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BDEN: A Timesaving Computer Program for Calculating Soil Bulk Density and Water Content

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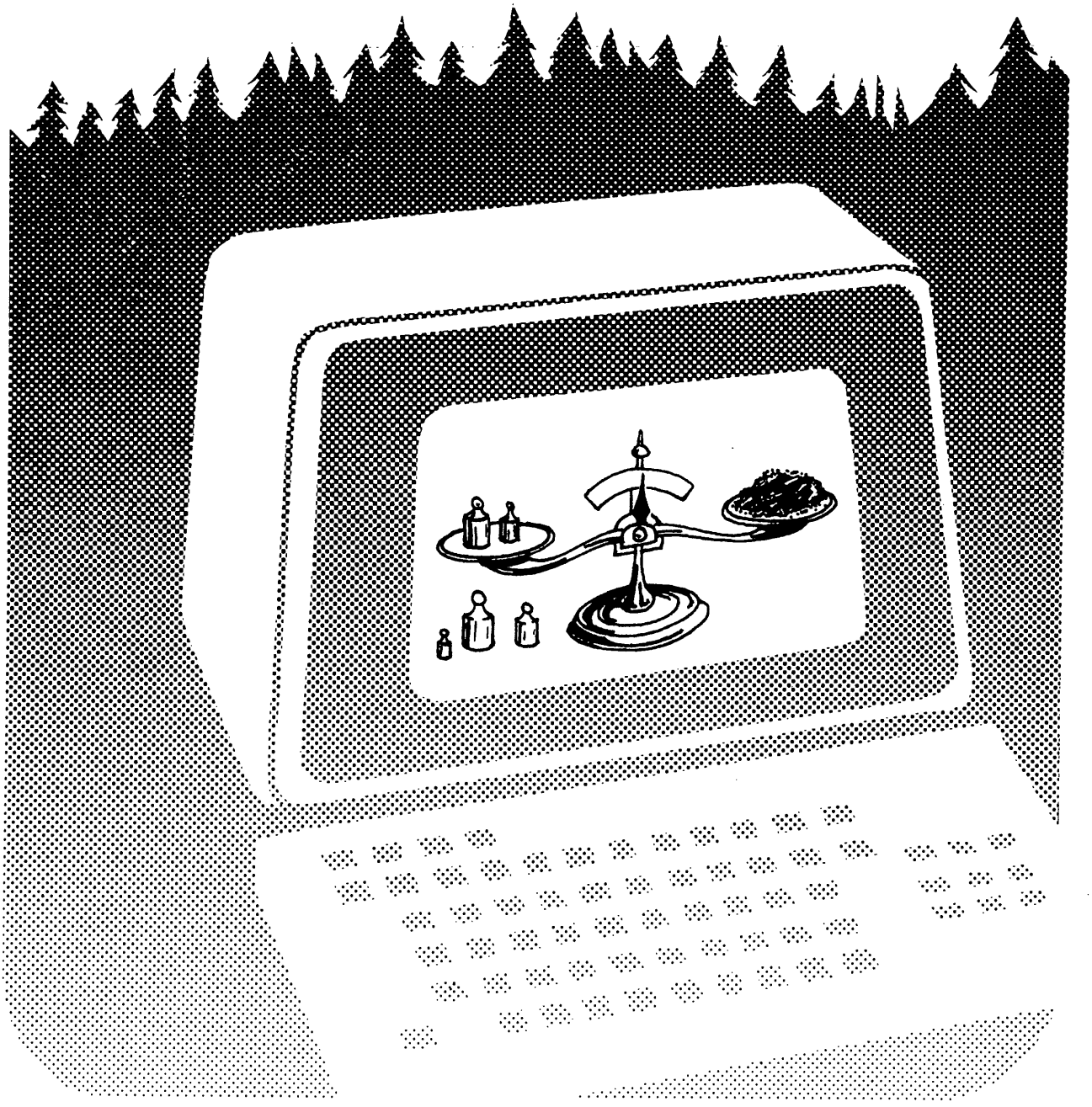

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Abstract

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This paper presents an interactive computer program written in BASIC language that will calculate soil bulk density and moisture percentage by weight and volume. Coarse fragment weights are required. The program will also summarize the resulting data giving mean, standard deviation, and 95-percent confidence interval on one or more groupings of data.

