Forestry Programs for Programmable Calculators

By Kama R. Sterrett and John E. Gunter

INTRODUCTION

Programmable calculators are making many forestry tasks simpler and their results more accurate. These instruments are easy to use, relatively inexpensive, and useful in the field or office. A continuous increase in the number of forestry applications appears likely.

This catalog is the result of a nationwide survey of the members of three Society of American Foresters working groups (i.e. Biometrics, Inventory, and Systems Analysis) by the Cooperative Extension Service and the Department of Forestry, Michigan State University. The purpose of this catalog is to provide potential users with a listing of currently available forestry programs for programmable calculators. No programs were received for six of the subject areas listed, indicating the need for future program development.

The catalog is indexed by subject area, program title, and author. In addition to a brief description of each program, the following are listed: The make and model of calculator used, number of program steps, price, author, and appropriate addresses. To learn more about an individual program or to obtain a copy, please write directly to the program author. These programs have not been reviewed, except for the correction of minor grammatical and typing errors in the program descriptions.

The authors of the catalog extend special thanks to those who contributed programs or otherwise supported the project.

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2 — Forest Ecology
3 — Forest Economics and Finance
4 — Forest Genetics and Tree Improvement
5 — Forest Measurements — Biometrics
6 — Forest Protection (Disease, Insects, Fire)
7 — Forest Silviculture
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PROGRAM DESCRIPTIONS

1 — Forest Administration
1 — 1 Quarterly Benefits Distribution
Program distributes by percentage and dollars the employee benefits for each quarter and summarizes the results.
Evan Boden, Robert Schweitzer
Pennsylvania Bureau of Forestry
Box 1467
Harrisburg, PA 17120
Ti-59 • 478 Steps • Free

3 — 2 Reforestation Tax Credit and Amortization
Costs of re-establishing timber stands after cutting or establishing new stands may be deductible on Federal income tax returns. The reforestation incentive is a 10% investment credit plus 7-year amortization on the first $10,000 of capitalized reforestation expenditures each year. Qualifications and restrictions are explained in the publication. Reforestation Tax Incentive Provisions of Public Law 96-451. Program tells whether qualifying cost share payments received for reforestation expenditures should be included or excluded from gross income on federal income tax returns. It then prints out the 10% tax credit and the following 7-year amortization on the reforestation costs.
John E. Gunter, Department of Forestry
126 Natural Resources Building
Michigan State University
East Lansing, MI 48824
Ti-59 • 400 Steps • Free

5 — Forest Measurements — Biometrics
5 — 1 Stem Volume From Cubic Content Sampling
Program computes the volumes of stem components as a series of frustums of a cone using the formula: Volume = 1/3h (BA₁ + BA₂ + √BA₁BA₂), where h = height of the frustum,
BA₁, BA₂ = the basal areas of each end (program computes from diameter).

L.O. House, C.W. McLaughlin
Great Northern Paper Co.
1024 Central Street
Millinocket, ME 04462
HP-97 • 110 Steps • Free

5 — 2 Cruise Calculation
Enter number of trees in each dbh/ht/species class and VBAR. Program calculates volumes and gives summary of volumes by species and dbh class in addition to number of trees.

Colin Bagwell
1601 Sun Valley Road
Huntsville, AL 35801
HP-97 • 83 Steps • $6.00

5 — 3 Prism Plot Processor with Cubic Foot and Board Foot Volumes
Program calculates Gevorkiantz board feet and cubic feet volumes per acre, basal area, number of trees per acre, mil-acre stocking, and mean diameter from dbh, species (20 maximum) and height by 8' bolts to a 4" top, and height in 16' logs to an 8" top of each tree occurring in a BAF 10 factor prism plot. Species entry by integer code.

Michael W. Finkbeiner
96 Zaccheus Mead lane
Greenwich, CT 06830
Canon SX-100, SX-510, SX-320 • 997 Steps • $30

5 — 4 APPRAZ
Program calculates timber volumes and summarizes same by species and log grade; additionally, numbers of trees by species and dbh class are summarized as are number of logs by species. Grand total volume, number of logs, and number of trees are also provided.

Thomas W. Beers
Department of Forestry and Natural Resources
Purdue University
West Lafayette, IN 47907
HP-41C • 297 Steps • Free

5 — 5 Minicruise
Program summarizes data from an angle gauge survey. At each point the forester enters dbh and height in logs. The program calculates the basal area, trees per acre, and volume on each point. At the end of the cruise the program gives the average basal area, trees per acre, and volume over all points.

James P. Barrett
L.N.E.R. James Hall
University of New Hampshire
Durham, NH 03824
HP-65, HP-67 • 95 Steps • Free

5 — 6 CRUZ
Program processes inventory data from fixed-size or horizontal point samples, where the tallied data are species, tree dbh, number of logs, and soundness. Per acre and total tract summaries are provided for volume, basal area, and number of trees, by species and overall inventory. Per acre and total estimates are by dbh classes. Estimates the mean, standard error, percent standard error and .95 confidence intervals for volume and basal area.

Thomas W. Beers
Department of Forestry and Natural Resources
Purdue University
West Lafayette, IN 47907
HP-41C • 297 Steps • Free

5 — 7 PPLP
Program provides variable radius plot data processing for Rocky Mountain, ponderosa and lodgepole pines.

Terry Beeson
Colorado State Forest Service
Colorado State University
Fort Collins, CO 80523
HP-41C • 140 Steps • $10.00

5 — 8 Tarif Tree Volumes
#1 Tarif Tree Volume: Calculates total cubic foot volume for trees greater than 2" dbh. Tarif number is computed using B.C. volume equations and displayed along with basal area as intermediate results.

#2 Scribner Volume: Calculates net board foot volume to 6" top for any tree greater than 2" bh.

Dannis R. Parent
Inland Empire Paper Company
N. 3320 Argonne Road
Millwood, WA 92206
HP-29C • #1-91, #2-88 • $5.00

5 — 9 TSSA Volume from Sample Weight 3P Scale
Program calculates volume to be reported but from 3P sample weight scaling data.

Leigh Reeves
Black Hills National Forest
240-½ North Fifth
Custer, SD 57730
HP-97 • 152 Steps • Free

5 — 10 Timber Sale
Program computes volumes by 2" diameter class based on the Girard form class table and the International ¼" rule. Output is by diameter class as well as total volume, number of trees tallied, and mean stand diameter.
5 — 11 Form Class Volumes
Program computes board foot tree volumes for the international ¼", Scribner, and Doyle rules. Input consists of dbh, merchantable height in logs, and Girard form class. It allows user to quickly compare volumes using different log rules.

