<u>FIA Volume Calculations</u>

Tree-level attributes are variables associated with individual trees tallied on FIA ground plots. Various expressions of tree volume and weight are among the most basic statistics reported by FIA. Tree volumes and weights are not directly measured in the field, but computed from other variables that *are* measured (e.g, species and DBH). The functions used to compute these values are typically regression or mathematical models that have been developed by state or region. Commonly reported volume and weight statistics are defined below:

VOLCFGRS (Gross cubic-foot volume). The total volume inside bark of the central stem of a tree 5.0 inches diameter or larger from a 1-foot stump to a minimum 4-inch top d.o.b. or to where the central stem breaks into limbs all of which are less than 4.0 inches d.o.b. Includes rotten/missing and form cull.

VOLCFSND (Sound cubic-foot volume). The volume of sound wood in the central stem of a tree 5.0 inches diameter or larger from a 1-foot stump to a minimum 4-inch top d.o.b., or to where the central stem breaks into limbs all of which are less than 4.0 inches d.o.b. Form cull is included, rotten/missing cull is excluded.

VOLCSGRS (Gross cubic-foot volume in the sawlog portion). The gross volume of wood in the central stem of a commercial species tree of sawtimber size (9.0 inches DBH minimum for softwoods, 11.0 inches DBH minimum for hardwoods) from a 1-foot stump to a minimum top d.o.b. (7.0 inches for softwoods, 9.0 inches for hardwoods) or to where the central stem breaks into limbs, all of which are less than the minimum top d.o.b.

VOLCSNET (Net cubic-foot volume in the sawlog portion). The net volume of wood in the central stem of a commercial species tree of sawtimber size (9.0 inches DBH minimum for softwoods, 11.0 inches DBH minimum for hardwoods) from a 1-foot stump to a minimum top d.o.b. (7.0 inches for softwoods, 9.0 inches for hardwoods) or to where the central stem breaks into limbs, all of which are less than the minimum top d.o.b. Form cull and rotten/missing cull are excluded.

VOLBFGRS (Gross board-foot volume in the sawlog portion). The gross volume of wood in the central stem of a commercial species tree of sawtimber size (9.0 inches DBH minimum for softwoods, 11.0 inches DBH minimum for hardwoods) from a 1-foot stump to a minimum top d.o.b. (7.0 inches for softwoods, 9.0 inches for hardwoods) or to where the central stem breaks into limbs all of which are less than the minimum top d.o.b. Volume is based on International 1/4-inch rule.

VOLBFNET (Net board-foot volume in the sawlog portion). The net volume of wood in the central stem of a commercial species tree of sawtimber size (9.0 inches DBH minimum for softwoods, 11.0 inches DBH minimum for hardwoods) from a 1-foot stump to a minimum top d.o.b. (7.0 inches for softwoods, 9.0 inches for hardwoods) or to where the central stem breaks into limbs all of which are less than the minimum top d.o.b. Volume is based on International 1/4-inch rule. Form cull and rotten/missing cull are excluded.

DRYBIOT (Total gross biomass oven-dry weight for live trees). The total above-ground oven-dry biomass of a tree 1.0 inch diameter or larger, including all tops and limbs (but excluding foliage).

DRYBIOM (Merchantable stem biomass oven-dry weight for live trees). The total gross oven-dry biomass (including bark) of a tree 5.0 inches DBH or larger from a 1-foot stump to a minimum 4-inch top d.o.b. of the central stem.

Let $f(X_{ikt})$ be a function that computes the desired tree-level value (volume, weight, etc.) of tally tree *t* in condition *k* on plot *i*, where X_{ikt} is the array of measured attributes $x_1, x_2, x_3 \ldots x_n$ for that tree. Appendix Tables A3.1 to A3.8 present the form of the function $f(X_{ikt})$, the data items in the array X_{ikt}, and the states in which the function is used along with references for the following attributes listed and defined below. Unless otherwise noted, The *b* values in these tables are regression parameter estimates and the *x* values are the observed attributes.