Keywords: Soil bulk density, soil water, soil monitoring, computer programs/ programing.

Introduction

Bulk density is commonly used to monitor impacts of management activities on soil conditions. A computer program was developed that computes soil bulk density and moisture content. Its use will save computation time and will reduce errors. BDEN, an interactive program, is written in BASIC language for Jacquard' systems. The program listing is provided *so* modifications can easily be made to suit systems using other languages.

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What the Program Does

Our main objective was to generate individual soil bulk density values. These may come from core samples of fixed or variable volumes. Provision is made in the calculations to adjust for coarse fragment content based on an assumed particle density of 2.65 grams per cubic centimeter (g/cc). Thus, core volume is reduced by coarse fragment volume, leaving only soil volume and weight for computation of soil bulk density.

In addition, if weights of field-moist samples are obtained, soil moisture percentages by both weight and volume can be calculated (based on soil volume and weight adjusted for coarse fragments). This, however, is optional and wet weights are not required for the bulk density calculation.

BDEN will also compute mean, standard deviation, and confidence interval for a user-selected group of observations. The 95-percent probability level was chosen for the confidence interval because it is the value most commonly reported. The program could be altered to allow selection of a different probability level, if desired.

What Values are Needed

The program uses these values: total core volume (cc), dry weights in grams of empty can (can dry wt), can plus coarse fragments (cf) plus soil (total dry wt), and can plus coarse fragments (cf + can dry wt). In addition, total wet weight is needed to calculate percent water. If total wet weight is unavailable, a zero value must be entered *so* the data following will be read properly.

Preparing the File

Following are instructions you will need to prepare for program operation. Before the program can be used, data files, auxiliary files, and the program file must be entered onto computer disc storage.

Data File Entry

Establish data files using the editor program in your computer. Enter site designation, date, and any other information establishing the identity and field location in the first few lines of the file. Use any format and any number of lines here; however, the last line of this information **must have an asterisk** in the first column.

There **must** be **two and only two lines for column headings** before data begins. These headings are for the user's convenience only, because the program will skip two lines following the asterisk before reading data. The spelling and spacing of these headings is flexible; however, we have suggested headings that will allow National Forests or Districts the opportunity to standardize labels. Such standardization would avoid confusion when information is exchanged.

Next, enter data values. The first six spaces (columns 1-6) are available for the sample number, followed by one blank and then three spaces (columns 8-10 for class. This class is assigned by the user to provide a simple means of grouping related samples in the summarization process. Class designations may be either numbers or letters. (For example, class could be according to soil type or possibly by plant community.) The rest of the data can be entered free-format (one or more spaces between entries) but must be in the order from left to right specified in the example below (see also table 1):

All weights are in grams and core volumes in cubic centimeters. Values may be as precise as you wish, but commonly only one decimal place is necessary. If total wet weights are not available, **do not omit this column,** but enter zero for the wet weight.

Auxiliary File Entry

The summarization step computes standard deviations and 95-percent confidence intervals. For this step to operate, two auxiliary files must be on your system's nominal disc. (The nominal disc is the one your system "assumes" when no disc designation is included with a filename.) One of these is TTBLE, which is a t-table including values for 2-tailed probabilities of 10, 5, 2, and 1 percent.[2] Values for TTBLE are entered (exactly as shown in table 2) into a file named TTBLE using your computer's edit program. The other file needed is TABLE, a subprogram that selects the appropriate value from the t-table. Entering and compiling of TABLE is explained below.

[2] BDEN uses the 5-percent probability level. The additional values are used by TTABLE for other applications.

Because TBLE and TTABLE are referred to in the BDEN program by name, these file names must be spelled exactly as shown here, and they must reside on the nominal disc.

Program Entry

Using the editor program of your computer, write a file (BDEN.SC in our example) into which you will type the program listing, or source code, for BDEN exactly as shown in table **3.** The listing must then be translated into binary code, which the computer uses; this requires instructing the computer to compile the source code as shown below. Compiling need be done only once and is accomplished by entering one command line after exiting from the editor program. Assuming the source code is in a file named BDEN.SC, the command line would be:

```
$SGBASC BDEN.SC B=BDEN
```

Similarly, the source code for TABLE (table 4) must be keyed in to a file using the editor and must be compiled. Assuming the source code for this program is in a file name TTABLE.SC, the command line to compile would be:

```
$SGBASC TTABLE.SC B=TTABLE
```

Meadow T.S. 11/80 Unit 25
*Winter logged

SAMP NO	CLASS	TOTAL WETWT	TOTAL DRYWT	CF + CAN DRYWT	CAN WT	CORE VOL
9-300	A	95.57	72.40	38.50	37.97	58.52

etc.

