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Forestry Programs for Programmable Calculators
Michigan State University Extension Service
Kama R. Sterrett and John E. Gunter
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Forestry Programs for Programmable Calculators

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MICHIGAN STATE UNIVERSITY



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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- 3 — Forest Economics and Finance
- 4 — Forest Genetics and Tree Improvement
- 5 — Forest Measurements — Biometrics
- 6 — Forest Protection (Disease, Insects, Fire)
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- 8 — Forest Soils and Water
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- 12 — Timber Harvesting
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- 15 — Wood Products
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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 — Forest Economics and Finance

3 — 1 Economic Evaluation of Reforestation Projects

Given discounted project costs and current stumpage returns, program calculates the Net Present Value per unit of output and a Cost-Price Index for any type of forest development project.

Forest Economist
Minnesota Department of Natural Resources
Box 44, Centennial Office Building
658 Cedar Street
St. Paul, MN 55155
HP-67/97, TI-59 • 26 Steps • Self-Addressed
Stamped Envelope

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

3 — 3 FAME (Forest Asset Management Evaluation)

Program provides internal rate of return (IRR) calculations for rapid analysis of alternative management activities and their expected outcomes. Input is based on basal area and allows stratification of management costs by species and size class.

Alan C. Page, President
Green Diamond Forestry Service, Inc.
125 Blue Meadow Road
Belchertown, MA 01007
HP-41C • 284 Steps • \$200/year

3 — 4 Investment Analysis for Timber Management Using a Programmable Calculator

Program calculates net present worth (NPW), benefit-cost ratio (B/C), composite rate of return (CPR), and soil expectation value (SEV) for any timber management program or action.

Robert Marty, Department of Forestry
126 Natural Resources Building
Michigan State University
East Lansing, MI 48824
TI-59 • 411 Steps • Free

3 — 5 Present, Future Values, and Interest Rate

Program calculates future value (V_n) of an investment (V_0) in n years at an interest rate of i ; calculates V_0 of a single sum due n years hence at interest or discount rate i ; calculates V_0 of a series of terminable (n) annual payments (a) at interest rate i ; calculates i given V_n , V_0 , and n .

Paul E. Sendak
Northeastern Forest Experiment Station
George D. Aiken Sugar Maple Laboratory
P.O. Box 968, 705 Spear Street
Burlington, VT 05402
HP-67 • 51 Steps • Free

3 — 6 Investment Analysis with the Realizable Rate of Return (RRR)

For each selected year or period of the investment's expected useful life, program calculates (and prints): 1) Amount of the cash flow, 2) net present value (NPV), 3) discounted net cash balance (NCB), and 4) realizable rate of return (RRR). Program operates sequentially and can handle any number of years or periods for even (annuities), uneven, or a combination of cash flows.

M.E. Wirth, Department of Agricultural Economics
Washington State University
Pullman, WA 99164
HP-67/97, 41C • 120 Steps • One blank card

5 — Forest Measurements — Biometrics

5 — 1 Stem Volume From Cubic Content Sampling

Program computes the volumes of stem components as a series of frustrums of a cone using the formula: $\text{Volume} = 1/3h (BA_1 + BA_2 + \sqrt{BA_1 BA_2})$, where h = height of the frustrum,

BA_1, BA_2 = 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-310, 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.

Dennis 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
240-1/2 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 1/4" rule. Output is by diameter class as well as total volume, number of trees tallied, and mean stand diameter.

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 — 11 Form Class Volumes

Program computes board foot tree volumes for the International 1/4", 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 • 202 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 Service, Inc.
Mail Stop D-234
Building 50, Denver Federal Center
Denver, CO 80225
HP-67 • 80 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:

$$\text{Total BA} = \sum_{i=1}^n \text{BA}$$

C.W. McLaughlin
Great Northern Paper Company
1024 Central Street
Millinocket, ME 04462
HP-97 • 37 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 JOV 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:

$$V = \frac{A_s + A_t}{2} \times L$$

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 JOV 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 JOV 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-97 • 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
168 Main Street South
Maniwaki, Quebec
J9E 1Z7
TI-59 • 397 Steps • Free

5 — 20 Point Sampling Volume Determination (International 1/4" 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 ¼" 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
240-½ 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.

Tony Aaron
U.S. Forest Service
Box 138, 11th and Main Street
Delta, CO 81416
HP-97 • 69 Steps • S.A.S.E.

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 distance 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 surveying using vertical point sampling. The limiting 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 angle to desired point on tree (total or merchantable) (all in degrees), program computes crown height, tree height and crown ratio.

