.11744	0.532	0.99	4.09
Virginia pine	0.84730	-0.00102	0.389	0.99	3.77
All soft hardwoods combined	0.90145	-0.15631	0.590	0.99	4.22
Sweetgum	0.87869	-0.07452	0.628	0.99	4.88
Yellow-poplar	0.90397	0.00711	0.370	0.99	2.35
All hard hardwoods combined	0.90030	-0.08087	0.585	0.99	4.31
Hickory	0.91091	-0.04887	0.491	0.99	3.70
White oak	0.91329	-0.12951	0.591	0.99	4.28
Chestnut oak	0.88341	0.11844	0.328	0.99	2.40
Post oak	0.88656	-0.09893	0.556	0.99	4.40
All white oaks combined	0.90764	-0.10112	0.554	0.99	4.09
Scarlet oak	0.89654	-0.06428	0.681	0.99	4.87
Southern red oak	0.88762	-0.18478	0.426	0.99	3.14

Continued

Table 16.--Regression coefficients for estimating d.o.b. at 17.3 feet from d.b.h. and height to 7-inch d.o.b. top (softwoods) and height to 9-inch d.o.b. top (hardwoods), for species and species groups sampled across the South and in seven subregions[1/] --Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
All red oaks combined	0.88737	-0.08039	0.617	0.99	4.47
All oaks combined	0.89691	-0.08598	0.596	0.99	4.36
All hardwoods combined	0.90393	-0.11296	0.595	0.99	4.35
		DEEP SOUTH			
All pines combined	0.90405	-0.14674	0.469	0.99	3.64
Shortleaf pine	0.91208	-0.22463	0.536	0.99	4.27
Slash pine	0.89700	-0.09284	0.400	0.99	3.27
Longleaf pine	0.90581	-0.10801	0.391	0.99	3.26
Loblolly pine	0.90501	-0.21582	0.479	0.99	3.39
All major pines	0.90377	-0.14943	0.474	0.99	3.68
Spruce pine	0.90721	-0.10376	0.386	0.99	3.06
All soft hardwoods combined	0.87631	-0.08096	0.623	0.99	5.12
Red maple	0.87340	-0.07097	0.774	0.99	6.69
Sweetgum	0.87836	-0.06979	0.513	0.99	3.97
Yellow-poplar	0.88515	-0.00714	0.556	0.99	4.16
Magnolia	0.90273	-0.11105	0.556	0.99	4.80
Sweetbay	0.86747	-0.06931	0.395	0.99	3.54
Blackgum (Upland)	0.85086	-0.05688	0.562	0.99	4.81
Sycamore	0.84174	-0.05884	0.538	0.99	4.58
Elm	0.91384	-0.10113	0.499	0.99	3.95
All hard hardwoods combined	0.88461	-0.05764	0.593	0.99	4.50
Hickory	0.90099	-0.11825	0.589	0.99	4.39
Beech	0.89309	-0.03558	0.501	0.99	3.88
Green ash	0.91066	-0.08218	0.537	0.99	4.49
White oak	0.91207	-0.16172	0.615	0.99	4.47
Post oak	0.87123	-0.00340	0.663	0.99	5.25
All white oaks combined	0.89907	-0.09613	0.643	0.99	4.85
Southern red oak	0.87359	-0.11618	0.612	0.99	4.59
Cherrybark oak	0.87570	-0.07148	0.484	0.99	3.48
Water oak	0.87032	-0.00260	0.537	0.99	4.04
All red oaks combined	0.87351	-0.06005	0.546	0.99	4.12