David S. Linden
Technicolor Graphic Services, Inc.
Mail Stop D-234
Building 50, Denver Federal Center
Denver, CO 80225
HP-67 • 213 Steps • Free

5 — 12 HPPP
Program is a field aid and data tabulator for 3P sampling. The user enters the tree dbh and height. Calculator displays the estimated volume and indicates whether tree is to be a 3P sample tree or not. Program sums up estimated volume of all trees visited.

David S. Linden
Technicolor Graphic Services, Inc.
Mail Stop D-234
Building 50, Denver Federal Center
Denver, CO 80225
HP-67 • 202 Steps • Free

5 — 13 Individual and Accumulated Basal Area
Program computes the basal area/stem for each diameter entered, using the formula: \( BA = 0.005454154D^2 \). The basal area is summed for all observations entered:

Total \( BA = \sum_{i=1}^{n} BA_i \)

C.W. McLaughlin
Great Northern Paper Company
1024 Central Street
Millinocket, ME 04462
HP-67 • 80 Steps • Free

5 — 14 Average Diameter, Basal Area/Unit Area
Program calculates the geometric dbh for grouped data, and with an entry of sample area, the BA/Unit area. Metric and English units can be used for input and output with the appropriate factor.

Helmut Bitto
Compagnie Internationale de Papier du Canada
(Harrington) R.R. 2
Calumet, Quebec J0V 1B0
TI-57 • 43 Steps • Free

5 — 15 Total Volume From Tree Sections
Program finds total volume from entries of diameter (from largest to smallest) and total height, assuming stump = cylinder, log = paraboloid frustum, tip = cone.

Log volume is based on Smalian's formula:

\[ V = \frac{A_3 + A_0}{2} \times L \]

Entries and resultant volumes in any combination of metric — English units.

Helmut Bitto
Compagnie Internationale de Papier du Canada
(Harrington) R.R. 2
Calumet, Quebec J0V 1B0
TI-57 • 47 Steps • Free

5 — 16 merchantable Volume From Tree Sections
Program calculates gross merchantable volume from short tree sections. Input and output can be either metric or English, depending on the conversion factor used.

Helmut Bitto
Compagnie Internationale de Papier du Canada
(Harrington) R.R. 2
Calumet, Quebec J0V 1B0
TI-57 • 31 Steps • Free

5 — 17 TSI Cost-Sharing
On a per acre basis, program determines number of trees marked; basal area marked; cost of treating marked trees; basal area marked in sapling, pole, and sawtimber classes; and cords of firewood marked. Output is labeled on printout.

Richard Arps
Department of Natural Resources, Suite 6D
350 Ottawa, N.W.
Grand Rapids, MI 49503
TI-59 • 370 Steps • Free

5 — 18 Variable Plot Stand Table
Program calculates basal area per acre and number of trees per acre by diameter class.

Joseph F. Murray
Star Rt. 2, Box 11F
Port Angeles, WA 98362
HP-87 • 80 Steps • $5.00

5 — 19 Wood Volume Estimate
Program estimates volume of wood on an area.

Pierre Garceau
Compagnie Internationale de Papier du Canada
1024 Central Street
Maniwaki, Quebec
J9E 1Z7
TI-57 • 397 Steps • Free

5 — 20 Point Sampling Volume Determination (International ¼" Scale)
Program calculates total volume by diameter class and species from a point sampling timber cruise. Acreage and number of plots entered once; then form class for each species. Enter diameter class (if diameter-volume table desired) and number of trees tallied for each height class (1 log, 1½, 2, etc.). Prints labels.

David A. Tice
Mid-Atlantic Forestry Services, Inc.
6 Tennis Drive
Charlottesville, VA 22901
Ti-59 (+ 100C Printer) • 330 Steps • Free

5 — 21 Volume Determination for 100% Inventory (International 1/4" Scale)
Program calculates total volume by diameter and species and average per tree by species. Form class, diameter class and number of trees tallied for each height class (1 log, 1½, 2, etc.). Prints labels.

David A. Tice
Mid-Atlantic Forestry Services, Inc.
6 Tennis Drive
Charlottesville, VA 22901
Ti-59 (- 100C Printer) • 300 Steps • Free

5 — 22 Cubic Feet and Tons
Program uses short-cut formulas to give estimates of cubic foot volumes for hardwoods or pine, or tons of biomass for hardwoods. Inputs are site index, basal area, average dbh, number of trees/acre. Not statistically accurate, but valuable for planning purposes. Prints labels, instructions.

David A. Tice
Mid-Atlantic Forestry Services, Inc.
6 Tennis Drive
Charlottesville, VA 22901
Ti-59 (+ 100C Printer) • 453 Steps • Free

5 — 23 Traverse with Area
Program easily used for creating working maps and calculating acreage with hand compass (azimuth) and pacing. Latitude and departure are displayed at each station, and acreage is available on closed traverses.

Mike Meredith
Medford Corporation
Box 550
Medford, OR 97501
HP-33D • 24 Steps • S.A.S.E.

5 — 24 Acreage by Type
Program will accumulate acreage for up to 25 separate timber types or other breakdown using a dot grid.

Colin Bagwell
1601 Sun Valley Road
Huntsville, AL 35801
HP-97 • 55 Steps • $6.00

5 — 25 Traverse Closure and Area
Program will calculate compass and tape traverse for acreage, closure error, and perimeter distance. Input must be in bearings or azimuth, slope %, and feet or chains. If desired, program will also balance the traverse.

Tony Aaron
U.S. Forest Service
Box 138, 11th and Main Street
Delta, CO 81416
HP-97 • 156 Steps • S.A.S.E.

5 — 26 3P Random Numbers
Program is used to generate 3P (cruising) random number lists.

J. David Estola
6123 Sherborn Lane
Springfield, VA 22152
Ti-59 • 118 Steps without Printer, 156 Steps with Printer • Free

5 — 27 N Plots
Program calculates number of plots needed in a variable radius cruise to attain desired accuracy.

Terry Beeson
Colorado State Forest Service
Colorado State University
Fort Collins, CO 80523
HP-41C • 46 Steps • $10.00

5 — 28 Sample Weight Frequency
Program calculates the number of samples needed for conventional weight scaling or 3P weight scaling using number/BF.

Leigh Reeves
Black Hills National Forest
240-1/2 North Fifth
Custer, SD 57730
HP-97

5 — 29 Preliminary Calculations for 3P Cruising
Program used for preliminary calculations in setting up a 3P cruise. Calculates CV of preliminary plots, error, and finds 3rd value when any 2 values are given in the equation

\[ N = \frac{(CV)^2}{E} \]

where N is the number of plots or samples needed in a cruise.