Program Use

Once the data file(s), t-table, and compiled program files are on disc, computation may proceed. Simply type BDEN and respond to queries as they appear on the screen.

Your first response should be B to initiate calculation of bulk density, percent water by volume and by weight for each sample in the file. These values are output as new columns added to the original data file on your disc (for example, see table 5). (Percent water values will be zero if zero wet weights were entered.) After exiting BDEN, you may view the data file on the screen to see the results, or print the file using your computer's print program.

Once the computation of bulk density has been done, you may compute the mean, standard deviation, and 95-percent confidence interval by entering a response of **M.** Output from this summarization step will be appended to the end of a disc file the user has named in response to screen inquiry. (You may exit BDEN and print the output file as mentioned above for the data file. Or you may choose to send the output directly to the printer; for example, respond DPR1 when asked for output filename. If the latter method is used, no copy of the output is saved on disc.)

The next request from the computer is that you indicate which samples are to be included in the mean. You may choose one of three ways to group samples for this step. First, a mean can be computed on an entire file by responding 'ALL' to the request (table 6). Second, a response of 'EACH' will compute a mean for each different class in the file. (For this use, the members of a class **must be consecutive** in the data file.) Or third, certain classes may be grouped by entering the class codes to be selected. For example, a response of **'A'** will compute a mean for any sample with class A. A response of 'A' 'D' would compute a single mean for all samples with a class of either A or D (table 7). **(Up** to eight different classes can be grouped into one mean be this method.) This response **must be surrounded by single or double quotes,** and in the case of two or more classes in the same mean, there must be a blank space between the designated classes.

If you want to compute a mean on sample data entered on two or more files, merge the files into one file via the editor or word-processor program prior to using BDEN.

We would appreciate your correspondence on the usefulness of this program and any suggestions for its improvements.

Formulas Used:

$$\text{cc soil} = \text{core vol} - \frac{\text{cf} + \text{can dry wt} - \text{can wt}}{2.65}$$

$$\text{g dry soil} = \text{total dry wt} - (\text{cf} + \text{can dry wt})$$

$$\%\ \text{water content by volume} = \frac{(\text{total wet wt} - \text{total dry wt})}{\text{cc soil}} \times 100$$

$$\%\ \text{water content by weight} = \frac{(\text{total wet wt} - \text{total dry wt})}{\text{g dry soil}} \times 100$$

$$\text{Bulk Density} = \frac{\text{g dry soil}}{\text{cc soil}}$$

$$\text{Standard deviation} = \sqrt{\frac{\Sigma(X^2) - \frac{(\Sigma X)^2}{n}}{n-1}} \quad \text{where } X = \%H_2O_{(v)} \text{ or } \%H_2O_{(w)} \text{ or BD}$$

$$\text{Confidence interval} = \frac{t_\alpha s}{\sqrt{n}}$$

Table 1 — Data Entry Set

MEADOWTS UNIT 25 11/80
*

SAMP NO.	CLASS	TOTAL WETWT	TOTAL DRYWT	CF+CAN DRYWT	CAN WT	CORE VOL
9-300	A	95.57	72.40	38.50	37.97	58.52
9-301	A	88.12	70.28	38.60	38.05	58.52
9-302	A	95.35	80.90	46.10	38.82	58.52
9-303	A	89.90	75.90	40.30	38.60	58.52
9-304	A	113.49	93.30	42.90	38.15	58.52
5-305	B	92.62	71.45	38.60	37.98	58.52
5-306	B	100.05	77.58	40.38	38.95	58.52
5-307	B	103.67	80.28	38.60	37.82	58.52
5-308	B	93.96	75.35	39.92	38.95	58.52
5-309	B	99.65	75.20	38.60	37.70	58.52
1-310	C	97.02	77.20	40.18	39.68	58.52
1-311	C	98.79	75.30	38.28	37.35	58.52
1-312	C	93.50	73.38	39.20	38.30	58.52
1-313	C	92.43	72.00	38.95	38.75	58.52
1-314	C	104.37	83.71	38.15	37.30	58.52
3-315	D	93.98	75.82	40.05	38.90	58.52
3-316	D	82.33	66.67	39.10	38.60	58.52
3-317	D	98.10	75.03	38.25	37.75	58.52
3-318	D	93.66	73.02	38.02	37.40	58.52
3-319	D	97.61	75.12	39.90	38.90	58.52