Continued

Table 16.--Regression coefficients for estimating d.o.b. at 17.3 feet from d.b.h. and height to 7-inch d.o.b. top (softwoods) and height to 9-inch d.o.b. top (hardwoods), for species and species groups sampled across the South and in seven subregions--[1/] Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
All oaks combined	0.88172	-0.06750	0.600	0.99	4.53
All hardwoods combined	0.88299	-0.07351	0.608	0.99	4.76
ARKANSAS AREA					
All pines combined	0.90823	-0.12280	0.529	0.99	3.68
Shortleaf pine	0.91457	-0.13997	0.515	0.99	3.65
Loblolly pine	0.89650	-0.17194	0.494	0.99	3.20
Blackgum (Upland)	0.86231	-0.05064	0.592	0.99	4.49
All hard hardwoods combined	0.88382	-0.05841	0.562	0.99	4.13
Hickory	0.90624	-0.08721	0.557	0.99	4.13
White oak	0.87927	-0.02809	0.595	0.99	4.34
Post oak	0.85901	-0.04033	0.496	0.99	3.93
All white oaks combined	0.87865	-0.05788	0.584	0.99	4.37
Southern red oak	0.86351	-0.10450	0.427	0.99	3.35
Northern red oak	0.87765	-0.02615	0.472	0.99	3.44
Black oak	0.88674	-0.05935	0.540	0.99	3.81
All red oaks combined	0.87891	-0.04968	0.515	0.99	3.73
All oaks combined	0.87894	-0.05410	0.544	0.99	3.99
All hardwoods combined	0.88430	-0.06610	0.588	0.99	4.33
DELTA AREA					
All soft hardwoods combined	0.85798	-0.06997	0.838	0.99	5.24
Hackberry	0.83640	-0.01717	0.862	0.99	5.66
Sweetgum	0.86664	-0.09771	0.746	0.99	4.27
Yellow-poplar	0.89722	-0.16110	0.467	0.99	3.13
Elm	0.84253	0.00962	0.886	0.99	5.56
All hard hardwoods combined	0.83794	0.00241	1.261	0.99	8.04
Hickory	0.88758	-0.07605	0.512	0.99	3.94
Pecan	0.85551	0.01046	0.916	0.99	5.71
Green ash	0.72220	0.10776	0.947	0.99	6.51
White oak	0.89997	-0.04969	0.742	0.99	4.91
Post oak	0.92180	-0.11379	0.437	0.99	3.39
Overcup oak	0.84450	-0.01481	0.840	0.99	4.74

Continued

Table 16.--Regression coefficients for estimating d.o.b. at 17.3 feet from d.b.h. and height to 7-inch d.o.b. top (softwoods) and height to 9-inch d.o.b. top (hardwoods), for species and species groups sampled across the South and in seven subregions[1/] --Continued

Species or species group	Regression coefficients		Standard error of estimate	Coefficient of determination	Coefficient of variation
	a	b	$S_{y.x}$	R^2	c.v.
All white oaks combined	0.85393	0.06089	0.873	0.99	5.46
Southern red oak	0.88647	-0.18579	0.647	0.99	4.39
Nuttall oak	0.85522	-0.03149	0.882	0.99	4.80
Black oak	0.87628	-0.08848	0.769	0.99	5.05
All red oaks combined	0.86567	-0.06502	0.823	0.99	4.91
All oaks combined	0.86074	-0.00526	0.857	0.99	5.23
All hardwoods combined	0.84333	-0.02483	1.178	0.99	7.38

[1/] $DOB17 = D(a + b(17.3/H_x)^2)$

where: DOB17 = d.o.b. at 17.3 feet, in inches

D = d.b.h. in inches

H_x = tree height to a 7-inch d.o.b. top (softwoods) or 9-inch d.o.b. top (hardwoods), in feet

a and b = regression coefficients

Table 17.--Average d.i.b. at 4.0 and 7.0 inches d.o.b. (softwoods) and at 4.0 and 9.0 inches d.o.b. (hardwoods)[1/]