Tony Aaron
U.S. Forest Service
Box 138, 11th and Main Street
Delta, CO 81416
HP-97 • 138 Steps • S.A.S.E.

5 — 30 3P Random Number Generator
Program prints a list of random numbers for 3P sampling given LIM, K, KZ and 9 numbers at random.
5 — 31 Prism Calibration
Using transit to calibrate prism and entry of
distance to target and target deviation with
prism, program calculates prism basal area,
plot radius factor and horizontal limiting dis-
tance in increments of 0.1 inches.

R.H. Greene
Bowridge Hill
RFD 1, Box 311
Ashland, ME 04732
TI-59* 285 Steps* $3.00

5 — 32 Regeneration Survey Using Vertical Point
Sampling
Program computes the stems/acre per plot
and average stems/acre for regeneration sur-
veying using vertical point sampling. The limit-
ing distance must be a multiple of stem height.

K.M. Laustsen, C.W. McLaughlin
Great Northern Paper Company
1024 Central Street
Millinocket, ME 04462
HP-97* 85 Steps* Free

5 — 33 Solution for Tree Height, Crown Height and
Crown Ratio Using Known Bole Height
Given angle to base, angle to top of known
pole height, angle to base of crown, and
glance to desired point on tree (total or mer-
chantable) (all in degrees), program com-
putes crown height, tree height and crown
ratio.

Nick MacKenzie
Forest Service Lab
Intermountain Forest and Range Experiment Sta-
tion
1221 S. Main Street
Moscow, ID 83843
HP-25* 42 Steps* Free

5 — 34 Pocket Electronic Calculator for Barr and
Stroud Dendrometer
Three programs are described. The first uses
dendrometer readings to calculate diameter at
the point of sight, and the vertical distance,
slope distance, and horizontal distance from
the instrument to the point of sight. The other
two programs calculate instrument in clinome-
ter readings to enable users to sight at pre-
determined heights on the tree bole.

Douglas Jager
School of Natural Resources
Humboldt State University
Arcata, CA 95521
HP-65 • 94, 41, and 94 Steps • Free

5 — 35 Barr and Stroud Model 15
Program is an adaptation of the three pro-
grams Jager wrote for the HP-65, (Journal of
Forestry 74(7):438) (see above). The three
programs have been combined into one
HP-67 program. Programs convert Barr and
Stroud dendrometer readings to English units.

David S. Linden
Technicolor Graphic Services, Inc.
Mail Stop D-234
Building 50, Denver Federal Center
Denver, CO 80225
HP-67 • 142 Steps • Free

5 — 36 Tarif Number Access Program
Program calculates tarif numbers from total
height and dbh for Pacific Northwest species.

Joseph F. Murray
Star Rt. 2, Box 11F
Port Angeles, WA 98362
HP-97 • 80 Steps • $5.00

5 — 37 One-Shot Tree Height Measurements on
Permanent Sample Plots
Program calculates and/or locates heights on
all trees on permanent sample. Plots visible
from one observation point using rectangular
or polar coordinates of tree locations and one
vertical measurement per height; documenta-
tion includes model forms; not compatible with
HP-41C calculator. (Hewlett-Packard Program
No. 04484D).

Robert L. Neal, Jr., Research Forester
Pacific Southwest Forest and Range Experiment
Station
2400 Washington Avenue
Redding, CA 96001

or
Order Processing
Hewlett-Packard Company
1000 NE Circle Blvd.
Corvallis, OR 97330
HP-67 • 427 Steps • Free from Author,
$6.00 from HP

5 — 38 Growth \((1 + P)^n\)
Program calculates tree growth for two growth
periods based on present dbh and growth
rate.

Bob Irvine
P.O. Box 1137
Alamosa, CO 81101
HP-97 • 44 Steps • Free

5 — 39 Growth Percent
Program calculates tree growth (%) for more
than one growth period.
5 — 40 Growth Calculation — Stand Table Movement
Program input is growth per period and number of trees per dbh class. Program calculates trees moving and trees remaining stationary. It then takes the volume per tree and calculates projected stand table.

Colin Bagwell
1601 Sun Valley Road
Huntsville, AL 35801
HP-97 • 40 Steps • $6.00

5 — 41 Nelder Plot Dimensions
Program determines spacing between two adjacent points, their distance from the center, the number of points on a radius and for the entire nelder from entered values of maximum and minimum spacing and half angle. The nelder plot design is used to test the effect of spacing on the growth of trees. It uses much less space than block planting to the same range of spacing.

Helmut Bitto
Compagnie Internationale de Papier du Canada
Harrington R.R. 2
Calumet, Quebec J0V 1B0
TI-57 • 49 Steps • Free

5 — 42 Growth Plot Volume Program
Program calculates the volume of pole timber and sawtimber on a fixed tenth-acre plot. There are two versions to this program: Version 1 uses dbh for volume calculation of the butt section; version 2 uses both dbh and basal diameter.

Michael Buck, Roger Imoto
Department of Land and Natural Resources
Division of Forestry
1151 Punchbowl Street
Honolulu, HI 96813
HP-97 • 119/117 Steps • Free

5 — 43 Growth-Shortcut Formulas
Two choices are offered for estimating growth of forest stands: one for Central Hardwoods, the other for all species in the East.

David A. Tice
Mid-Atlantic Forestry Services, Inc.
6 Tennis Drive
Charlottesville, VA 22901
TI-59 (+ 100C Printer) • 824 Steps • Free

5 — 44 Random Number, Means, Regression, and the Programmable Calculator
Random Number Generation (HP-25)
Random Number Generation (HP-19C)
Random Number Generation (HP-67)
Random Number Generation (HP-97)

5 — 45 Weighted Statistics
Program computes weighted statistics of mean, coefficient of variation, standard error, and % standard error for a list of weighted observations.

C.W. McLaughlin
Great Northern Paper Company
1024 Central Street
Millinocket, ME 04462
HP-97 • 74 Steps • Free

5 — 46 Two-Way ANOVA
Program performs a 2-way analysis of variance when appropriate data are entered into the correct data registers. It includes arc sine $\sqrt{\frac{x}{n}}$ and $\sqrt{x} + .5$ transformations, calculation of co-variance for each plot mean, and basic missing plot equation RCB.