Table 2 —TTBLE

	.2	.1	.05	.02	.01
1	3.078	6.314	12.706	31.821	63.657
2	1.886	2.920	4.303	6.965	9.925
3	1.638	2.353	3.182	4.541	5.841
4	1.533	2.132	2.776	3.747	4.604
5	1.476	2.015	2.571	3.365	4.032
6	1.440	1.943	2.447	3.143	3.707
7	1.415	1.895	2.365	2.998	3.499
8	1.397	1.860	2.306	2.896	3.355
9	1.383	1.833	2.262	2.821	3.250
10	1.372	1.812	2.223	2.764	3.169
11	1.363	1.796	2.201	2.718	3.106
12	1.356	1.782	2.179	2.681	3.055
13	1.350	1.771	2.160	2.650	3.012
14	1.345	1.761	2.145	2.624	2.977
15	1.341	1.753	2.131	2.602	2.947
16	1.337	1.746	2.120	2.583	2.921
17	1.333	1.740	2.110	2.567	2.898
18	1.330	1.734	2.101	2.552	2.878
19	1.328	1.729	2.093	2.539	2.861
20	1.325	1.725	2.086	2.528	2.845
21	1.323	1.721	2.080	2.518	2.831
22	1.321	1.717	2.074	2.508	2.819
23	1.319	1.714	2.069	2.500	2.807
24	1.318	1.711	2.064	2.492	2.797
25	1.316	1.708	2.060	2.485	2.787
26	1.315	1.706	2.056	2.479	2.779
27	1.314	1.703	2.052	2.473	2.771
28	1.313	1.701	2.048	2.467	2.763
29	1.311	1.699	2.045	2.462	2.756
30	1.310	1.697	2.042	2.457	2.750
99	1.282	1.645	1.960	2.326	2.576

Table 3 — BDEN Source Code Listing

```
10      FULL
20      BLKSCN
30      ROLL
40      A$='*',BL$=' ',M$='M',END$='E',ALL$='ALL',EACH$='EACH',BL4$='    '
50      OCLASS$=' ',Z=0,WHAT$=' ',WHERE$='  '
60      STRING CLS(8)
70      PRINT 'TO COMPUTE BULK DENSITY ENTER  B '
80      PRINT 'TO COMPUTE MEAN, S AND CI ENTER  M (MUST HAVE COMPUTED '&
        +'BULK DENSITY PREVIOUSLY)'
90      PRINT 'TO EXIT ENTER  E '
100     INPUT IN IMAGE '#':WHAT$
110     IF SCOMP(WHAT$,END$)=0 THEN GOTO 1320
120     PRINT 'TYPE IN NAME OF INPUT FILE'
130     INPUT IN IMAGE '14#':FILE$
140     OPEN FILE$: F1;ON ERROR GOTO 200
150     IF SCOMP(WHAT$,M$)=0 THEN GOTO 490
160     ON ENDFILE F1 GOTO 390
170     OPEN 'DUMMY',OUTPUT:F2
180     GOSUB 220
190     GOTO 280
200     PRINT 'ERROR ON OPENING FILE - TRY AGAIN'
210     GOTO 130
220             ! INPUT HEADER SUBROUTINE - SEARCHES FOR *
230     INPUT FROM F1 IN IMAGE '80#':HEADER$
240     PRINT ON F2 IN IMAGE '80#':HEADER$
250     IF SCAN(HEADER$,A$,1,V@)<>0 THEN GOTO 270
260     GOTO 230
270     RETURN
280     INPUT FROM F1 IN IMAGE '80#':JUNK$  ! SKIPS COLUMN HEADINGS
290     INPUT FROM F1 IN IMAGE '80#':JUNK$
```

