T-Volume Weight Software

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Obtaining TVolWt (Carbon Calculator) and Growth and Yield Software

The Carbon Calculator dynamic link library (dll) is currently linked to an individual tree volume and weight program (TVolWt) and three growth and yield systems (Cutover Loblolly GYM, CSlash, and NLongleaf) that produce dry weight biomass calculations and are downloadable free of charge from http://fwrc.msstate.edu/software.asp or www.timbercruise.com (Download Center/Growth and Yield Models/or Tree Volume Table and Equation Generator). A fourth growth and yield system for natural red oak-sweetgum bottomland hardwood mixtures (NBHardwood GYM) will be available soon.

TVolWt: An Individual Tree Volume and Weight Program

I. Running TVolWt (the individual tree volume and weight program)
    After starting the program, an empty window will appear with a title and menu bar. Start by clicking on the "Define" menu. The window entitled "**Select volume table/equation options**" will appear. The selections for this window are defined below (VI.). Make desired selections and click the "Run Problem" button.

II. TVolWt Printouts - general information
    1) Press **PgDn** key to view next page of printout on screen.
    2) Click on **File** and **Print** to print results.
    3) Click on **File** and **Save Output As ASCII** to save results to a file.

III. TVolWt Printouts - output types

    Output for routine use:
    1) **Single tree volume/weight/biomass and stem profile** - these are printed if "Single Tree Volume and Profile" is selected from the "Operation" drop down box.
    2) **Tables of single tree volumes and weights by dbh and height classes** - these are printed if "Local or Standard Volume Equation" is selected from the "Operation" drop down box. There is one table for each volume/weight/biomass unit and "Merchantable Top" designation.

Output for advanced users:

1) **Standard and local volume equation model forms, merchantable height equation model forms, and form class equation model forms** - these are printed if "Local or Standard Volume Equation" is selected from the "Operation" drop down box.

2) **Standard or local volume equations and parameters** - these are printed if "Standard or Local Volume Equation" is selected from the "Operation" drop down box. The volume equations and parameters are printed for each model form . The program uses either a linear or non-linear model form for standard volume, local volume, merchantable height, and form class. Each volume model form also has a form class dependent and independent form. Note that the table volumes are exact for each entry. Volume equations are approximations of the exact table entries.

IV. TVolWt Printouts - volume and weight units

Units used for traditional volume and weight estimates:
Int ¼ = International ¼ inch board-foot log rule; makes allowance for log taper; divide by 0.905 to convert to International 1/8 inch board-foot log rule.
Doyle = Doyle board-foot log rule; historically used in Mississippi and South
Scribner = Scribner board-foot log rule; official log rule of USFS
Cubic OB = cubic foot volume outside bark
Cubic IB = cubic foot volume inside bark
Pounds OB = pounds outside bark
Wt. Cords = green weight of wood and bark in pounds / pounds per cord
Cunits IB = 100 cubic feet of solid wood (inside bark)

Units used for biomass estimates:
cvobsm = cubic foot volume outside bark stem
cvibsm = cubic foot volume inside bark stem
gwobtsm = green weight outside bark total stem in pounds
gwibsm = green weight inside bark total stem in pounds
***dwobtsm = dry weight outside bark total stem in pounds. This is the unit important to carbon calculation. Take this figure, divide it by 2 and then multiple by 3.67 to get CO_2 equivalents (lbs). Divide CO_2 equivalents (lbs) by 2205 to get CO_2 equivalents (metric tonnes).
dwibtsm = dry weight inside bark total stem in pounds
cvobbran = cubic foot volume outside bark branches
cvibbran = cubic foot volume inside bark branches
gwobbran = green weight outside bark branches in pounds
gwibbran = green weight inside bark branches in pounds
dwobbran = dry weight outside bark branches in pounds
dwibbran = dry weight inside bark branches in pounds
gwfoil = green weight foliage in pounds
dwfoil = dry weight foliage in pounds
cvobpwtp = cubic foot volume outside bark to pulpwood top
cvibpwtp = cubic foot volume inside bark to pulpwood top

gwobpwtp = green weight outside bark to pulpwood top in pounds
gwibpwtp = green weight inside bark to pulpwood top in pounds
dwobpwtp = dry weight outside bark to pulpwood top in pounds
dwibpwtp = dry weight inside bark to pulpwood top in pounds
cvobsttp = cubic foot volume outside bark to sawtimber top
cvibsttp = cubic foot volume inside bark to sawtimber top
gwobsttp = green weight outside bark to sawtimber top in pounds
gwibsttp = green weight inside bark to sawtimber top in pounds
dwobsttp = dry weight outside bark to sawtimber top in pounds
dwibsttp = dry weight inside bark to sawtimber top in pounds