Dr. Timothy LaFarge
Research Geneticist
P.O. Box 5106
Macon, GA 31208
TI-59 • 345 Steps • Free

5 — 47 Coefficient of Variation
Program calculates the coefficient of variation (C.V.) for measured plots using $D^2/H$ (D-diameter, H-height). The C.V. is used as an estimation of variation within the stand to be measured.

Roger H. Imoto
Department of Land and Natural Resources
Division of Forestry
1151 Punchbowl Street
Honolulu, HI 96813
HP-97 • 44 Steps • Free

5 — 48 Statistical Analysis of Field Data and Projection of Stand after Thinning
Program projects remaining stand spacing, given the growing stock desired, from raw field data (variable plot cruise) of ponderosa pine after the data are analyzed statistically to determine if the sample is sound.

Raymond A. Sowers, Julia Watson
South Dakota Division of Forestry
Sigurd Anderson Building
Pierre, SD 57501
SR-60A • 1920-2400 Steps (still flaws) • Free
5 — 49 Allegheny Hardwood Stand Analysis and Prescription
Program reads in stand cruise data, computes stand values and calculates a prescription and distribution of cut for a thinner in the pole and larger size classes.
Richard L. Ernst, David A. Marquis
Northeastern Forest Experiment Station
P.O. Box 928
Warren, PA 16365
HP-41C • 680 Steps • Free

5 — 50 Weibull Life Testing
Program runs Weibull Life Testing Formula for instantaneous and continuous time. \[ Z(t) = \frac{a}{3t} \left(1 - e^{-\frac{t}{b}}\right) \]
where \( t \) = time, and estimates for \( a \) and \( b \) are available.
David Maass
Scott Paper Company
Winslow, ME 04902
TI-59 • 36 Steps • Free

5 — 51 Stand and Stock Table Preparation
Program processes forest inventory data from any type of cruise (HPS, FAP, Strip, etc.; any kind of sample unit) to develop per acre and total stand and stock tables.
D.L. Rockwood, D.K. Riman
School of Forest Resources and Conservation
University of Florida, 118 Newins-Ziegler
Gainesville, FL 32611
HP-67 • 188 Steps • (One magnetic card)

5 — 52 Cubic Foot Volume Equations
Program calculates the cubic foot volume of a log using Smalian's cubic foot formula and/or Bruce's butt log formula.
Janet Ayer Sachet, Timber Quality Research
Pacific Northwest Forest and Range Experiment Station
809 NE 6th Avenue
Portland, OR 97232
HP-97 • 90 Steps • Free

5 — 53 MIL3 — Extension of MILL, Totals Obtained
5 — 54 SINDEX — 9 Species Site Index and Height
5 — 55 LOGVOL — 9 Species Site Index and Height
5 — 56 LR — Simple Linear Regression, Compact Version Simulating HP-34C Function Keys
5 — 57 Log Volume Calculations (U.S. and Metric)
5 — 58 Five Species Site Index Calculations
5 — 59 Sawmill Conversion Surplus Calculations
5 — 60 Comprehensive Simple Linear Regression
Thomas W. Beers
Department of Forestry and Natural Resources
Purdue University
West Lafayette, IN 47907
HP-41C, 67, and 97 • Free

5 — 61 Satterthwaite Approximation
Program calculates approximate df for testing F values when mean squares have been combined to calculate the F value.
John F. Kraus
P.O. Box 5106
Macon, GA 31208
TI-59 • 56 Steps • Free

5 — 62 Transformations
Program calculates arc sine \( \sqrt{\frac{x}{y}} \), accumulates sum. Also calculates square root transformation for small number \( \sqrt{x + 0.5} \), accumulates sums, performs back conversions for both transformations.
John F. Kraus
P.O. Box 5106
Macon, GA 31208
SR-52 and TI-59 • 48 Steps • Free

5 — 63 Calculations with a Constant
Using a stored constant, the product, quotient, sum or difference can be calculated from a keyboard entry.
John F. Kraus
P.O. Box 5106
Macon, GA 31208
SR-52 and TI-59 • 48 Steps • Free

5 — 64 Calculate Missing Plot Values
Program uses procedure of Cochran and Cox (p. 110-111, 2nd Ed.,) to obtain missing plot values. Especially useful when many values are missing because program produces new replication, treatment and grand total. Not all inputs need be changed for multiple missing plots.
John F. Kraus
P.O. Box 5106
Macon, GA 31208
SR-52 and TI-59 • 139 Steps • Free

5 — 65 Pulpwood and Sawtimber Limit of Error
Program calculates sawtimber and pulpwood volume/acre, standard error, and other statistical data from 10 BAF Variable plot cruises.
Evan Boden
Pennsylvania Bureau of Forestry
P.O. Box 1467
Harrisburg, PA 17120
TI-59 • 72 Steps • Free

5 — 66 Pulpwood Volume Program
Program calculates pulpwood values using J & K factors for mixed oaks or northern hardwoods.
Thomas Fuller, Forest Technician
Box 111
Mifflinburg, PA 17844
TI-59 • 128 Steps • Free
5 — 67 Softwood Tree Volumes, Scribner Board Feet or Cubic Feet

Program calculates Scribner board foot or cubic foot volumes, basal area in square feet, and Scribner VBAR for an individual tree given its species, dbh in inches, and height in feet. Program can handle the following eight species: Jeffrey pine, ponderosa pine, sugar pine, lodgepole pine, white fir, California red fir and incense cedar. Program also has ability to reduce both fixed and variable plots as well as sum data for groups of trees. Equations for tree volumes are based on “Softwood Tree Volume Equations for Major California Species,” PNW-266, 1976.

John Henshaw
Tahoe National Forest
Highway 49
Nevada City, CA 95959
TI-59, HP-67/97, HP-41C • TI-500 Steps, • HP-67 224 Steps, HP-41C 300 Steps • $5.00

5 — 68 CIA Growth, Cubic Feet

Program calculates cubic foot volume, basal area in square feet, 10-year basal area growth, and 10-year cubic foot volume growth for individual trees of the following species: Douglas fir, Jeffrey pine, ponderosa pine, sugar pine, white fir, red fir and incense cedar. Program can expand to per acre values.

John Henshaw
Tahoe National Forest
Highway 49
Nevada City, CA 95959
TI-59* 560 Steps* $5.00
HP-69/97* 224 Steps* $5.00
HP-41C • 377 Steps • $5.00

5 — 69 Yields of Site-Prepared Loblolly Pine Plantations

This is Texas Instruments conversion of Varner's program written for Hewlett-Packard 97. Required RPN Simulator Module. Three parts. Predicts a yield per acre by diameter class for loblolly pine plantations. Original program by Allen Varner, School of Forest Resources, University of Georgia.

