A PROGRAM FOR THE TRUNK FORMULA METHOD OF TREE APPRAISAL[1]

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Abstract. A program is presented that computes tree appraisal by the trunk formula method as presented in the Guide for Plant Appraisal, 8th edition (2). It is written in the RPN language and requires 62 lines of memory. It is designed for hand-held, battery-operated calculators that have a minimum of 10 storage registers and the capability of conditional branching in their programming format. Use of this program can reduce the problem of computational error and possible lack of precision in determining tree value by the trunk formula method and significantly reduces the time required for the calculations.

Accurate and defensible appraisal of tree value is a subject that is very important in the practice of professional arboriculture. There have been numerous approaches made and procedures developed for determining the monetary value of trees over the past 100 years, and each successive development or revision has increased the precision, and often the objectivity, in making these determinations. A recent critique (5) examined certain causes of distortion in tree appraisal, pointing out the important differences in the subjective and objective aspects of appraisal. The eighth edition of the Council of Tree and Landscape Appraiser's Guide for Plant Appraisal (2) has made significant advances in reducing important sources of distortion that had been present in appraising the value of amenity trees, including the problem of unrealistically high formula appraisals for trees with trunk diameters greater than 30 inches and the assignment of a fixed dollar value for basal area of all species of trees.

The improvements made to the formula approach for amenity tree appraisal have not been made without cost. There are more data requirements and some of the inputs needed are to be determined by regional groups. Moreover, the trunk formula method is much more mathematically complex than the previous basic formula methods. It had been observed previously (3) that many people, including university students who had already studied college algebra and calculus, experienced some difficulty in performing the calculations necessary for accurate appraisal. One approach to managing that problem was the introduction of programs for the automatic computation of the basic formula method on battery operated, programmable, hand calculators (3). The programs that employ electronic calculators were not intended to supplant the various spread sheet programs that some arborists have used in making tree appraisals. Rather, they were intended for use by arborists who may not have had access to the spread sheet programs and the personal computers needed to support these programs. Moreover, using the relatively inexpensive programmable calculators (retail prices less than $50) allows the arborist to perform the computational aspects of tree appraisal in the field, which can increase the arborist's productivity, since frequent trips to and from a computer station would not be necessary.

The Program

This program is written in the RPN language (1, 6). It requires 62 lines of calculator memory and the calculator must have a minimum of 10 storage registers and the programming capability of conditional branching, as one of the important features of the program is the automatic calculation of trunk area (TA_A) for trees that are 30 inches or less in trunk diameter, or adjusted trunk area (ATA_A) for trees greater than 30 inches in diameter. The program is written for the Hewlett-Packard HP 32SII calculator, but with minor transcriptional changes will work on calculators made by other

[1]Florida Agricultural Experiment Stations Journal Series No. R-03117.
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manufacturers, as well. If programmable calculators that do not employ the RPN language are used, it is likely that as much as 20% more memory capacity will be required, due to the lower level of program line economy in other languages. Each of the 9 separate factors necessary to compute appraisals by the trunk formula method is entered into a storage register, and the number 30 is entered into a tenth storage register. The number 30 is used at the conditional branching command at line A04, where the program computes TA_A for trees having diameters equal to or less than 30 inches, and ATA_A for trees having diameters greater than 30 inches. The program requires that the user key in the following information:

(a) trunk diameter of the appraised tree (storage register A),
(b) replacement cost of the largest-size available replacement tree (storage register B),
(c) trunk diameter of the replacement tree (storage register C),
(d) wholesale cost of the replacement tree (storage register D),
(e) species rating of the appraised tree (storage register E),
(f) condition rating of the appraised tree (storage register F),
(g) site rating of the appraised tree (storage register G),
(h) contribution rating of the appraised tree (storage register H), and
(i) placement rating of the appraised tree (storage register I).
(j) the number 30 is keyed into storage register X.

A Sample Run

The following example takes data presented in the 8th edition of the Guide for Plant Appraisal (2). A tree with a 35 inch diameter, replacement cost of the largest commonly available transplantable tree of the same species of $1,040.00, trunk diameter of the replacement tree of 4 inches, wholesale cost of the replacement tree of $415.00, species rating of 90%, condition rating of 80%, site rating of 90%, contribution rating of 80%, and placement rating of 70%. This information is entered into the calculator according to the instructions on Table 1. Note that percent ratings are entered as decimal fractions (i.e., 90% = 0.90).

After the data have been entered, press the XEQ key, then the A key. The word "running" will appear briefly on the display, then the trunk area, either TA_A or ATA_A (depending on trunk diameter entered).