Nick MacKenzie
Forest Service Lab
Intermountain Forest and Range Experiment Station
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 clinometer readings to enable users to sight at predetermined 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 programs 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; documentation 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.

Bob Irvine
P.O. Box 1137
Alamosa, CO 81101
HP-97 • 68 Steps • Free

- 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)

Calculation of Means
Simple Linear Regression
Multiple Regression Summary (MRI)
Simultaneous Equation Solution (MRII)
Multiple Regression Testing, etc. (MRIII)
Variable Deletion and Testing (MRIIV)

Thomas W. Beers
T and C Enterprises
Box 2196
West Lafayette, IN 47906
\$10.00 for entire publication

- 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 $\sqrt{\%}$ 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^2H (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 thinning 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. $Z(t) = \alpha\beta t^{(\beta-1)}$, where t = time, and estimates for α and β 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 — Board Feet (4 rules) and Cubic Volume (3 formulas). U.S. and metric.**
- 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 **Satterthwaites 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 $\sqrt{\%}$, 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, Jeffery 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 Pickel
% 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 1/4" 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
TI-59 • 470 Steps • Free

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 moistures; and 3) perform computations required by fire behavior officers.

Charles Hardin, NFDR Liaison
Boise Interagency Fire Center
3905 Visto Avenue
Boise, ID 83705
TI-59 • 5000 Steps • \$25.00

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
HP-67/97 • Free

6 — 5 Downed Woody Computation

Program performs calculations described in the "Handbook for Inventorying Downed Woody Material" by James K. Brown (USDA Forest Service General Technical Report, INT-16, 1974).

Director
Aviation and Fire Management
Northern Region
Box 7669
Missoula, MT 59807
TI-59 • 440 Steps • Free

7 — Forest Silviculture

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.

Forest Economist
Minnesota Department of Natural Resources
Box 44, Centennial Office Building
658 Cedar Street
St. Paul, MN 55155
HP-67/97 • 213 Steps • S.A.S.E.

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.

Ken Estes
Lassen National Forest
707 Nevada Street
Susanville, CA 96130
HP-41C • 155 Steps • Free

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.

Robert Marty, Department of Forestry
Michigan State University
East Lansing, MI 48824
TI-59 • 799 Steps • Free

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.

Robert J. Laacke
Pacific Southwest Forest and Range Experiment
Station
2400 Washington Avenue
Redding, CA 96001
TI-59 • 184 Steps • Free

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.

Pierre Garceau
Compagnie Internationale de Papier
du Canada
168 Main Street South
Maniwaki, Quebec J9E 1Z7
TI-59 • 319 Steps • Free

- 7 — 6 All Age Size-Class Distribution (Q Factor)
Given inputs of $\sqrt{8}$, maximum dbh desired to manage, desired residual basal area, program calculates and prints dbh and associated number of trees/acre for selected distribution of Q (for 1" dbh classes) in descending order. Also prints total number of trees/acre.

R.H. Greene
Bowridge Hill
RFD 1, Box 311
Ashland, ME 04732
TI-59 • 363 Steps • \$4.00

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

Michigan State University
East Lansing, MI 48824
TI-59 • Free

- 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

or
Order Processing
Hewlett-Packard Company
1000 NE Circle Blvd.
Corvallis, OR 97330
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 as 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 \times 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) • 338 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 guyline tensions 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 guyline 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 International 1/4" 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 1/4" 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, program 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 97880
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 (contour 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.

Dennis J. Caird
U.S. Forest Service — TM (Logging Systems)
517 Gold Avenue SW
Albuquerque, NM 87102
HP-41C and HP-67/97 • 69 Steps (41C), 73 Steps
(67/97) • Free

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 • 190 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 • 371 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.

237 Traverse

Program will calculate the area enclosed by a traverse and the azimuth and distance of the closure error. Inputs may be slope distance and % slope, horizontal distance, or slope in topogs and distance in chains.

241 Air Photo Height Equation

Program computes the change in elevation between two points from measurements taken from an aerial photograph stereo pair.

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. Program will also determine the stretched and unstretched skyline lengths so that a load path for 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 traveling 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 an approximation of the Bergstrom Observation method of critical point identification. Program calculates all geometry parameters necessary for computing payload, using Singlespan 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.

Regional Forester
USFS-Region 6
P.O. Box 3623
Portland, OR 97208
Attn: TM-Logging System

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, MI 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 Smilians formula, 2) Lumber Recovery Factor, 3) Overlength on Logs, 4) Log Scale and percent overrun for the Doyle, International 1/4" and Scribner rules.

Philip H. Steele

State and Private Forestry

U.S. Forest Products Lab

Madison, WI 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, OR 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, VT 05402

HP-67 • 35 Steps • Free

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