David A. Tice
Mid-Atlantic Forestry Services, Inc.
6 Tennis Drive
Charlottesville, VA 22901
TI-59 • 1,265 Steps • Free

5 — 70 Pinyon-Juniper

Program calculates cubic foot volume of Pinyon (Pinus monophylla) and Juniper (Juniperus osteosperma) on mixed plots and gives volume per acre by species and combined volume based on diameter at root collar and crown width (maximum and minimum).

David Picket
% Harry T. Rhea
Star Route 5, Box 1
Ely, NV 89301
TI-58/59 • 187 Steps • Free

5 — 71 Timber Sale Volume Summary for the Lake States

Program aids in the determination of timber sale volumes in the Lake States. Species code, appropriate correction factor, dbh in inches, height in 16' logs, and number of trees are entered. An unlimited number of species may be entered, and dbh classes may be set at any interval. Program assumes a 100% cruise; volumes are calculated in board feet, International ¼" rule, Doyle, or Scribner. Number of trees and volume are summarized by species and by dbh class within a species. Estimated volume per acre may also be determined.

John E. Gunter
126 Natural Resources Building
Michigan State University
East Lansing, MI 48824
TI-59 • 633 Steps • Free

6 — Forest Protection (Disease, Insects, Fire)

6 — 1 Fire Containment Equation for Pocket Calculators

Program presents simplified equations for solving the fire containment problem. Equations can be used on a programmable pocket calculator to derive the burned area, given forward rate of spread, initial area, fire shape length/width ratio, and control-line construction rate. Equation also can be used to find the line construction rate needed to hold the burned area to a fixed value, knowing the other variable listed. Potential uses for this capability are in preliminary fire control planning and as a dispatching aid.

Carolyn H. Chase
USDA Forest Service
Intermountain Forest and Range Experiment Station
507 25th Street
Ogden, UT 84401
TI-59 • 750 and 273 Steps • Free

6 — 2 Spot Fire Distance Equation for Pocket Calculators

Program presents equations for calculating maximum spot fire distance from firebrand sources in the Intermountain West based on prevailing windspeed, vegetation cover, and terrain. The equations include the capability to
predict spotting distance from a torching tree(s) or from a continuous flame source such as slash piles or jackpots of heavy fuels. Potential uses are in fire management planning and realtime fire behavior predictions.

Carolyn H. Chase
USDA Forest Service
Intermountain Forest and Range Experiment Station
507 25th Street
Ogden, UT 84401

6 — 3 Fire Danger/Fire Behavior Computations
A fire danger/fire behavior Custom Read Only Memory (CROM) developed for use in office or field situations to compute both 1978 National Fire Danger Rating (NFDR) indexes and components and several variables used to estimate wildfire behavior. Calculations can be performed in three operational modes: 1) Compute NFDR indexes and components from standard NFDRs weather observations; 2) compute NFDR indexes and components using direct entry of live and dead fuel moisture; and 3) perform computations required by fire behavior officers.

Charles Hardin, NFDR Liaison
Boise Interagency Fire Center
3905 Visto Avenue
Boise, ID 83705

6 — 4 Fuel Inventory
Program reduces field data taken by planar intersect to fuel loading by size class.

R. Gordon Schmidt
USDA Forest Service
Aviation and Fire Management Region Six
P.O. Box 3623
Portland, OR 97208

6 — 5 Downed Woody Computation

Robert Marty, Department of Forestry
Michigan State University
East Lansing, MI 48824

7 — 1 Simulation of Thinning Options
Program is based on Richardson's Growth Model and Dynamic Programming solutions to simulate growth and yield (intermediate and final) for managed stands under alternative use specified, management/cutting regimes.

7 — 2 Silviculture Exam
A series of programs that calculate basal area, volume in cubic or board feet, volume growth in cubic or board feet (Scribner), basal area growth, and average dbh for each measured tree. A summary program calculates BA/acre, trees/acre, volume/acre, BAG/acre, and volume growth/acre. A program also corrects data input if needed.

7 — 3 Red Pine Yield Projection
Program projects the yield of red pine stands when regular commercial thinning is employed. For any set of initial stand conditions at minimum age 25, and for any selected residual basal area and thinning interval, program projects the stand age, tree height, number of trees, average dbh, basal area, total cubic foot yield, cordwood yield and sawtimber yield for the total stand and for thinnings, at the end of each interval.

7 — 4 Tree Spacer
Program converts trees per acre to the average area occupied by each tree and gives the dimensions of that area expressed as the side of a square or a diameter of a circle. Program converts all information (including number of trees per unit area) from English to metric and from metric to English units.

7 — 5 Marden Scarification — Cost Prediction
Program calculates the total cost and cost per hectare of salaries, fringe benefits, tractor, Marden, transportation, administration and others. Necessitates 11 input data.
9 — General Forestry

9 — 1 Constraint Quanta — An Index of Diversity
A modification of the Shannon diversity index based on percentages of habitats or vegetation types. Formula based on work of Stephen Boyce, Southeastern Experiment Station.

David A. Tice
Mid-Atlantic Forestry Services, Inc.
6 Tennis Drive
Charlottesville, VA 22901
TI-59 (+ 100C Printer) • 139 Steps • Free

9 — 2 Hand-Held-Calculator Programs for the Field Forester
A library of programs written for hand-held programmable calculators which eliminates many of the computations previously done by hand in the field. Programs for scaling aerial photos, variable plot cruising, basal area factor gauge calibration, and volume calculations are included.

Wayne D. Shepperd
General Technical Report RM-76
Rocky Mountain Forest and Range Experiment Station
240 W. Prospect Street
Fort Collins, CO 80526
Outline for adaptation to any programmable calculator • Free

9 — 3 TI-59 Calculator Programs for the Field Forester
Detailed program listings developed for the TI-59 programmable calculator following the outlines featured in the USDA Forest Service Technical Report RM-76, by Wayne D. Shepperd (see above).

Michael J. Beauregard
Department of Forestry
126 Natural Resources Building

9 — 4 Universal Plane Triangle Program (Hewlett-Packard Program No. 00930D)
Program automatically selects and executes solution procedures when given any three parts (except three angles) of any plane triangle; calls for and outputs the six triangle parts. No format restrictions except standard labeling of triangle parts.