Species or species group	Stem diameter inside bark where stem measures--(Average and standard deviation)	
	4.0 inches d.o.b.	7.0 inches d.o.b. (softwood) 9.0 inches d.o.b. (hardwoods)
	Inches	
All pines combined	3.5 ± 0.2	6.3 ± 0.2
Shortleaf pine	3.5 ± 0.1	6.3 ± 0.2
Slash pine	3.4 ± 0.2	6.1 ± 0.2
Longleaf pine	3.5 ± 0.1	6.2 ± 0.2
Loblolly pine	3.6 ± 0.1	6.4 ± 0.2
All major pines combined	3.5 ± 0.2	6.3 ± 0.2
All other pines combined	3.6 ± 0.2	6.4 ± 0.3
Sand pine	3.5 ± 0.1	6.5 ± 0.1
Spruce pine	3.6 ± 0.1	6.4 ± 0.1
Table Mountain pine	3.5 ± 0.1	6.3 ± 0.1
Pitch pine	3.5 ± 0.1	6.1 ± 0.1
Pond pine	3.4 ± 0.1	6.0 ± 0.2
White pine	3.6 ± 0.1	6.4 ± 0.2
Virginia pine	3.8 ± 0.1	6.7 ± 0.1
All cypress combined	3.5 ± 0.2	6.3 ± 0.3
Baldcypress	3.6 ± 0.1	6.5 ± 0.1
Pondcypress	3.4 ± 0.2	6.2 ± 0.3
Hemlock	3.6 ± 0.1	6.3 ± 0.1
All soft hardwoods combined	3.5 ± 0.2	8.0 ± 0.3
Red maple	3.6 ± 0.1	8.2 ± 0.2
Buckeye	3.5 ± 0.2	8.1 ± 0.3
Hackberry	3.6 ± 0.2	8.2 ± 0.2
Sweetgum	3.5 ± 0.1	8.0 ± 0.2
Yellow-poplar	3.5 ± 0.1	7.9 ± 0.2
Sweetbay	3.4 ± 0.2	7.9 ± 0.3
Blackgum (Upland)	3.3 ± 0.2	7.7 ± 0.3
Blackgum (Lowland)	3.3 ± 0.2	7.9 ± 0.2
Sycamore	3.7 ± 0.1	8.6 ± 0.1
Magnolia	3.6 ± 0.1	8.2 ± 0.2
Basswood	3.4 ± 0.2	8.1 ± 0.2
Elm	3.4 ± 0.1	8.1 ± 0.2

Continued

Table 17.--Average d.i.b. at 4.0 and 7.0 inches d.o.b. (softwoods) and at 4.0 and 9.0 inches d.o.b. (hardwoods)[1/]--Continued

Species or species group	Stem diameter inside bark where stem measures--(Average and standard deviation)	
	4.0 inches d.o.b.	7.0 inches d.o.b. (softwood) 9.0 inches d.o.b. (hardwoods)
	Inches	
All hard hardwoods combined	3.5 ± 0.2	8.0 ± 0.3
Beech	3.7 ± 0.1	8.5 ± 0.1
Birch	3.6 ± 0.1	8.3 ± 0.2
Hickory	3.4 ± 0.2	7.9 ± 0.2
Pecan	3.2 ± 0.2	7.8 ± 0.2
White ash	3.3 ± 0.3	7.8 ± 0.4
Green ash	3.4 ± 0.2	7.9 ± 0.2
White oak	3.4 ± 0.2	8.0 ± 0.2
Overcup oak	3.3 ± 0.2	8.0 ± 0.2
Chestnut oak	3.3 ± 0.2	7.7 ± 0.2
Post oak	3.4 ± 0.1	7.9 ± 0.2
All white oaks combined	3.4 ± 0.2	8.0 ± 0.2
Scarlet oak	3.5 ± 0.1	8.1 ± 0.2
Southern red oak	3.5 ± 0.1	7.9 ± 0.2
Cherrybark oak	3.5 ± 0.1	8.1 ± 0.2
Water oak	3.6 ± 0.1	8.3 ± 0.1
Nuttall oak	3.5 ± 0.2	8.1 ± 0.2
Willow oak	3.5 ± 0.1	8.1 ± 0.2
Northern red oak	3.5 ± 0.1	8.1 ± 0.2
Black oak	3.4 ± 0.1	7.8 ± 0.2
All red oaks combined	3.5 ± 0.1	8.0 ± 0.2
All oaks combined	3.5 ± 0.2	8.0 ± 0.2
Black locust	3.4 ± 0.2	7.7 ± 0.2
All hardwoods combined	3.5 ± 0.2	8.0 ± 0.3

[1/] For use in equations 4, 5, and 6.

Table 18.--Regression coefficients for estimating topwood ratios used to expand volume to a 7-inch d.o.b. top (softwoods) or to a 9-inch d.o.b. top (hardwoods) to volume to a 4-inch d.o.b. top, by species and species groups[1/]