Table A3.1 Gross cubic-foot volume				
Region	States	Form of the model: VOLCFGRS = $f(x_1, x_2, \ldots x_n)$	Observed items: $(x_1, x_2, \ldots x_n)$	Reference:
North Central	IA, IL, IN, KS, MO, NE, SD	VOLCFGRS = $b_1 (x_2)^{b_2} (1 - e^{b_3 x_1^{b_4}})$	x_1 = DBH x_2 =SI	Hahn & Hansen, 1991
North Central	MI, MN, ND, WI	VOLCFGRS = $(b_0 + b_1 x_1 + b_2 4 + b_3 x_1^2 + b_4 x_1^2 h_4 + b_5 h_4^2 + b_6 h_4 4^2 + b_7 x_1^2 h_4^3 + b_8 x_1^2 h_4^2 4)(b_9 + b_{10} x_1)$ where h_4 = predicted BL = $4.5 + b_{11}(1 - e^{(-b_{12} x_1)})^{b_{13}} x_2^{b_{14}} \left(1.00001 - \frac{4.0}{x_1}\right)^{b_{15}} x_3^{b_{16}}$	x_1 = DBH x_2 =SI x_3 =BA	Hahn, 1984
North-eastern	All states in the region	VOLCFGRS = $b_1 + b_2 x_1^{b_3} + b_4 x_1^{b_5} x_2^{b_6}$	x_1 = DBH x_2 =bole ht	Scott, 1981
RMRS	Eastern MT & WY, SD	IF $(x_1^2 x_2 < b_0)$ VOLCFGRS = $(b_1 + b_2 x_1^2 x_2)$ IF $(x_1^2 x_2 \geq b_0)$ VOLCFGRS = $(b_3 + b_4 x_1^2 x_2)$	x_1 = dbh x_2 = ht	Myers, 1964 RM-8

	(SPP=PP)			
RMRS	Western WY, CO, NV, UT (All species except woodland)	IF $(x_1^2 x_2 < b_0)$ VOLCFGRS = $(b_6 + b_7 x_1^2 x_2)$ IF $(x_1^2 x_2 \geq b_0)$ VOLCFGRS = $(b_8 + b_9 x_1^2 x_2)$	x_1 = dbh x_2 = ht	Edminster, Beeson, and Metcalf, 1980 Myers and Edminster, 1972 Edminster, Mowrer, Hinds, 1982 Myers, 1964 RM-6

Table A3.1 Gross cubic-foot volume (continued)

RMRS	Western MT (SPP=PP) Montana (SPP=DF, GF, LP,WL,WP)	VOLCFGRS = $V_1 - \left(V_1\left(b_{13}\left(\left(\frac{4}{b_{14}}\right)^{b_{15}} \Big/ x_1^{b_{16}}\right)\right)\right)$ where $V_1 = b_{10}\left(x_1^{b_{11}}\right)\left(x_2^{b_{12}}\right)$	x_1 = dbh x_2 = ht	Moisen, unpublished
RMRS	ID (All species except woodland species) MT (All species except DF, GF, LP, PP, WL, WP & woodland species) AZ, NM (Cottonwood)	IF $(x_1^2 x_2 < b_{17})$ VOLCFGRS = $(b_{18} + b_{19} x_1^2 x_2)$ IF $(x_1^2 x_2 \geq b_{17})$ VOLCFGRS = $(b_{20} + b_{21} x_1^2 x_2)$	x_1 = dbh x_2 = ht	Kemp, 1957
RMRS	AZ, NM (All species except woodland species and Cottonwood)	VOLCFGRS = $V_t - V_u$ where: $V_t = (b_{26} + b_{27} x_1^2 x_2)$ $V_u = b_{22} + b_{23}\left(\frac{x_3^3 x_2}{x_1^{b_{24}}}\right) + b_{25} x_1^2$	x_1 = dbh x_2 = ht x_3 = 4; top diameter	Hann and Bare, 1978 with modification for ES & DF
RMRS	All woodland species	VOLCFGRS = various model forms		Chojnacky, 1988, 1986, 1988, 1985, & 1994 Pillsbury & Kirkley, 1983
SRS	All states in the region	VOLCFGRS = $b_1 + b_2(x_1^2 x_2)$ $x_2 = b_3 + b_4(\sqrt{\log_{10}(x_1)})$ if x_2 not measured or VOLCFGRS = $b_1 + b_2(x_1^2 x_3)$ $x_3 = b_3 + b_4 x_2 + b_5 x_1^{-2}$ if x_3 not measured	x_1 = dbh x_2 = bole ht x_3 = total ht	Royer, 2001