Robert L. Neal, Jr., Research Forester
Pacific Southwest Forest and Range Experiment Station
2400 Washington Avenue
Redding, CA 96001
HP-67 • 219 Steps • Free from author, $6.00 from HP

9 — 5 Slope Calculation
Program calculates slope in degrees, % and topographic (feet/chain) units given information from topographic maps. Inputs required: Map scale, elevation change, and horizontal distance expressed in number of scale (ruler) units. Inputs can be either English or metric units.

Robert J. Laacke
Pacific Southwest Forest and Range Experiment Station
2400 Washington Avenue
Redding, CA 96001
TI-59 • 94 Steps • Free

9 — 6 TABLE
Program adds up lines and rows of a table of maximum dimension (lines x rows) of 90. A validation step is provided.

Pierre Garceau
Compagnie Internationale de Papier du Canada
168 Main Street South
Maniwaki, Quebec J9E 1Z7
TI-59 • 158 Steps • Free

9 — 7 Percent Handling
Program calculates the proportion (in percent) of each input datum and applies the percentages to another value.

Pierre Garceau
Compagnie Internationale de Papier du Canada
168 Main Street South
Maniwaki, Quebec J9E 1Z7
TI-59 • 129 Steps • Free
9 — 8  Elevation Profiles for Visual Analysis
With input of elevations at intervals along sight
line, program prints graph of elevation change
(profile). Can be used to determine areas
visible from observation point to analyze visual
impact of proposed forestry plans.

David A. Tice
Mid-Atlantic Forestry Services, Inc.
6 Tennis Drive
Charlottesville, VA 22901
TI-59 (+100C Printer) • 336 Steps • Free

12 — Timber Harvesting

12 — 1  Allowable Harvest
Program uses Keen's formula to determine
allowable harvest.

Bob Irvine
P.O. Box 1137
Alamosa, CO 81101
HP-97 • 100 Steps • Free

12 — 2  Spar Tree Analysis and Spar Tree DBH
Program is designed to compute guyl ine ten-
sions and buckling forces on a standing tree
rigged with two guylines that is to be used as a
tailspar for skyline yarding. The computations
involved require that one guyl ine be rigged on
each side of the skyline. The intent is to
perform the desired analysis with input
parameters that can be easily measured in the
field.

John W. Mann, Director
Forestry and Harvesting Training Center
Gulf Park Campus
Long Beach, MS 39560
HP-67 • 266 Steps • S.A.S.E.

12 — 3  Board Footage of Logs/Doyle and Interna-
tional ¼” Scale
Given the two variables, diameter and length,
program solves for the approximate number of
board feet in a log by Doyle Rule and/or
International ¼” scale. Values are printed on
the PC100A or C or displayed if appropriate
R/S steps are entered.

Professional Program Exchange
P.O. Box 53
Lubbock, TX 79408
TI-59 • 354 Steps • $3.00

12 — 4  Weak Link Logging System Analyzer
Program calculates weak link and logging
costs as described by Baumgras and Martin,
Forest Service researchers at Princeton, WV.

Joe Smith
NE Area, State and Private Forestry
Federal Building, 80 Daniel Street
Portsmouth, NH 03801
HP-97 • 440 Steps • Free

12 — 5  Spacing Logging Roads
With tables prepared by Penn Peters, Forest
Service Researcher at Morgantown, WV, pro-
gram calculates optimum spacing of logging
roads and landings.

Joe Smith
NE Area, State and Private Forestry
Federal Building, 80 Daniel Street
Portsmouth, NH 03801
HP-97 • 200 Steps • Free

12 — 6  Forest Service Road Appraisal
Program gives prompts for appraisal of Forest
Service roads.

Gordon Estep
U.S. Forest Service
Dale, OR 97840
HP-140 • Free

12 — 7  Calculation of End Areas for Forest Roads
Program uses the cut/fill over centerline and
the side slope at each station to determine the
end area at each station.

Mike Wnek
Ragan Logging Co.
227 Fifth Street
St. Maries, ID 83861
HP-33E • 47 Steps • Free

12 — 8  Calculation of Excavation Quantities for Forest
Roads
Program uses calculations from program 12-7
to determine excavation and embankment
quantities for roads.

Mike Wnek
Ragan Logging Co.
227 Fifth Street
St. Maries, ID 83861
HP-33E • 48 Steps • Free

12 — 9  Map Profile Reduction (MAPRO)
Given map scale, contour interval, elevation of
first point, and convenient measuring scale,
program computes horizontal distance from
origin and elevation of proceeding points (con-
tour lines) for development of skyline profiles
from maps.

Dennis J. Caird
U.S. Forest Service — TM (Logging Systems)
517 Gold Avenue SW
Albuquerque, NM 87102
HP-41C • 87 Steps • Free

12 — 10  Log Density — Water Measure
Through measurements of log diameter and
submerged depth of a floating log, the density
in pounds/cubic foot is obtained. Results of
individual measurements are statistically
analyzed. Data is helpful in determining log
weights for skyline payload analysis.
12 — 11 Column Failure (COLFAIL)
If species, diameters inside bark, and height of a spar or tail tree are known, program calculates maximum permissible vertical load and notifies user of the failure mode (buckling or crushing). If "E" value and allowable compression stress are known, any species can be used. Original HP-67/97 version used "E" values for species indigenous to Pacific NW: Douglas fir, Western Hemlock, redwood, Sitka spruce, and ponderosa pine. HP-41C version is for use in southern Rocky Mountains and uses ponderosa pine, inland Douglas fir, Englemann spruce, and white fir.

Devon B. Nickerson, Dennis J. Caird
U.S. Forest Service — TM (Logging Systems)
517 Gold Avenue SW
Albuquerque, NM 87102
HP-41C • 90 Steps • Free

12 — 12 Skyline Payload Analysis
Program determines single-span skyline payloads at any point in the span for live or running skylines; provides associated payload at mid-span for standing skylines. Uses either span geometry or terrain point coordinates for input. Also can compute live skyline tensions if payload needs are known. Mainline and haul-back line tensions also provided.

Devon B. Nickerson, Ward W. Carson
U.S. Forest Service — TM (Logging Systems)
P.O. Box 3623
Portland, OR 97208
HP-41C • 190 Steps • Free

12 — 13 Library of Programs from the Logging Systems Group, Region 6
The following programs for Hewlett-Packard 67 and 97 programmable calculators have made easy solution possible for an array of logging systems problems:

100 Tower and Landing Design
101 Column Failure
Program predicts the mode of failure and the axial load at failure of wooden spars (columns) of known size and species.

102 Wooden Spar Analysis
Program approximates the diameter inside bark at the support height for a wooden spar based on Bhere's Hyperbolic Formula. To calculate the maximum axial force that can be supported without buckle guys, user selects the appropriate modulus of elasticity for the tree species being used.