V. TVolWt Program Specifications

Form class: Some profile equations require the use of Girard Form Class (GFC) as indicated by a "-FC" after the equation name. If you choose one of these equations from the drop down box, "Built-in Profile Functions", one of two form class equations in the "Form class calculation assumption" box may be selected. The default form class equation uses outside bark diameters. One table will be printed for each form class increment as indicated in the "FC" group box under "Volume Table Formatting". **For carbon estimation, use an equation that does not require form class (-FC).** FC is generally based on inside bark scaling diameter; thus, be sure to select the inside bark FC equation if you are using the standard definition of GFC.

VI. TVolWt Definitions for "**Select volume table/equation options**" User Interface Screen

Dialog group box title/Input	Function Definition
Initial	
Operation drop down box	
Standard Volume Equation	Produces tables (dbh by height) of single tree volumes that are calculated from dbh, height, and possibly form or taper. There is a table for each volume unit and top diameter specified in "Merchantable Tops".
Local Volume Equations	Produces tables (dbh by height) of single tree volumes that are calculated on the single variable of dbh. There is a table for each volume unit and top diameter specified in "Merchantable Tops".
Single Tree Volume and Profile	Produces a single tree stem profile (table of diameters at given heights) and table of tree volume, weight, and biomass (if "Biomass

	System" is selected) units to top diameters selected in "Merchantable Tops".
User defined profile function	Advanced users can enter custom profile functions that will be used in calculating volumes by selecting "Profile Manager" on the menu bar. The "User Defined Profile Function" will then appear in the drop down box. A program called Tree Profile (TProfile) is required to develop user defined equations.
Built-in profile function	Select a profile function that best describes your species and location. For carbon estimation, use an equation that does not require form class (-FC).
Biomass system	To obtain the dry weight outside bark of the tree bole for calculating carbon, a biomass system must be selected.
Reconcile biomass equation with ...	If a complete (branches and foliage in addition to bole) "Biomass System" is not available for a species chosen by the user (in the "Built-in or User Defined Profile Functions") and this box is checked, the volumes and weights of the selected biomass system tree components of the complete system are multiplicatively adjusted (based on the ratio of a biomass component to the bole volume from the profile function). The user should select a "Biomass System" that matches as closely as possible the "Built-in Profile Function" for the species of interest.

Merchantable tops

At Hm	The upper minimum diameter of the stem that defines the measurement height top of the tree stem; i.e., height is measured to this top diameter.
Pulpwood	The upper minimum diameter of the stem that defines the merchantable height for pulpwood.
Sawlog	The upper minimum diameter of the stem that defines the merchantable height for sawtimber.

Other Settings

Sawlog length	The default is 16' but will depend on targeted product. Doyle volume and Scribner volume change significantly with sawlog length.
Stump height	Historically was assumed 1' but now is considered 6" (default) because of changes in harvesting techniques.
Lbs/Cubic ft. (o.b.)	Green pounds per cubic foot outside bark. The default of 58.5 corresponds to loblolly pine; hardwoods may be heavier. This figure is used to convert cubic foot outside bark volume to weight.
Lbs(o.b.)/Cord	Some states control the weight of a cord outside bark (4 x 4 x 8 feet). In Mississippi, it is 5250 lbs. The default is set to 5450 lbs.

Volume Unit Selections
These are the traditional volume and weight units defined above. If a "Biomass System" is selected, biomass units will also be reported. Output tables are produced for each unit selected if the "Print Tables" box is selected.

Print Volume Tables
This box must be checked to obtain volume and weight tables; otherwise, only equations and parameters will be displayed.

Volume Table Formatting

Dbh	Diameter at breast height (4.5' above ground) start, end, and increment values for report tables.
Hm	Measurement height start, end, and increment values for report tables.
FC	If a "Built-in Profile Function" is chosen that requires form class (name ends in -FC) a report will be generated for each form class increment.

Form class calculation assumption ...
Select inside bark for the traditional definition.