PNW	All states	44 different models (24 softwood, 20 hardwood) These models all have different forms and parameter values. Basic models are for CVTS (total volume including tops and stumps) CVT (volume above stump, including top) or VOLCFGRS (volume above stump to 4" top). In all case the TARIF value is computed and used convert to between these values and VOLCFSND, and is also used to estimated sawtimber volume. One example from the 44 different models is presented here. Log_{10}(CVTS) = $b_1 + b_2 \log(x_1)\log(x_2) - b_3 \log(x_1)^2 +$ $b_4 \log(x_1) + b_5 \log(x_2) + b_6 \log(x_2)^2$ TARIF = $\frac{b_7 CVTS}{\left(\left(b_8\left(1 + b_9 \exp\left(b_{10}\left(\frac{x_1}{10.0}\right)\right)\right)\right)(x_3 + b_{11}) - b_{12}\right)}$ VOLCFGRS = $\frac{TARIF(x_3 + b_{13})}{b_{14}}$	x_1 = dbh x_2 = total ht x_3 = basal area	USDA, 2000

Table A3.2 Sound cubic-foot volume

Region	States	Form of the model: VOLCFSND = $f(x_1, x_2, \ldots x_n)$	Observed items: $(x_1, x_2, \ldots x_n)$	Reference:
North Central	IA, IL, IN, KS, MO, NE, SD	$\text{VOLCFSND} = VOLCFGRS\left(1 - \frac{(b_5 + b_6 \min(x_1, b_7))}{100}\right)$ b_5 , b_6 and b_7 are species-tree class specific	x_1 = dbh	Hahn and Hansen, 1991
North Central	MI, MN, ND, WI	VOLCFSND = $VOLCFGRS(1 - \frac{b_{17}}{100})$ b_{17} is species-tree class specific		Hahn, 1984
North-eastern	All states in the region	VOLCFSND = $VOLCFGRS(1 - \frac{x_1}{100})$	x_1 = percent rotten cull in bole	Scott, 1981
RMRS	All (Old design)	VOLCFSND = VOLCFGRS(CMERCH) (Live Growing Stock Trees – Timber Species) CMERCH = $\left(\frac{(e^{TC} - e^{TC1})b_{28}}{(1 - e^{TC1})}\right) + b_{29}$ TC = $-\left(ABS\left(\frac{SCALER}{FLEXC}\right)\right)^{b_{31}}$ SCALER = $\left(\frac{(40. - X_1)}{39}\right) - 1.$ FLEXC = $b_{30} - 1.$ TC1 = - $\left(ABS\left(\frac{-1.}{FLEXC}\right)\right)^{b_{31}}$ (Salvable Dead Trees) CMERCH = .65 (Nonsalvable Dead Trees) CMERCH = .25 (Rough Trees) CMERCH = .33 (Rotten Trees) CMERCH = .25 (Woodland Species) CMERCH = $1 - \frac{X_4}{100}$	X_1 = dbh x_4 = percent rotten and missing constants, coefficients & exponents are species specific	Region 3
RMRS	All (Mapped design)	VOLCFSND = VOLCFGRS (1-x_5)	X_5 = rotten and missing proportion	
SRS	All states in the region	VOLCFSND = VOLCFGR/F F = $(b_5 + b_6(x_1 - 3)^{-2})^{-1}$(pole and sawtimber) or F = $(b_5 + b_6 x_1^{\ 2}(bole - lenght))^{-1}$ (saplings)	F = total/gross volume factor	Royer, 2001
PNW	All	VOLCFSND = VOLCFGRS (1-x_5)	X_5 = rotten and	USDA,