110 Guyline Tension
Program first approximates the guyline length using slope distance, % slope and tower height. Tension is then calculated using the wave cycle method.

111 Tower Loads
Program calculates the result of a number of forces acting on a tower.

112 Guyline Analysis
Program computes tension and horizontal/vertical components in two guylines, given their geometry and the geometry and tension of a skyline. Compressive force in the spar is also returned.

200 Field Survey and Road Design
211 Earthwork
Program calculates mass, end-areas and staking information for simple road cross-sections: Balances, unbalances, throughcut, throughfill and full bench.

221 Simple Curves and Self-Propelled Yarders
Program will determine the radius of a simple curve; calculate minimum radius that a self-propelled yarder with tower unit can negotiate; compute curve widening needed for the curve measured; and find the tower offsets front or rear.

222 Log Truck Turn Radius
Program computes the minimum road width required in a deep curve for a log truck or lowboy.

223 Curve Radius
Given chord length and middle ordinate, program computes the radius of a curve.

231 Profile Coordinates and Plot (Field Data)
Program takes data from a field traverse of a skyline profile, reduces it to coordinate form, and produces a "plot" on the HP-97 printout.

232 Profile Plot (Topographic Map)
Program takes data from a topographic map traverse of a skyline profile, reduces it to coordinate form, and produces a "plot" on the HP-97 printout.

233 Profile Reduction
Program will convert slope distance, % slope to horizontal and vertical coordinates. Also, horizontal distances and elevation differences can be used to calculate slope in percent or degrees.

234 Rangefinder
Program calculates the horizontal distance and elevation difference to a distant point, based on compass and clinometer shots from two observation points.

236 Skyline Profile and Traverse Closure
Given profile and traverse information, program reduces slope distance and % slope between profile points to station and elevation at each point. It also computes the traverse closure, azimuth and horizontal distance from any profile point to either the starting point or to a point of known azimuth and horizontal distance from the starting point.
300 Skyline Design

330 Singlespan with Mainline, Load and Tension
Program determines the load that can be supported by a single span skyline which produces a specific tension in the skyline. With the cable system geometry and cable weights specified, program determines the load that can be supported and the tension which must be supplied by the mainline to hold the load and carriage in position.

331 Singlespan with Mainline, Tension and Length
Program determines the tension in the single span skyline caused by supporting a specific load at a specific point. The program will also determine the stretched and unstretched skyline lengths so that a load path for a fixed length skyline can be generated.

332 Singlespan with Haulback, Load and Tension
Program determines the load that can be supported by a single span skyline which produces a specific tension in the skyline. With the cable system geometry and cable weights specified, program determines the load that can be supported and the tension which must be supplied by the haulback to hold the load and carriage in position.

333 Singlespan with Haulback, Tension and Length
Program determines the tension in the single span skyline caused by supporting a specific load at a specific point. The program will also determine the stretched and unstretched skyline lengths so that a load path for a fixed length skyline can be generated.

334 Running Skyline, Load and Tension
This program determines the load that can be supported by a running skyline system which produces a specific tension in the skyline (i.e. running haulback line). With the cable system geometry and cable weights specified, this program determines the load that can be supported and the tensions which must be supplied by the mainline and slack-pulling (or operating) line.

335 Running Skyline Load Path
It is helpful to know what the path of an anticipated load will be before setting up a skyline corridor. Program determines the coordinates of this load path when the anchor point locations, equipment specifications and anticipated load are supplied. This enables the operator to more efficiently match the capabilities of his particular piece of equipment to the profile of a given corridor.

336 Error In Rigid-Link Analysis
The skyline design programs use an approximation to the more accurate catenary-type analysis of cable system. Errors are introduced by this approximation. The magnitude of error depends on the geometry of the cable segment, its weight per unit length and the tension in the segment. In general, the error is small for taut cables. This program computes the percent and magnitude of error. The forest engineer should use this program to become familiar with the error.

337 Elliptical Load Path
The path followed by a load suspended on a fixed length skyline is closely approximated by an ellipse with the foci at the left and right anchor points. Program determines the coordinates of such an ellipse when the anchor point geometry and the skyline length of the single span system are supplied.

338 Standing Skyline Abney Method
Program determines the load and log turn size that can be supported by a single span standing skyline which produces a specific tension in the skyline. With the cable system geometry and cable weights specified, program determines the load that can be supported by the skyline, and the dimensions of a log that produces this load.

341 Live Skyline, Clamped Carriage
Program calculates skyline payloads when using a carriage that is clamped to the skyline.

342 Slackline, Rowley-Parker Carriage
Program calculates payloads and cable tension when using a Rowley-Parker type (three-drum slackpulling) carriage.

343 Maximum Gravity Outhaul Distance
Program computes the maximum horizontal outhaul distance for a gravity return carriage on a skyline.

344 Singlespan with Mainline, Partial Suspension
Program performs the same payload calculations as 330, except that the logs may have one end on the ground.

345 Running Skyline, Partial Suspension
Program performs the same payload calculations as 334, except that the logs may have one end on the ground.

346 Partial/Full Suspension Log Ratio
Program calculates the ratio of vertical force required for full suspension vs partial suspension of log payloads, using the payload geometry and coefficient of friction between log and ground.

347 Live Skyline Contour Map Solution
Program performs the same payload calculations as 330, except that the user can work directly from a topographic map.

351 Unloaded Skyline Tension
Program calculates the line tension in a
skyline (or any cable segment) using the wave cycle method.

352 Log Weight
Program will estimate the weight and volume of a log if the large or small end diameter is known. Can also be used to compute maximum log diameter for a given payload capacity.

353 Critical Skyline Tension at a Multispan Jack
Program calculates the minimum upper-end tension in a multispan skyline to ensure that the carriage will pass over the intermediate jack travelling uphill.

361 Profile Reduction
Program allows input of skyline profile data (slope distance, % slope), for up to 99 legs. Data can be listed, edited, stored on blank cards, then reduced to coordinates, also stored on blank cards. The profile, in coordinate form, may be analyzed by Critical Standing Skyline #362, and Critical Running/Live Skyline #363.

362 Critical Standing Skyline
Program allows input and headspar and tailhold height and location, clearance, and yarding limits, then calculates the minimum live skyline length encountered between yarding limits. Program incorporates Elliptical Load Path #337 to calculate all the geometry parameters necessary for calculating the critical standing skyline payload, using Single-span, Load and Tension #330 or #332.