Calculation assumptions

Pulpwood threshold dbh	Minimum dbh for pulpwood (default = 4.6")
Sawtimber threshold dbh	Minimum dbh for sawtimber (default = 9.6")
Percent bark for the Mesavage/Behre ..	For equations 119-122, default % bark may be overridden (default = double bark thickness/dbh(ib)*100)

Treat standard profiles as Mesavage/...	Procedure (Matney & Schultz, 2007; reference below) allows the entry of usable height as opposed to height to a fixed top diameter.
Check this box to prepare Mesavage/...	Mesavage/Behre equations are usually used on sawlog sized trees but can be used on pulpwood sized trees if this box is checked. **Do not reconcile a biomass system to a Mesavage or Behre function.**
Cubic volume calculation rule/formula	The default is Smalian's formula but others may be chosen.
Cubic volume calculation bolt length	The standard and default is 4' bolt.
Use the Southern Doyle convention	Logs with scaling diameters of less than 8" are set to length of the log to avoid underscaling.
Scribner rule approximation	The Scribner rule is a diagram rule primarily used by the USFS. The drop down box offers different approximating formulae.
Spreadsheet	The spreadsheet allows the user to enter dbh-height (and form class) pairs representative of the region/area for which the volume/weight estimates will be used. TVolWt uses the spreadsheet data to build localized volume/weight tables that fit the height-dbh relationship for your localized area better than the program's default relationship.

Terms

Profile or taper equation: These equations describe tree taper along the height of a tree and allow the estimation of volume to merchantable height limits or segments.

Standard volume equation: Equations for tree volumes that use dbh, height, and possibly form or taper.

Local volume equation: Equations for tree volumes that use the single variable of dbh.

Outside bark Measurements (like diameter) taken on the outside of the bark or estimates (like volume) that include wood plus bark. Dbh is always considered outside bark.

Inside bark Measurements (like diameter on felled trees) taken on the inside of the bark or volume estimates that include wood only.

Form class Mesavage-Girard form class is the inside bark diameter (scaling diameter) at 17.3' above ground times 100 and quantity divided by dbh. This is a measure of tree taper that is sometimes used in tree volume calculations.

Merchantable height The length of the stem from which a merchantable product can be obtained. The usable portion of the stem.

Merchantable top diameter limit The upper minimum diameter of the tree stem below which defines the usable (merchantable) portion of the tree.

References

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Example
TVolWt: Table of Individual Tree Volume/Weight Estimates for Cut-Over Site Prepared Loblolly Pine

Example assumptions:

1) Standard Volume Equations
2) Tree Profile 2
3) Biomass system 4
4) Reconcile with biomass equation
5) Measure height to top diameter = 0
6) Take other defaults

Select volume table/equation options

Initial

Operation-> Standard Volume Equation ▼

User Defined Profile Functions
○ [_____] ▼

Built-in Profile Functions
◉ Cutover Loblolly Pine (2) ▼

Biomass system
CutOverLoblollyTX-Lenhart (4) ▼

☑ Reconcile biomass equation with profile function

OK
Cancel
Run Problem
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Merchantable Tops

At Hm-----> 0
Pulpwood-> 2
Sawlog----> 8

Tree Variables

Dbh--> 15
Hm--> 75
FC--> 88

Volume Unit Selections

☑ International-1/4 bf
☑ Doyle bf
☑ Scribner bf
☑ Green pounds (o. b.)
☑ Weight cord
☑ Cunit (i. b.)
☑ Cubic foot (i. b.)
☑ Cubic foot (o. b.)

☑ Print Volume Tables

Volume Table Formatting

	Start	End	Inc.
Dbh-->	6	25	1
Hm-->	40	90	5
FC-->	84	92	2

Other Settings

Sawlog Length---------> 16
Stump Height----------> 0.5
Lbs/Cubic ft. (o. b.)--> 58.5
Lbs (o. b.)/Cord-------> 5450

Form class calculation assumption (Outside or Inside bark at 17.3 feet ?)

◉ FC = (O.B. diameter at 17.3')100/dbh   ○ FC = (I.B. diameter at 17.3')100/dbh

Calculation assumptions

Pulpwood thresshold dbh 4.6   Sawtimber thresshold dbh 9.6

Percent bark for the Mesavage, and Behre variable bark percent model 119 to 122 0

☐ Treat standard profiles as Mesavage/Behre merchantable/useable ht models

☐ Check this box to prepare Mesavage/Behre equations on pulpwood dbh range

Cubic volume calculation rule/formula Smalian's ▼

Cubic volume calculation bolt length 4

☐ Use the Southern Doyle convention

Scribner rule approximation V = 0.79D^2 - 2D - 4 (Bruce, 1925) ▼

	Dbh	Hm	FC
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43			

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Table  23.  Stem DWOB volumes and weights to a   0.0 inch Stem top diameter(ob) limit
            for profile: Cutover Loblolly Pine (2).