Species or species group	Topwood ratio - inside bark					Topwood ratio - outside bark				
	Coefficients			Statistics		Coefficients			Statistics	
	a	b	c	MSE[2/]	R^2 [3/]	a	b	c	MSE[2/]	R^2 [3/]
All pines combined	544.38000	-3.95126	0.04895	0.047	0.79	492.48000	-3.93211	0.06304	0.044	0.80
Shortleaf pine	2097.01000	-4.41258	-0.06406	0.035	0.86	1545.33000	-4.35307	-0.01610	0.034	0.85
Slash pine	653.72000	-3.92245	-0.03116	0.044	0.82	530.20000	-3.92965	0.03395	0.042	0.83
Longleaf pine	270.68000	-3.97245	0.25000	0.042	0.81	239.88000	-3.96067	0.27941	0.040	0.82
Loblolly pine	1253.23000	-4.39794	0.09080	0.031	0.90	1173.88000	-4.46354	0.13776	0.030	0.89
All major pines combined	749.56000	-4.12066	0.06409	0.041	0.83	641.25000	-4.11121	0.09748	0.039	0.83
Sand pine	3862.68000	-5.70415	0.54318	0.059	0.79	2112.02000	-5.42004	0.55175	0.056	0.79
Spruce pine	270.17000	-2.84275	-0.40858	0.021	0.84	175.77000	-2.83176	-0.29944	0.022	0.83
Table Mountain pine	31.70965	-0.34635	-1.52283	0.031	0.73	32.80104	-0.28997	-1.55957	0.032	0.73
Pitch pine	2815.12000	-4.60657	-0.08642	0.038	0.89	3076.70000	-4.64326	-0.08611	0.039	0.89
Pond pine	209.55000	-3.44317	-0.06587	0.060	0.65	221.33000	-3.27548	-0.17591	0.059	0.67
White pine	322.25000	-4.12390	0.35310	0.030	0.92	397.23000	-4.18011	0.32821	0.028	0.93
Virginia pine	14031.04000	-5.85766	0.32641	0.050	0.85	12127.12000	-5.78899	0.32262	0.049	0.85
All other pines combined	303.52000	-3.51534	-0.05368	0.059	0.73	301.21000	-3.52776	-0.04275	0.057	0.74
All cypress combined	327.48000	-2.43779	-0.70017	0.091	0.65	357.07000	-2.58087	-0.62612	0.089	0.68
Baldcypress	8771.58000	-4.52535	-0.29103	0.028	0.96	7427.70000	-4.52370	-0.23437	0.031	0.96
Pondcypress	465.82000	-2.19470	-0.98729	0.100	0.62	533.10000	-2.35398	-0.91689	0.096	0.67
Hemlock	82.83459	-3.37920	0.26631	0.033	0.84	81.29160	-3.42125	0.30318	0.034	0.84
All soft hardwoods combined	808.01000	-2.06580	-0.96377	0.084	0.77	832.91000	-2.07225	-0.95463	0.086	0.78
Red maple	2327.77000	-2.55917	-0.94958	0.066	0.84	2207.62000	-2.55500	-0.92514	0.069	0.84
Buckeye	10137.52000	-4.11506	-0.32156	0.044	0.93	9179.16000	-4.09132	-0.29731	0.046	0.93
Hackberry	1726.53000	-1.53656	-1.60073	0.056	0.85	1412.19000	-1.51282	-1.54605	0.056	0.86
Sweetgum	1492.35000	-1.95264	-1.18297	0.077	0.84	1386.28000	-1.84537	-1.21653	0.081	0.85

Continued

Table 18.--Regression coefficients for estimating topwood ratios used to expand volume to a 7-inch d.o.b. top (softwoods) or to a 9-inch d.o.b. top (hardwoods) to volume to a 4-inch d.o.b. top, by species and species groups[1/] --Continued