In this example, the ATA_A, in square inches, 928.13, would appear. Then press the XEQ key again, then the B key. The word "running" will appear briefly on the display, then the appraised value, in dollars, 18,090.49, will appear. This amount is different from the appraised value given in the Guide for Plant Appraisal (2), $18,057.92, because the example in the Guide rounds off numbers at several points during the computation process, whereas the program does not. This slight difference would not normally pose a problem, as most appraisers would round off the appraised value to the nearest hundred dollars. Therefore, the appraised value for the tree in this example would be $18,100, regardless of whether the data were computed manually or using the program.

The data entered will remain in the calculator's storage registers, even if the calculator's power is turned off. To compute additional appraisals, new data can be entered, and as these data are entered, they override and erase the previous data. For example, if an arborist was conducting an appraisal of a tree that was equal in all respects to the one in the example above, except that its trunk diameter was 20 inches rather than 35 inches, it would be necessary to only enter the number 20 into storage register A. The remaining storage registers would retain the previously entered data. When the XEQ key and A key were pressed, the computed TA_A in square inches, 314.00, would appear and when the XEQ key and B key were pressed, the appraised value in dollars, $6,402.56, would appear.

Applications and Use

Use of this program allows greater precision in the computation of the trunk formula method, substantially reduces the risk of computational error, and increases the potential efficiency of the

Table 1. Operating directions for computing tree appraisal using the trunk formula method, for use on a Hewlett-Packard HP 32SII programmable calculator.

Step	Instructions	Keystrokes	Output data
1.	If the calculator has been programmed, go to step 4. If not, switch calculator into program mode	☐ PRGM	
2.	Key in program (Table 2)		
3.	Switch calculator into run mode	☐ PRGM	
4.	Enter trunk diameter, in inches	STO A	
5.	Enter replacement cost, in dollars	STO B	
6.	Enter replacement tree diameter, in inches	STO C	
7.	Enter wholesale cost, in dollars	STO D	
8.	Enter species rating	STO E	
9.	Enter condition rating	STO F	
10.	Enter site rating	STO G	
11.	Enter contribution rating	STO H	
12.	Enter placement rating	STO I	
13.	Enter 30	STO X	
14.	Execute first part of program	XEQ A	TA_A or ATA_A
15.	Execute second part of program	XEQ B	Appraised value in dollars

Table 2. Program listing for the trunk formula method for tree appraisal using a Hewlett-Packard HP 32SII programmable calculator.

Keystrokes	Display
PRGM	PRGM TOP
LBL A	A01 LBL A
RCL A	A02 RCL A
RCL X	A03 RCL X
x?y{<y}	A04 x<y?
GTO F	A05 GTO F
RCL A	A06 RCL A
x^2	A07 x^2
.785	A08 0.785
X	A09 X
STO L	A10 STO L
RTN	A11 RTN
LBL F	F01 LBL F
RCL A	F02 RCL A
69.3	F03 69.3
X	F04 X
ENTER	F05 ENTER
RCL A	F06 RCL A
x^2	F07 x^2
.335	F08 0.335
X	F09 X

(Continued from col 1)

-	F10 -
1087	F11 1,087
-	F12 -
STO L	F13 STO L
RTN	F14 RTN
LBL B	B01 LBL B
RCL G	B02 RCL G
ENTER	B03 ENTER
RCL H	B04 RCL H
+	B05 +
RCL I	B06 RCL I
+	B07 +
ENTER	B08 ENTER
3	B09 3
—	B10 —
STO J	B11 STO J
RCL C	B12 RCL C
x^2	B13 x^2
.785	B14 0.785
X	B15 X
STO K	B16 STO K

(Continued from col 2)

RCL L	B17 RCL L
RCL K	B18 RCL K
-	B19 -
STO M	B20 STO M
RCL D	B21 RCL D
RCL K	B22 RCL K
÷	B23 ÷
STO N	B24 STO N
RCL M	B25 RCL M
RCL N	B26 RCL N
X	B27 X
RCL E	B28 RCL E
X	B29 X
RCL B	B30 RCL B
+	B31 +
RCL F	B32 RCL F
X	B33 X
RCL J	B34 RCL J
X	B35 X
RTN	B36 RTN
PRGM	0.00

arborist by eliminating the need to transport field data to the office for computation.

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Zusammenfassung. Es wird ein Programm vorgestellt, das Baumschätzungen nach der Stammformelmethode rechnerisch erfaßbar macht, die in der 8, Ausgabe des Führers zur Pflanzenschätzung vorgestellt wurde. Es ist in der RPN-Sprache geschrieben und erfordert 62 Speichereinheiten. Es ist entwickelt für batteriebetriebene Taschenrechner. Der Gebrauch dieses Programms kann Recherfehler und den möglichen Mangel an Prezision in der Baumwerterfassung reduzieren und resuziert sicherlich die benötige Zeit für Kaltulationen.