Table 3 — BDEN Source Code Listing, continued

```
300     PRINT ON F2 IN IMAGE '74#':' SAMP CLASS  TOTAL   TOTAL   CF+CAN   CAN'&
        +'     CORE   SOIL    BD    %WATER'
310     PRINT ON F2 IN IMAGE '74#':'  NO.        WET WT  DRY WT  DRY WT  DRY '&
        +'WT   VOL    VOL           VOL  WT'
320     INPUT FROM F1 IN IMAGE '6# B 3# B 5F':SNO$,CLASS$,WWT,DWT,GWT,CAN,CORVOL
330     H2O=WWT-DWT,CC=CORVOL-((GWT-CAN)/2.65),H2OV=H2O*100/CC,H2OV=ROUND(H2OV)
340     H2OW=H2O*100/(DWT-GWT),BD=(DWT-GWT)/CC,H2OW=ROUND(H2OW)
350     IF H2O<0 THEN H2OW=0
360     IF H2O<0 THEN H2OV=0
370     PRINT ON F2 IN IMAGE '6# B 3# 6(2B 3%.%%) 2B 18.3% B 2(B 3%)':SNO$,&
        CLASS$,WWT,DWT,GWT,CAN,CORVOL,CC,BD,H2OV,H2OW
380     GOTO 320
390     CLOSE F1
400     CLOSE F2
410     LINK '$DELETE ' + FILE$
420     LINK '$RENAME DUMMY ' + FILE$
430     PRINT 'BULK DENSITY COMPUTATIONS COMPLETE'
440     GOTO 70
450     PRINT 'ERROR ON OPENING FILE - TRY AGAIN'
460     GOTO 520
470     IF %ERROR=117 THEN PRINT '** CLASS MUST BE ENCLOSED IN QUOTES **'
475     %ERROR=0
480     GOTO 560
490     ON ENDFILE F1 GOTO 900
500     ON ERROR F1 GOTO 790
510     PRINT 'TYPE IN NAME OF OUTPUT FILE'
520     INPUT IN IMAGE '14#':RESULT$
530     OPEN 'CRT':F3  !  TO ENABLE THE 'ON ERROR' STATEMENT
540     ON ERROR F3 GOTO 470
550     OPEN RESULT$,OUTPUT(MOD):F2;ON ERROR GOTO 450
```

Table 3 — BDEN Source Code Listing, continued

```
560   PRINT 'ENTER CLASSES TO INCLUDE IN MEAN (ENCLOSE EACH CLASS IN '&
      +'QUOTES && SPACE BETWEEN)'
570   PRINT '      ENTER "ALL" TO INCLUDE WHOLE FILE'
580   PRINT '      ENTER "EACH" TO COMPUTE EACH CLASS INDIVIDUALLY'
590   PRINT 'PRESS "RETURN" TO EXIT MEAN COMPUTATION LOOP NOW'
600   CLS=' ',TH2OV=0,TH2OW=0,TBD=0,TSH2OV=0,TSH2OW=0,TSBD=0,N=0
610   INPUT FROM F3 IN IMAGE 'F':CLS
620   IF LENGTH(CLS(1))=0 THEN GOTO 1130
630   GOSUB 220
640   ON DIVCHECK GOTO 820
650   INPUT FROM F1 IN IMAGE '80#':JUNK$ ! SKIPS COLUMN HEADINGS
660   INPUT FROM F1 IN IMAGE '80#':JUNK$
670   CLS(1)=SUBSTR(CLS(1),1,4)
680   IF SCOMP(CLS(1),EACH$)=0 THEN GOTO 1210
690   CLS(1)=SUBSTR(CLS(1),1,3)
700   IF SCOMP(CLS(1),ALL$)=0 THEN GOTO 840
710   INPUT FROM F1 IN IMAGE '7B 3# 50B %.3% B 2(B 3%)':CLASS$,BD,H2OV,H2OW
720   CLASS$=LSPACE(RSPACE(CLASS$))
730   FOR I@=1 TO 8
740   CLS(I@)=SUBSTR(CLS(I@),1,3)
750   IF SCOMP(CLS(I@),CLASS$)=0 THEN GOTO 770
760   NEXT I@
765   GOTO 710
770   GOSUB 870
780   GOTO 710
790   IF %ERROR=117 THEN PRINT '** ERROR IN DATA FORMAT. CHECK INPUT FILE **'
795   FOR L@=1 TO 20000
796   NEXT L@
800   %ERROR=0
810   GOTO 1130
```