	states		missing proportion	2000

Table A3.3 Gross cubic-foot volume in the sawlog portion				
Region	States	Form of the model: VOLCSGRS = $f(x_1, x_2, ... x_n)$	Observed items: $(x_1, x_2, ... x_n)$	Reference:
North Central	IA, IL, IN, KS, MO, NE, SD	VOLCSGRS = $VOLCFGRS - .005454 \frac{(x_1 - 4)(x_1{}^2 + 4^2)}{2b_8}$	$x_1 = 7; (sfwd)$ $x_1 = 9; (hdwd)$	Hahn and Hansen, 1991
North Central	MI, MN, ND, WI	VOLCSGRS = $(b_0 + b_1 x_1 + b_2 x_3 + b_3 x_1{}^2 + b_4 x_1{}^2 h_s + b_5 h_s{}^2$ $+ b_6 h_s x_3{}^2 + b_7 x_1{}^2 h_s{}^3 + b_8 x_1{}^2 h_s{}^2 x_3)(b_9 + b_{10} x_1)$ where $h_s =$ height to the top of the sawlog $4.5 + b_{11}(1 - e^{(b_{12} x_1)})^{b_{13}} x_2^{b_{14}} \left(1.00001 - \frac{x_3}{x_1}\right)^{b_{15}} x_4^{b_{16}}$	x_1 = dbh x_2 = site index $x_3 = 7; SW$ $x_3 = 9; HW$ $x_4 =$ all live basal area	Hahn, 1984
North-eastern	All states in the region	VOLCSGRS = $VOLCFGRS(1 - x_1)$	x_1 = portion of volume in upper stem	Scott, 1981
RMRS	All states (Timber species)	IF $(x_1 \le 42)$ VOLCSGRS = VOLCFGRS $\left(b_{32} - b_{33} \frac{(42 - x_1)^{b_{34}}}{33}\right)$ IF $(x_1 > 42)$ VOLCSGRS = VOLCFGRS * b_{35}	x_1 = dbh	Jensen and Homeyer, 1971
RMRS	All states (Woodland species)	VOLCSGRS = VOLCFGRS * RATIO RATIO = $1 - \left(\frac{b_{38}(TOP - 1.5)^{b_{39}}}{(b_{35} + b_{36} x_1 + b_{37} x_5)^{b_{40}}}\right)$	TOP = 3 x_1 = dbh x_5 = 0; multiple stems = 1; single stem	Chojnacky, 1987
SRS	All states in the region	VOLCSGRS = VOLCFGRS $\left(b_7 + b_8 (x_1 - 5)^{-2}\right)$		Royer, 2001

Table A3.4 Net cubic-foot volume in the sawlog portion				
Region	States	Form of the model: VOLCSNET = $f(x_1, x_2, ... x_n)$	Observed items: $(x_1, x_2, ... x_n)$	Reference:
North Central	IA, IL, IN, KS, MO, NE, SD	$\text{VOLCSNET} = VOLCSGRS\left(1 - \frac{(b_5 + b_6 \min(x_1, b_7))}{100}\right)$ b_5 , b_6 and b_7 are species-tree class specific	x_1 = dbh	Hahn and Hansen, 1991
North Central	MI, MN, ND, WI	$\text{VOLCSNET} = VOLCSGRS(1 - \frac{b_{17}}{100})$ b_{17} is species-tree class specific		Hahn, 1984
North-eastern	All states in the region	$\text{VOLCSNET} = VOLCFNET(1 - x_1)$	x_1 = portion of volume in upper stem	Scott, 1981
RMRS	All states (Timber species)	IF $(x_1 \leq 42)$ VOLCSNET = $\text{VOLCFSND}\left(b_{32} - b_{33}\frac{(42 - x_1)^{b_{34}}}{33}\right)$ IF $(x_1 > 42)$ VOLCSNET = VOLCFSND * b_{35}	x_1 = dbh	Jensen and Homeyer, 1971
RMRS	All states (Woodland species)	VOLCSNET = VOLCFSND * RATIO $\text{RATIO} = 1 - \left(\frac{b_{38}(TOP - 1.5)^{b_{39}}}{(b_{35} + b_{36}x_1 + b_{37}x_5)^{b_{40}}}\right)$	TOP = 3 x_1 = dbh x_5 = 0; multiple stems = 1; single stem	Chojnacky, 1987
SRS	All states in the region	$\text{VOLCSNET} = \text{VOLCFSND}\left(b_7 + b_8(x_1 - 5)^{-2}\right)$		Royer, 2001