Species or species group	Topwood ratio - inside bark					Topwood ratio - outside bark				
	Coefficients			Statistics		Coefficients			Statistics	
	a	b	c	MSE[2/]	R^2[3/]	a	b	c	MSE[2/]	R^2[3/]
Yellow-poplar	3421.78000	-3.14845	-0.62006	0.050	0.90	3121.82000	-3.05142	-0.64951	0.052	0.90
Sweetbay	2485.43000	-2.77553	-0.86911	0.100	0.71	582.78000	-2.16738	-0.81731	0.092	0.77
Blackgum (Upland)	894.12000	-1.93752	-1.14822	0.063	0.84	883.16000	-1.93753	-1.12364	0.070	0.83
Blackgum (Lowland)	14231.48000	-4.26925	-0.38234	0.085	0.83	11456.51000	-4.05755	-0.43561	0.091	0.83
Sycamore	3184.46000	-2.25465	-1.12228	0.077	0.88	3029.23000	-2.20819	-1.13561	0.076	0.89
Magnolia	1061.47000	-1.94681	-1.19023	0.097	0.77	831.04000	-1.72652	-1.26013	0.098	0.78
Basswood	13286.54000	-2.79296	-1.19864	0.046	0.87	8339.96000	-2.66620	-1.14255	0.049	0.86
Elm	590.65000	-1.20817	-1.49539	0.055	0.89	510.72000	-1.12455	-1.48817	0.058	0.89
All hard hardwoods combined	1825.80000	-2.43971	-0.99275	0.065	0.79	1568.59000	-2.37061	-0.98418	0.068	0.79
Beech	257.76000	-1.84770	-0.86672	0.045	0.69	235.85000	-1.78718	-0.87668	0.046	0.68
Birch	10417.39000	-3.70789	-0.58295	0.079	0.85	7095.10000	-3.45634	-0.63156	0.081	0.85
Hickory	630.67000	-1.42993	-1.37185	0.066	0.78	516.82000	-1.37200	-1.34525	0.067	0.77
Pecan	765.79000	-1.07488	-1.64620	0.036	0.88	622.63000	-1.07075	-1.56049	0.040	0.88
White ash	1124.84000	-0.68661	-1.99037	0.066	0.88	1057.85000	-0.68648	-1.95678	0.069	0.88
Green ash	782.40000	-1.06622	-1.66719	0.045	0.94	626.05000	-0.93812	-1.66882	0.049	0.94
White oak	2142.11000	-2.71150	-0.84808	0.054	0.83	1789.90000	-2.63067	-0.83755	0.056	0.83
Overcup oak	369.19000	-2.55005	-0.47367	0.048	0.84	309.79000	-2.48819	-0.44524	0.049	0.85
Chestnut oak	1940.09000	-2.53246	-0.97033	0.050	0.74	1606.29000	-2.38996	-0.99773	0.052	0.73
Post oak	1864.13000	-2.42265	-1.07396	0.058	0.77	1309.47000	-2.27359	-1.05712	0.059	0.77
All white oaks combined	1539.24000	-2.69777	-0.79071	0.057	0.78	1214.70000	-2.58072	-0.78690	0.059	0.78
Scarlet oak	710.94000	-2.10508	-0.96103	0.041	0.78	578.14000	-2.04308	-0.93710	0.042	0.77
Southern red oak	3419.94000	-2.45803	-1.19112	0.068	0.81	2838.68000	-2.39290	-1.17271	0.071	0.80
Cherrybark oak	4334.69000	-3.03331	-0.80795	0.062	0.78	2872.27000	-2.82647	-0.82020	0.063	0.78

Continued

Table 18.--Regression coefficients for estimating topwood ratios used to expand volume to a 7-inch d.o.b. top (softwoods) or to a 9-inch d.o.b. top (hardwoods) to volume to a 4-inch d.o.b. top, by species and species groups[1/]--Continued

Species or species group	Topwood ratio - inside bark					Topwood ratio - outside bark				
	Coefficients			Statistics		Coefficients			Statistics	
	a	b	c	MSE[2/]	R^2[3/]	a	b	c	MSE[2/]	R^2[3/]
Water oak	5794.34000	-3.39559	-0.63582	0.068	0.79	2465.54000	-2.78766	-0.78561	0.069	0.80
Nuttall oak	4387.47000	-2.71126	-0.99958	0.030	0.93	3440.58000	-2.58508	-0.99784	0.032	0.93
Willow oak	13172.92000	-2.17560	-1.70700	0.055	0.91	10890.15000	-2.10774	-1.68962	0.057	0.90
Northern red oak	1323.26000	-2.50142	-0.85748	0.049	0.70	1007.45000	-2.40559	-0.83780	0.051	0.68
Black oak	2701.87000	-1.40189	-1.82902	0.054	0.88	2045.81000	-1.31680	-1.79590	0.056	0.87
All red oaks combined	2201.36000	-2.11421	-1.26115	0.062	0.80	1796.98000	-2.03319	-1.24878	0.064	0.79
All oaks combined	1987.32000	-2.44197	-1.02312	0.061	0.78	1581.63000	-2.34012	-1.01477	0.063	0.78
Black locust	785.59000	-1.66896	-1.19537	0.058	0.88	651.02000	-1.57780	-1.19558	0.061	0.87
All hardwoods combined	1386.24000	-2.21576	-1.04276	0.071	0.80	1270.47000	-2.19525	-1.01963	0.073	0.80

[1/] For use in equations 4, 5, and 6.