a

Table 3 — BDEN Source Code Listing, continued

```
820     IF N=0 THEN PRINT '** CLASS NOT FOUND - TRY AGAIN **'
825     $ERROR=0
830     GOTO 1170
840     INPUT FROM F1 IN IMAGE '7B 3# 50B %.3% B 2(B 3%)':CLASS$,BD,H2OV,H2OW
850     GOSUB 870
860     GOTO 840
870     TH2OV=TH2OV+H2OV,TH2OW=TH2OW+H2OW,TBD=TBD+BD,TSH2OV=TSH2OV+H2OV*H2OV
880     TSBD=TSBD+BD*BD,TSH2OW=TSH2OW+H2OW*H2OW,N=N+1
890     RETURN
900     SVS=(TSH2OV-(TH2OV/N)*TH2OV)/(N-1),&
        SWS=(TSH2OW-(TH2OW/N)*TH2OW)/(N-1),&
        SBDS=(TSBD-(TBD/N)*TBD)/(N-1)
910     SV=SQR(SVS),SW=SQR(SWS),SBD=SQR(SBDS)
920     MV=TH2OV/N,MW=TH2OW/N,MBD=TBD/N
930     DF=N-1,ALPHA=.05
940     LINK 'TTABLE',DF,ALPHA,T
950     CIV=T*SV/SQR(N),CIW=T*SW/SQR(N),CIBD=T*SBD/SQR(N)
960     GROUP$=CLS(1)+' '+CLS(2)+' '+CLS(3)+' '+CLS(4)+' '+CLS(5)+' '&
        +CLS(6)+' '+CLS(7)+' '+CLS(8)
970     IF Z=0 THEN GROUP$=RSPACE(GROUP$) ELSE GROUP$=OCLASS$
980             ! Z IS AN INDEX INDICATING 'EACH' LOOP
990     PRINT ON F2 IN IMAGE '16B 63#':'MEAN N STD.DEV. 95% CI FOR '+GROUP$
1000    IM$='14# B 3%.% B 3% 2B 3%.% 6B 3%.%'
1010    PRINT ON F2 IN IMAGE IM$:'% WATER (VOL.)',MV,N,SV,CIV
1020    PRINT ON F2 IN IMAGE IM$:'% WATER (WT.)',MW,N,SW,CIW
1030    PRINT ON F2 IN IMAGE '14# B %.3% B 3% 2B %.3% 6B %.3%': 'BULK DENSITY',&
        MED,N,SBD,CIBD
1040    PRINT ON F2
```

Table 2 — TTBLE

	.2	.1	.05	.02	.01
1	3.078	6.314	12.706	31.821	63.657
2	1.886	2.920	4.303	6.965	9.925
3	1.638	2.353	3.182	4.541	5.841
4	1.533	2.132	2.776	3.747	4.604
5	1.476	2.015	2.571	3.365	4.032
6	1.440	1.943	2.447	3.143	3.707
7	1.415	1.895	2.365	2.998	3.499
8	1.397	1.860	2.306	2.896	3.355
9	1.383	1.833	2.262	2.821	3.250
10	1.372	1.812	2.223	2.764	3.169
11	1.363	1.796	2.201	2.718	3.106
12	1.356	1.782	2.179	2.681	3.055
13	1.350	1.771	2.160	2.650	3.012
14	1.345	1.761	2.145	2.624	2.977
15	1.341	1.753	2.131	2.602	2.947
16	1.337	1.746	2.120	2.583	2.921
17	1.333	1.740	2.110	2.567	2.898
18	1.330	1.734	2.101	2.552	2.878
19	1.328	1.729	2.093	2.539	2.861
20	1.325	1.725	2.086	2.528	2.845
21	1.323	1.721	2.080	2.518	2.831
22	1.321	1.717	2.074	2.508	2.819
23	1.319	1.714	2.069	2.500	2.807
24	1.318	1.711	2.064	2.492	2.797
25	1.316	1.708	2.060	2.485	2.787
26	1.315	1.706	2.056	2.479	2.779
27	1.314	1.703	2.052	2.473	2.771
28	1.313	1.701	2.048	2.467	2.763
29	1.311	1.699	2.045	2.462	2.756
30	1.310	1.697	2.042	2.457	2.750
99	1.282	1.645	1.960	2.326	2.576