Table A3.5 Gross board-foot volume in the sawlog portion				
Region	States	Form of the model: VOLBFGRS = $f(x_1, x_2, ... x_n)$	Observed items: $(x_1, x_2, ... x_n)$	Reference:
North Central	IA, IL, IN, KS, MO, NE, SD	VOLBFGRS = $b_1(x_2)^{b_2}(1-e^{b_3 x_1^{b_4}})$	x_1 = DBH x_2 =SI	Hahn & Hansen, 1991
North Central	MI, MN, ND, WI	VOLBFGRS = $\left[\begin{matrix} (b_0 + b_1 x_1 + b_2 h_s + b_3 x_1^2 + b_4 x_1^2 h_s + \\ b_5 h_s^2 + b_6 h_s x_3^2 + b_7 x_1^2 h_s^3 + \\ b_8 x_1^2 h_s^2 x_3)(b_9 + b_{10} x_1) \end{matrix} \right] b_{17}$ $+ b_{18} x_1 + b_{19} h_s + b_{20} x_3 + b_{21}$ where h_s = estimated SL = $4.5 + b_{11}(1 - e^{(b_{12} x_1)})^{b_{13}} x_2^{b_{14}} \left(1.00001 - \frac{x_3}{x_1}\right)^{b_{15}} x_4^{b_{16}}$	x_1 = DBH x_2 =SI x_3 = 7; Sfwd x_3 = 9; Hdwd x_4 =BA	Hahn, 1984
North-eastern	All states in the region	VOLBFGRS = $b_1 + b_2 x_1^{b_3} + b_4 x_1^{b_5} x_2^{b_6}$	x_1 = dbh x_2 = sawlog height (height to 7" or 9" diameter outside bark)	Scott, 1979
RMRS	Eastern MT, Eastern WY, SD (SPP=PP)	Young Growth $(x_1^2 x_2$ Lt $b_{41})$ VOLBFGRS = $(b_{42} + b_{43} x_1^2 x_2)$ Old Growth $(x_1^2 x_2$ Ge $b_{44})$ VOLBFGRS = $(b_{45} + b_{46} x_1^2 x_2)$	x_1 = dbh x_2 = ht	Myers, 1964 RM-8
RMRS	Western WY, CO, NV, UT (SPP=PP)	Young Growth $(x_1^2 x_2$ Lt $b_{47})$ VOLBFGRS = $(b_{48} + b_{49} x_1^2 x_2)$ Old Growth $(x_1^2 x_2$ Ge $b_{47})$ VOLBFGRS = $(b_{50} + b_{51} x_1^2 x_2)$	x_1 = dbh x_2 = ht	Edminster, Beeson, and Metcalf, 1980 Myers and Edminster, 1972 Edminster, Mowrer,