[2/] MSE = mean squared error.

[3/] R^2 = coefficient of determination.

Table 19.--Accuracy of volume estimates obtained by using form-class segmented-profile equations and of volume estimates obtained by using Max and Burkhart's segmented-profile equation. Accuracy based on actual and simulated field measurements of loblolly pine, yellow-poplar, and white oak

Equation and stem measurements used to predict stem volume	Average absolute difference (observed-predicted) and standard deviation					
	Total stemwood volume	Stemwood volume from stump to--				
		4.5 feet	17.3 feet	Hgt to 9-in d.o.b. top	Hgt to 7-in d.o.b. top	Hgt to 4-in d.o.b. top
	Percent					
LOBLOLLY PINE						
Form class model with observed measurements	4.1 ± 3.5	5.4 ± 4.2	2.4 ± 2.3	3.3 ± 3.5	3.7 ± 4.4	3.7 ± 3.3
Max-Burkhart model with observed measurements	8.8 ± 8.0	6.6 ± 5.1	5.4 ± 4.9	7.0 ± 6.1	7.5 ± 6.4	8.5 ± 7.4
Form class model with D and DOB17 observed and DIBD and DIB17 estimated with equations (7) and (8), respectively	5.4 ± 4.6	6.4 ± 5.2	4.1 ± 3.5	4.7 ± 4.3	5.0 ± 4.7	5.1 ± 4.3
Form class model with DOB17 measured to an average of ± 0.2 inch	6.0 ± 4.9	6.4 ± 5.2	4.4 ± 3.6	5.0 ± 4.4	5.4 ± 4.8	5.7 ± 4.6
Form class model with form class estimated to an average of ± 2 units and used to estimate DIB17	5.4 ± 4.1	6.4 ± 5.2	3.7 ± 2.9	4.9 ± 4.1	5.1 ± 4.4	5.2 ± 3.9
Form class model with DIB17 estimated using regional equation (9) and D and H	7.9 ± 6.9	6.4 ± 5.2	5.3 ± 4.4	6.8 ± 5.7	7.3 ± 6.2	7.8 ± 6.6
Form class model with average form class for pole and sawtimber used	9.6 ± 8.6	6.3 ± 5.2	5.5 ± 4.7	7.2 ± 6.1	8.2 ± 6.8	9.0 ± 7.8
YELLOW-POPLAR						
Form class model with observed measurements	3.7 ± 2.8	4.9 ± 3.9	2.1 ± 1.9	2.9 ± 2.7	3.4 ± 3.5	3.4 ± 2.7
Max-Burkhart model with observed measurements	7.2 ± 5.2	5.9 ± 4.7	4.0 ± 3.5	5.8 ± 4.6	6.1 ± 4.8	6.7 ± 4.9
Form class model with D and DOB17 observed and DIBD and DIB17 estimated with equations (7) and (8), respectively	4.4 ± 3.5	5.4 ± 4.6	3.5 ± 2.8	3.9 ± 3.5	4.2 ± 4.0	4.2 ± 3.3

Continued

Table 19.--Accuracy of volume estimates obtained by using form-class segmented-profile equations and of volume estimates obtained by using Max and Burkhart's segmented-profile equation. Accuracy based on actual and simulated field measurements of loblolly pine, yellow-poplar, and white oak--Continued