363 Critical Running/Live Skyline
Program allows input of headspar and tailhold height and location, clearance, and yarding limits, then searches to find the critical point for Running or Live Skyline payloads, using Single-span Load and Tension #330 or #332 (for Live Skyline) or Running Skyline Load and Tension #334.

400 Economic Analysis
401 Interior Road Standard #1
Program determines the optimum number of stations to construct a low-standard road before upgrading to a high standard, for a road where the volume being hauled increases at a constant rate.

402 Interior Road Standard #2
Program computes the optimum number of stations to skid by ground skidder before upgrading the skid trail to a swing road for a setting where the volume being hauled increases at a constant rate.

403 Interior Road Standard #3
Program computes the optimum number of stations to construct a low-standard road before upgrading to a high standard, for a road where the volume being hauled increases at a variable rate.

411 Multiperiod Road Spacing Analysis
Program calculates the optimum (cheapest) road spacing for tractor-yarded stands logged in stages over time. Program uses Matthews' optimization formulas.

412 Two-Way Skid, Parallel Roads and Landings
Program estimates optimum road spacing, given landing spacing and yarding costs, for two-way tractor yarding to landings on parallel truck roads. Total cost/MBF is calculated, as is cost for suboptimal spacing configurations.

413 Optimum Road/Landing Spacing
Program simultaneously solves for both road and landing spacing that produce optimum logging cost. A second card calculates costs associated with suboptimal spacing configuration.

414 Tractor Skid, Parallel Roads, No Landings
Program calculates optimum road spacing for one-way or two-way yarding direct to haul roads, and associated logging costs.

415 Optimize Lateral Yarding Distance
Program computes economic optimum yarding distance and associated logging costs for parallel or fan-shaped settings.

421 Cost/MBF
Program computes the average cost of yarding and average production per hour from cost and production relationships.

431 AYD Continuous Landings
Program computes the average yarding distance for a continuous landing by breaking the area into segments and summing the mid-length of each segment multiplied by the segment's area.

432 AYD, Single Landings, Irregular Settings
Program calculates the acreage and average yarding distance for irregular-shaped settings yarded to a single landing.

441 Interest and Annuity Factors
Program calculates compounding, discounting, annuity, and gradient factors for dealing with cash flows.

451 Quickie Time-Study Aid
Program uses the HP-67 as a timer to record time observations on up to four different production elements: Mean, standard deviation, cumulative mean and cumulative standard deviation of observations.

500 Watershed and Hydrologic Analysis
501 Culvert Discharge
Program uses the HP-67 as a timer to estimate the flow, in cubic feet per second, and velocity, in feet per second, of water through a pipe or pipe-arch culvert.

502 Stream Gauging
Program reduces streamflow velocity data for natural or artificial streamchannel cross-sections into velocity, discharge, and Manning's Roughness Coefficient.
503 Throughfall (Interception Losses)  
Program predicts losses of precipitation due to interception and evaporation from coniferous forest canopy, based on models by two different west-coast researchers.

504 Bethlahmy's Two-Axis Raingauge Method  
Program weights observations from several raingauges to find an average figure for precipitation in a watershed.

505 Flood Event Probabilities  
Program uses known frequency observations to predict the chance of occurrence (or nonoccurrence), and the average return period of a flood event (or any other probabilistic event).

506 Potential Evapotranspiration  
Program computes potential moisture losses through evaporation and transpiration from a forest canopy for determining water balance for forested terrain.

511 Darcy's Permeability Law  
Program determines rate of flow through a porous medium, given head and coefficient of permeability; or coefficient of permeability given head and rate of flow.

512 Soil Consolidation  
Program determines ultimate settling that can be expected on unconsolidated or preconsolidated plastic soils under load.

513 Approximate Bearing Capacity  
Program calculates approximate factors to determine load-bearing capacity of plastic soils.

600 Mechanical Engineering

610 Torsion  
Program will find maximum stress, required torque, or amount of torsion for hollow, cylindrical, or tapered shafts.

620 Wood Density Water Measure  
Program computes wood density in lbs/ft based on a ratio of submerged log end area to total end area of a floating log.

630 General Catenary Solution  
Program uses cable segment length, height difference, horizontal span, and weight per foot to determine the catenary parameter, lowest point, tension, and orientation at each support, using a numerical solution for the catenary equation requiring no initial guess.

640 Stress/Strain  
Strain is a function of applied force, Modulus of Elasticity, length, and cross-section area. Given any four of these parameters, program determines the fifth. Either English or metric unit may be used.

13 — Urban Forestry

13 — 1 Instant Inventory for City Trees  
In the past, tree inventories have meant a field tally of tree data with transfer of data to tape or cards followed by computer processing. Using this program (program 1), data for each tree is entered into the calculator as one 6 digit number. Inventory values are generated and summarized by the calculator while walking to the next tree. Summarized data can be printed out at any time using a second printout program (program 2). Answers show tree values (dollars) and numbers by species, size class, tree condition and treatment needed.

George N. Semmens  
T.W.I.G.  
Route 2, Box 179-D  
Escanaba, Michigan 49829  
TI-59 • #1-1445 Steps #2-2470 Steps • $18.00

15 — Wood Products

15 — 1 A Series of Programs to Calculate Log Volume, Lumber Recovery, and Log Scale  
The following calculations are made by the program series: 1) Log Volume by Smallians formula, 2) Lumber Recovery Factor, 3) Overlength on Logs, 4) Log Scale and percent overrun for the Doyle, International ½" and Scribner rules.

Philip H. Steele  
State and Private Forestry  
U.S. Forest Products Lab  
Madison, Wisconsin 53705  
TI-59 • 400 Steps • Free

15 — 2 Lumber Value and Volume Equations  
There are two programs, one for lumber selling value and the other for lumber tally volume. Equations cover the following species: Inland Douglas-fir, young growth Douglas-fir (lumber and veneer), western white pine, old growth ponderosa pine and western larch.

Janet Ayer Sachet, Timber Quality Research  
Pacific Northwest Forest and Range Experiment Station  
809 NE 6th Avenue  
Portland, Oregon 97232  
HP-96 • Volume-168 Steps, Value-169 Steps • Free

16 — Other

16 — 1 Maple Syrup Evaporator Thermal Efficiency  
Program calculates thermal efficiency of an oil-fired open pan evaporator, boiling water.

Paul E. Sendak  
Northeastern Forest Experiment Station  
George D. Aiken Sugar Maple Laboratory  
P.O. Box 968, 705 Spear Street  
Burlington, Vermont 05402  
HP-67 • 35 Steps • Free