				Hinds, 1982 Myers, 1964 RM-6
RMRS	Idaho (All species) AZ, NM (Cottonwood) Montana (All species except PP in Eastern MT and woodland species)	Young Growth $(x_1^2 x_2 \text{ Lt } b_{52})$ VOLBFGRS = $(b_{53} + b_{54} x_1^2 x_2)$ Old Growth $(x_1^2 x_2 \text{ Ge } b_{52})$ VOLBFGRS = $(b_{53} + b_{54} x_1^2 x_2)$	x_1 = dbh x_2 = ht	Kemp, 1957
RMRS	AZ, NM (All species except woodland species and Cottonwood)	VOLBFGRS = VOLCFGRS $b_{55} - \frac{b_{56}}{x_1} - \frac{b_{57}}{x_1^2} - \frac{b_{58}}{x_1^3}$	x_1 = dbh	Hann and Bare, 1978 with modification for ES & DF
RMRS	All woodland species	VOLBFGRS = various model forms		Chojnacky, 1988, 1986, 1988, 1985, & 1994 Pillsbury & Kirkley, 1983
SRS	All states in the region	VOLBFGRS = VOLCFGRS $\left(b_3 + b_4(1 - 1/x_1)\right) =$ $\left(b_1 + b_2(x_1^2 x_2)\right)\left(b_3 + b_4(1 - 1/x_1)\right)$	x_1 = dbh	Royer, 2001
PNW		Softwoods: VOLBFGRS = $b_{15} + b_{16}\log(x_1 TARIF) + b_{17}x_1 + b_{18}TARIF^2 + \frac{b_{19}}{x_1^2}$ Hardwoods: VOLBFGRS = $\left(b_{23} + b_{24}\log(x_1 TARIF) + b_{25}x_1 + b_{26}TARIF^2 + \frac{b_{27}}{x_1^2}\right)$ $\left(\left(b_{20} - b_{21}b_{22}^{(x_1-6.0)}\right)(VOLCFGRS)\right)\left(b_{28} + b_{29}\left(b_{30}^{(x_1-9.5)}\right)\right)$	x_1 = dbh	USDA, 2000

Table A3.6 Net board-foot volume in the sawlog portion				
Region	States	Form of the model: VOLBFNET = $f(x_1, x_2, \ldots x_n)$	Observed items: $(x_1, x_2, \ldots x_n)$	Reference:
North Central	IA, IL, IN, KS, MO, NE, SD	$\text{VOLBFNET} = VOLBFGRS(1 - (b_5 + b_6 x_1))$ b_5 and b_6 are species-tree class specific	x_1 = dbh	Hahn and Hansen, 1991
North Central	MI, MN, ND, WI	VOLBFNET = $VOLBFGRS(1 - b_{22} x_1)$ b_{22} is species-tree class specific	x_1 = dbh	Hahn, 1984
North-eastern	All states in the region	VOLBFNET = $VOLBFGRS(1 - \frac{x_1}{100})$	x_1 = percent cull in sawlog	Scott, 1979
RMRS	All states in the region Old Design	VOLBFNET = VOLBFGRS(BMERCH) where: (Live Growing Stock Trees – Timber Species) BMERCH = $\left(\frac{(e^{TB} - e^{TB1}) b_{59}}{(1 - e^{TC1})}\right) + b_{60}$ TB = $-\left(ABS\left(\frac{SCALER}{FLEXB}\right)\right)^{b_{61}}$ SCALER = $\left(\frac{(40. - X_1)}{39}\right) - 1.$ FLEXB = $b_{62} - 1.$ TB1 = $-\left(ABS\left(\frac{-1.}{FLEXB}\right)\right)^{b_{61}}$ (Salvable Dead Trees) BMERCH = .50 (Nonsalvable Dead Trees) BMERCH = .25 (Rough Trees) BMERCH = .25 (Rotten Trees) BMERCH = .25	x_1 = dbh	Region 3
RMRS	All states in the region	VOLBFNET = VOLBFGRS (1-x_5)	x_5 = rotten and missing proportion	

	(Mapped Design)			
SRS	All states in the region	VOLBFNET = VOLCFSND $\left(b_9 + b_{10}(1 - {}^{1}\!/_{x_1}) \right)$		Royer, 2001