Table 4 — TTABLE Source Code Listing

```
10      GETVAL DF,ALPHA,T
20      IF DF>30 THEN DF= 99
30      OPEN  'TTBLE':TVAL
35      INPUT FROM TVAL IN IMAGE '80#':JUNK$
40      INPUT FROM TVAL IN IMAGE '3% B 5(2%.3% B)':DFT,NUM1,&
        NUM2,NUM3,NUM4,NUM5
50      IF DFT<DF THEN GOTO 40
55      IF ALPHA= .2 THEN T = NUM1
60      IF ALPHA = .1 THEN T = NUM2
70      IF ALPHA= .05 THEN T = NUM3
80      IF ALPHA= .02 THEN T = NUM4
90      IF ALPHA= .01 THEN T = NUM5
100     CLOSE TVAL
110     STOP
```

Table 5. — Data Computation Results:

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*

SAMP NO.	CLASS	TOTAL WET WT	TOTAL DRY WT	CF + CAN DRY WT	CAN WT	CORE VOL	SOIL VOL	BD	%WATER VOL	%WATER WT
9-300	A	95.57	72.40	38.50	37.97	58.52	58.32	0.581	39	68
9-301	A	88.12	70.28	38.60	38.05	58.52	58.31	0.543	30	56
9-302	A	95.35	80.90	46.10	38.82	58.52	55.77	0.624	25	41
9-303	A	89.90	75.90	40.30	38.60	58.52	57.88	0.615	24	39
9-304	A	113.49	93.30	42.90	38.15	58.52	56.73	0.888	35	40
5-305	B	92.62	71.45	38.60	37.98	58.52	58.29	0.564	36	64
5-306	B	100.05	77.58	40.38	38.95	58.52	57.98	0.642	38	60
5-307	B	103.67	80.28	38.60	37.82	58.52	58.23	0.716	40	56
5-308	B	93.96	75.35	39.92	38.95	58.52	58.15	0.609	32	52
5-309	B	99.65	75.20	38.60	37.70	58.52	58.18	0.629	42	66
1-310	C	97.02	77.20	40.18	39.68	58.52	58.33	0.635	33	53
1-311	C	98.79	75.30	38.28	37.35	58.52	58.17	0.636	40	63
1-312	C	93.50	73.38	39.20	38.30	58.52	58.18	0.587	34	58
1-313	C	92.43	72.00	38.95	38.75	58.52	58.44	0.565	34	61
1-314	C	104.37	83.71	38.15	37.30	58.52	58.20	0.783	35	45
3-315	D	93.98	75.82	40.05	38.90	58.52	58.09	0.616	31	50
3-316	D	82.33	66.67	39.10	38.60	58.52	58.33	0.473	26	56
3-317	D	98.10	75.03	38.25	37.75	58.52	58.33	0.631	39	62
3-318	D	93.66	73.02	38.02	37.40	58.52	58.29	0.600	35	58
3-319	D	97.61	75.12	39.90	38.90	58.52	58.14	0.606	38	63

Table 6 — Data Summary for Entire File

MEADOWTS UNIT 25 11/80
*

	MEAN	N	STD.DEV.	95% CI FOR ALL
%WATER (VOL.)	34.3	20	5.1	2.4
% WATER (WT.)	55.6	20	0.7	4.1
BULK DENSITY	0.627	20	0.087	0.041

Table 7 — Data Summary for a Class

MEADOW TS UNIT 25 11/80
*

	MEAN	N	STD.DEV.	95% CI FOR A D
% WATER (VOL.)	32.2	10	5.8	4.2
%WATER (WT.)	53.3	10	10.4	7.4
BULK DENSITY	0.618	10	0.106	0.076

Starr, G. Lynn; Geist, J. Michael. BDEN: a timesaving computer program for calculating soil bulk density and water content. Gen. Tech. Rep. PNW-153. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest And Range Experiment Station; 1983. 12p.

This paper presents an interactive computer program written in BASIC language that will calculate soil bulk density and moisture percentage by weight and volume. Coarse fragment weights are required. The program will also summarize the resulting data giving mean, standard deviation, and 95-percent confidence interval on one or more groupings of data.

Keywords: Soil bulk density, soil water, soil monitoring, computer programs/programing.

The **Forest Service** of the **U.S.** Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.

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