       Merchantable height
       --------------------------------------------------------------------------------
 Dbh   -- 40-- -- 45-- -- 50-- -- 55-- -- 60-- -- 65-- -- 70-- -- 75-- -- 80-- -- 85-- -- 90--
-----  ------- ------- ------- ------- ------- ------- ------- ------- ------- ------- -------
   6    108.53  123.08  138.00  153.31  169.01  185.09  201.54  218.35  235.53  253.08  271.00
   7    144.84  164.23  184.17  204.64  225.57  247.02  268.97  291.42  314.37  337.80  361.69
   8    185.99  210.88  236.47  262.73  289.65  317.21  345.38  374.19  403.63  433.71  464.42
   9    231.91  262.95  294.81  327.51  361.04  395.40  430.56  466.51  503.22  540.71  578.98
  10    282.40  320.29  359.06  398.90  439.74  481.58  524.38  568.14  612.88  658.57  705.20
  11    337.44  382.73  429.17  476.79  525.63  575.59  626.74  679.07  732.51  787.10  842.84
  12    397.11  450.29  505.02  561.06  618.58  677.35  737.54  799.09  862.00  926.24  991.81
  13    461.17  523.05  586.48  651.64  718.39  786.79  856.69  928.18 1001.22 1075.84 1152.01
  14    529.78  600.69  673.67  748.45  825.17  903.69  984.03 1066.21 1150.09 1235.81 1323.27
  15    602.58  683.45  766.34  851.54  938.74 1028.09 1119.52 1212.97 1308.52 1406.01 1505.53
  16    679.86  771.06  864.66  960.63 1059.12 1159.90 1263.03 1368.54 1476.26 1586.32 1698.68
  17    761.45  863.50  968.42 1075.93 1186.15 1299.11 1414.58 1532.68 1653.42 1776.68 1902.47
  18    847.43  960.84 1077.52 1197.32 1319.93 1445.50 1574.10 1705.50 1839.79 1976.96 2117.01
  19    937.42 1063.02 1192.04 1324.51 1460.31 1599.22 1741.41 1886.90 2035.46 2187.17 2342.06
  20   1031.62 1170.02 1311.96 1457.68 1607.12 1760.12 1916.57 2076.62 2240.23 2407.22 2577.66
  21   1130.04 1281.78 1437.25 1596.82 1760.46 1928.12 2099.57 2274.82 2453.98 2637.00 2823.74
  22   1232.64 1398.06 1567.91 1741.91 1920.34 2103.13 2290.25 2481.49 2676.86 2876.41 3080.15
  23   1339.36 1518.95 1703.55 1892.82 2086.64 2285.23 2488.52 2696.42 2908.69 3125.50 3346.85
  24   1450.17 1644.56 1844.50 2049.43 2259.30 2474.29 2694.34 2919.39 3149.40 3384.19 3623.81
  25   1565.05 1774.84 1990.45 2211.69 2438.38 2670.35 2907.80 3150.66 3398.86 3652.38 3910.98
       --------------------------------------------------------------------------------
```

Note: These dry weights outside bark are in pounds.

Example
TVolWt: Individual Tree Volume/Weight Estimates for a Cut-Over Site Prepared Loblolly Pine

Example assumptions:

1) Single tree volume and profile
2) Tree Profile 2
3) Biomass system 4
4) Reconcile with biomass equation
5) Measure height to top diameter = 0
6) Take other defaults

Select volume table/equation options

Initial

Operation-> Single Tree Volume and Profi ▼

User Defined Profile Functions

○ [▼]

Built-in Profile Functions

◉ Cutover Loblolly Pine (2) ▼

Biomass system

CutOverLoblollyTX-Lenhart (4) ▼

☑ Reconcile biomass equation with profile function

OK
Cancel
Run Problem
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Merchantable Tops

At Hm-----> 0

Pulpwood-> 2

Sawlog----> 8

Tree Variables

Dbh--> 15

Hm---> 75

FC----> 88

Volume Unit Selections

☑ International-1/4 bf
☑ Doyle bf
☑ Scribner bf
☑ Green pounds (o. b.)
☑ Weight cord
☑ Cunit (i. b.)
☑ Cubic foot (i. b.)
☑ Cubic foot (o. b.)

☑ Print Volume Tables

Volume Table Formatting

Start End Inc.
Dbh--> 6 25 1

Start End Inc.
Hm--> 40 90 5

Start End Inc.
FC--> 84 92 2

Other Settings

Sawlog Length---------> 16

Stump Height----------> 0.5

Lbs/Cubic ft. (o. b.)--> 58.5

Lbs (o. b.)/Cord-------> 5450

Form class calculation assumption (Outside or Inside bark at 17.3 feet ?)

◉ FC = (O.B. diameter at 17.3')100/dbh   ○ FC = (I.B. diameter at 17.3')100/dbh

Calculation assumptions

Pulpwood thresshold dbh 4.6   Sawtimber thresshold dbh 9.6

Percent bark for the Mesavage, and Behre variable bark percent model 119 to 122 0

☐ Treat standard profiles as Mesavage/Behre merchantable/useable ht models

☐ Check this box to prepare Mesavage/Behre equations on pulpwood dbh range

Cubic volume calculation rule/formula Smalian's ▼

Cubic volume calculation bolt length 4

☐ Use the Southern Doyle convention

Scribner rule approximation V = 0.79D^2 - 2D - 4 (Bruce, 1925) ▼

	Dbh	Hm	FC
1			
2			
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File View Help Define Run Options Profile Manager