Table A3.7 Total gross biomass oven-dry weight for live trees

Region	States	Form of the model: DRYBIOT = $f(x_1, x_2, \ldots x_n)$	Observed items: $(x_1, x_2, \ldots x_n)$	Reference:
North Central	All states in the region	For DBH $\geq$ 5.0"DRYBIOT $= x_2 b_4 + (b_1 + x_1 b_2) x_2 b_5 + b_3 {x_1}^2 b_4$	x_1 = DBH x_2 = VOLCFGRS x_3 = VOLCFGRS of a 5" DBH tree	Hahn, 1984 and Smith, 1985
		For DBH < 5.0" DRYBIOT $= \frac{(x_3 b_4 + (b_1 + 5b_2) x_3 b_5 + b_3 5^2 b_4)}{b_6 5^{b_7}} b_6 {x_1}^{b_7}$		
North-eastern	All states in the region	For DBH $\geq$ 5.0" DRYBIOT $= e^{(.b_1 + b_2 \ln(x_1))} b_4$ or $= 10^{(.\log_{10}(b_1) + b_2 \log_{10}(x_1))} b_4$ or $= 2.2046(b_1 + b_2 25.4 x_1 + b_3 (25.4 x_1)^2) b_4$ model form is species dependent b_4 is DBH class dependent	x_1 = dbh	Wharton & Griffith, 1998
		For DBH < 5.0" DRYBIOT $= e^{(.95595 + 2.42640 \ln(x_1))}$		
RMRS	All states in the region (Timber species)	DRYBIOT = $\text{DRYBIOM} + 193.5 - (43.5412 {X_1}^2) + 3.1659 {X_1}^2$ for Pines with dbh $\geq$ 5.0 DRYBIOT = $\text{DRYBIOM} + .191 + (2.0304 X_1) + (.7031 {X_1}^2)$ for other conifers with dbh $\geq$ 5.0 DRYBIOT = $\text{DRYBIOM} + (129.69P - .05) 2.2046$ where: P = e^{Prime} Prime = $-1\left(\text{ABS}\left(\left(\left(\frac{X_1}{27.56}\right) - 1.\right) 1.56\right)\right)^{3.5}$ for hardwoods with dbh $\geq$ 5.0 DRYBIOT = DRYBIOM for hardwoods with dbh $\geq$ 5.0	X_1 = dbh	Van Hooser and Chojnacky, 1983
RMRS	All states in the region (Woodland species)	DRYBIOT = various model forms		Chojnacky, 1993 INT-RB-332 Nov. 1984 Chojnacky,

				1985 Chojnacky, 1994 GTR-RM-218, April 1992
SRS	All states in the region	For DBH $\geq$ 5.0” DRYBIOT $= b_1 + b_2 x_1^2 \left(b_3 + b_4 x_2 + \frac{b_5}{x_1^2} \right)$ or $= b_1 \left(x_1^2 \left(b_2 + b_3 x_2 + \frac{b_4}{x_1^2} \right) \right)^{b_5}$ model form is species dependent	x_1 = DBH x_2 = Bole ht x_3 = Total ht	Royer, 2001
		For DBH < 5.0” DRYBIOT $= b_1 + b_2 x_1^2 x_3$ or $= b_1 \left(x_1^2 x_3 \right)^{b_2}$ model form is species dependent		

Table A3.8 Merchantable stem biomass oven-dry weight for live trees				
Region	States	Form of the model: DRYBIOM = $f(x_1, x_2, \ldots x_n)$	Observed items: $(x_1, x_2, \ldots x_n)$	Reference:
North Central	All states in the region	$\text{DRYBIOM} = (b_1 + x_1 b_2) x_2 b_4$	x_1 = dbh x_2 = VOLCFGRS	Hahn, 1984
North-eastern	All states in the region	$\text{DRYBIOM} = (1 - (b_1 + b_2)) x_1$	x_1 = DRYBIOT	Wharton & Griffith, 1998
RMRS	All states in the region	DRYBIOM = $x_1 b_1 (b_2 + 1)$ for Timber species with dbh $\geq$ 5.0” species dependant	x_1 = VOLCFGRS	Van Hooser and Chojnacky, 1983
RMRS	All states in the region	DRYBIOM = b_3 for Timber species with dbh $\geq$ 5.0” species and dbh dependant		Van Hooser and Chojnacky, 1983
RMRS	All states in the region	DRYBIOM = various model forms		Chojnacky, 1993,1985, 1994,1992, & 1984
SRS				

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