Equation and stem measurements used to predict stem volume	Average absolute difference (observed-predicted) and standard deviation					
	Total stemwood volume	Stemwood volume from stump to--				
		4.5 feet	17.3 feet	Hgt to 9-in d.o.b. top	Hgt to 7-in d.o.b. top	Hgt to 4-in d.o.b. top
	Percent					
Form class model with DOB17 measured to an average of ± 0.2 inch	4.9 ± 3.9	5.4 ± 4.6	3.7 ± 3.0	4.3 ± 3.6	4.7 ± 4.2	4.7 ± 3.7
Form class model with form class estimated to an average of ± 2 units and used to estimate DIB17	4.9 ± 3.3	5.4 ± 4.6	3.1 ± 2.4	4.4 ± 3.1	4.8 ± 3.8	4.7 ± 3.1
Form class model with DIB17 estimated using regional equation (9) and D and H	6.1 ± 5.0	5.4 ± 4.6	3.9 ± 3.3	5.4 ± 4.4	5.8 ± 4.9	6.6 ± 5.6
Form class model with average form class for pole and sawtimber used	6.8 ± 5.3	5.4 ± 4.6	3.9 ± 3.3	6.0 ± 4.7	6.5 ± 5.3	6.6 ± 5.1
WHITE OAK						
Form class model with observed measurements	4.6 ± 4.2	6.3 ± 5.2	2.3 ± 2.4	3.9 ± 4.5	4.8 ± 6.6	4.2 ± 3.7
Max-Burkhart model with observed measurements	6.6 ± 5.7	7.6 ± 6.1	4.3 ± 3.8	6.4 ± 6.0	6.6 ± 5.8	6.4 ± 5.4
Form class model with D and DOB17 observed and DIBD and DIB17 estimated with equations (7) and (8), respectively	5.4 ± 4.6	6.9 ± 5.6	3.7 ± 3.0	4.7 ± 4.6	5.5 ± 6.5	5.1 ± 4.0
Form class model with DOB17 measured to an average of ± 0.2 inch	5.9 ± 4.8	7.0 ± 5.6	3.9 ± 3.2	5.0 ± 4.7	5.8 ± 6.6	5.5 ± 4.3
Form class model with form class estimated to an average of ± 2 units and used to estimate DIB17	5.6 ± 4.7	7.0 ± 5.6	3.4 ± 2.8	5.1 ± 4.6	5.8 ± 6.6	5.3 ± 4.2
Form class model with DIB17 estimated using regional equation (9) and D and H	6.7 ± 5.9	6.9 ± 5.6	4.2 ± 3.8	6.1 ± 5.5	6.8 ± 7.1	6.5 ± 5.3
Form class model with average form class for pole and sawtimber used	7.6 ± 6.1	6.9 ± 5.6	4.5 ± 3.8	6.7 ± 5.8	7.4 ± 7.3	7.2 ± 5.6

Table 20.--Accuracy of volume estimates obtained by using form-class segmented-profile equations and known d.b.h. and total height, known d.b.h. and height to 4-inch d.o.b. top, and known d.b.h. and height to 7-inch or 9-inch d.o.b. top

Diameter inside bark at d.b.h. and 17.3 ft[1/]	Average absolute difference (observed-predicted) and standard deviation					
	Equation					
	D.b.h. and total height		D.b.h. and height to 4-inch top		D.b.h. and height to 7- or 9-inch top	
	Stemwood volume from stump to--		Stemwood volume from stump to--		Stemwood volume from stump to--	
	Saw-log top	4-inch top	Saw-log top	4-inch top	Saw-log top	4-inch top
	Percent					
	LOBLOLLY PINE					
Observed	2.4 ± 2.2	4.0 ± 3.4	2.6 ± 2.2	3.0 ± 2.6	2.1 ± 2.0	2.8 ± 2.7
Estimated	6.6 ± 5.2	7.8 ± 6.6	6.0 ± 5.0	6.4 ± 5.1	6.0 ± 4.9	5.6 ± 4.8
	YELLOW-POPLAR					
Observed	2.1 ± 1.9	3.7 ± 3.2	2.9 ± 2.0	3.6 ± 2.7	2.4 ± 1.8	3.3 ± 3.1
Estimated	4.9 ± 4.5	6.6 ± 5.6	5.1 ± 4.4	5.6 ± 4.9	4.6 ± 4.2	5.1 ± 4.6
	WHITE OAK					
Observed	2.4 ± 2.2	4.7 ± 4.1	3.7 ± 2.4	4.3 ± 3.5	2.4 ± 1.9	4.0 ± 3.7
Estimated	5.3 ± 4.6	6.5 ± 5.3	5.6 ± 4.7	6.0 ± 4.7	5.5 ± 5.1	6.4 ± 5.2

[1/] Inside-bark diameter at d.b.h. estimated using equation (7) and inside-bark diameter at 17.3 feet estimated using equation (9) for total height model and equation (11) for height to fixed d.o.b. model.