```
Table   1. Stem diameters and volumes of a 15.0 dbh tree with a
           merchantable height of 75 to a 0.0  top diameter for
           profile: Cutover Loblolly Pine (2).

Profile                    Volume units and top diameter(ob)
--------------------------  -------------------------------------

  h    Dia(ob) Dia(ib)  Unit                  Volume   TopDia
-----  ------- -------  ------------------    --------  ------
  0.5   16.0    14.2    International-1/4       199.3    8.0
  2.5   15.4    13.7    Doyle                  113.6    8.0
  4.5   15.0    13.4    Scribner               167.9    8.0
  8.5   14.4    12.9    Cubic feet(o.b.)        39.69   8.0
 12.5   13.8    12.5    Cubic feet(i.b.)        32.55   8.0
 16.5   13.3    12.0    Green pounds(o.b.)    2321.9    8.0
 17.3   13.2    11.9    Weight cords             0.426  8.0
 20.5   12.7    11.6    Cunits(i.b.)             0.326  8.0
 24.5   12.2    11.1    Cubic feet(o.b.)        43.45   2.0
 28.5   11.6    10.6    Cubic feet(i.b.)        35.51   2.0
 32.5   11.0    10.1    Green pounds(o.b.)    2541.7    2.0
 36.5   10.4     9.5    Weight cords             0.466  2.0
 40.5    9.7     8.9    Cunits(i.b.)             0.355  2.0
 44.5    8.9     8.2    Cubic feet(o.b.)        43.48   0.0
 48.5    8.2     7.4    Cubic feet(i.b.)        35.53   0.0
 52.5    7.3     6.6    Green pounds(o.b.)    2543.9    0.0
 56.5    6.4     5.7    Weight cords             0.467  0.0
 60.5    5.3     4.7    Cunits(i.b.)             0.355  0.0
 64.5    4.2     3.6
 68.5    3.0     2.4
 72.5    1.5     1.1
 75.0    0.0     0.0
```

File   View   Help   Define   Run   Options   Profile Manager

```
Table 1. Continued

Total stem outside bark cubic volume.:      43.48
Total stem inside bark cubic volume..:      35.53
Total stem outside bark green weight.:    2609.38
Total stem inside bark green weight..:    2288.29
Total stem outside bark dry weight...:    1212.97
Total stem inside bark dry weight....:    1051.16

Branch outside bark cubic volume.....:       8.59
Branch inside bark cubic volume......:       7.29
Branch outside bark green weight.....:     458.27
Branch inside bark green weight......:     434.47
Branch outside bark dry weight.......:     197.66
Branch inside bark dry weight........:     184.58

Green weight of foilage..............:      47.09
Dry weight of foilage................:      23.43

Outside bark cubic volume to PW top..:      43.45
Inside bark cubic volume to PW top...:      35.51
Outside bark green weight to PW top..:    2603.51
Inside bark green weight to PW top...:    2285.89
Outside bark dry weight to PW top....:    1210.72
Inside bark dry weight to PW top.....:    1050.52

Outside bark cubic volume to ST top..:      39.69
Inside bark cubic volume to ST top...:      32.55
Outside bark green weight to ST top..:    2309.39
Inside bark green weight to ST top...:    2077.00
Outside bark dry weight to ST top....:    1082.01
Inside bark dry weight to ST top.....:     963.36
```