A COMPUTER PROGRAM FOR METEOROLOGIC DATA REDUCTION

J. KENT MITCHELL and FERRON L. ANDERSEN
Department of Agricultural Engineering and College of Veterinary Medicine, University of Illinois, Urbana

ABSTRACT. — A computer program is presented for use in reducing basic meteorologic data and presenting the data in tabular form. The program includes an adaptation of soil-moisture meter data to computer analysis.

Digital computers provide an efficient method for handling large amounts of data. The purpose of this paper is to present a computer program which reduces basic meteorologic data and presents them in summary tables. The program is used to calculate and tabulate meteorologic measurements in standard weather shelters, as well as additional measurements that are taken at or below the ground surface. A description of the overall research project and instruments used for meteorologic measurements has been published (Andersen and Levine, 1967). Parts of the computer program presented here could be applied directly to other projects which collect meteorologic data; with minor modifications it could be adapted to many more.

DESCRIPTION OF THE PROGRAM

The program is written in the Fortran II language (IBM, 1963) for the University of Illinois IBM 7094 computer. It requires 6,383 storage locations and approximately three minutes of computer time to process one year's data.

The program consists of a main section and one subroutine. The main program reads the input data, performs preliminary computations on the daily values, stores these daily values, and controls the use of subroutine MONTH. Subroutine MONTH performs monthly summary computations and produces the output in the form of monthly summary tables.

The input consists of up to 3 cards of data for each day. The number of cards varies with the season of the year since not all measurements can be made during freezing weather. Each of these cards has a number code to indicate which section of the main program is used for the preliminary data reduction. Figure 1 is an example of the data sheet which is used with this program. Each of the 3 daily cards has the day, month, year, and card number, followed by a maximum of 13 items of data, as identified in Figure 1. When there are missing data the columns are left blank, except that the temperature and dew duration columns are coded with the values of 999.0 and 99.0, respectively. Also, when the high range of the ammeter is used, a value of 9000 is added to the soil moisture basic data readings (microamperes).

One input data card, which is common to all runs, must precede the daily data cards. This card lists the number of days for the year on the last day of each month, e.g., 0, 31, 59, etc.

The output from the program is illustrated in Figures 2, 3, and 4. Some of the data are merely totaled and averaged for this presentation; other items

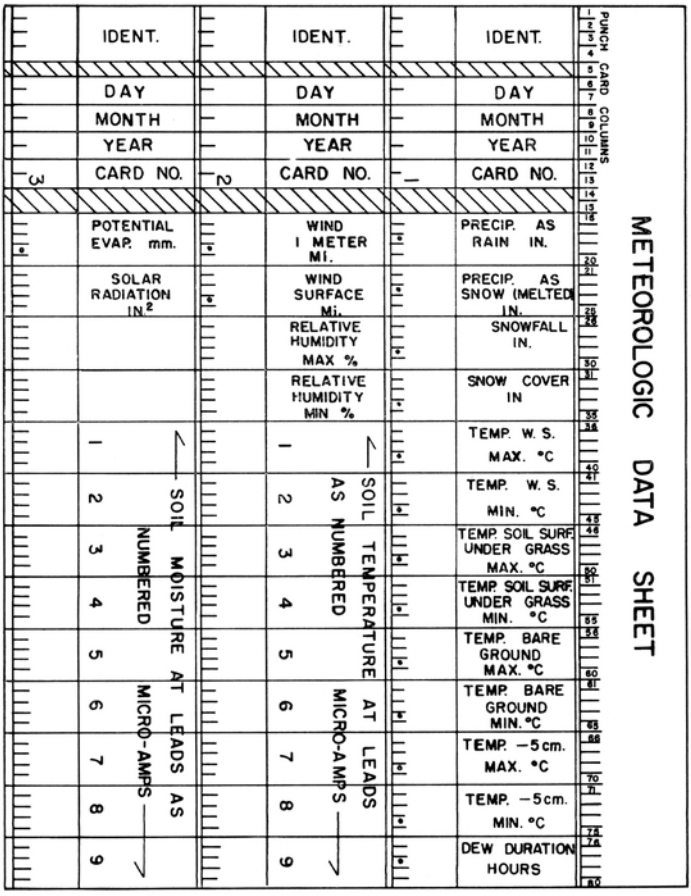

FIGURE 1. — Meteorologic data sheet.

require conversion of units from the raw data recorded on the meteorologic data sheet. Solar radiation, for example, is measured on a pyrheliograph and is converted from sq. in. of strip chart record to the appropriate units (Figure 2). The maximum and minimum temperatures for each day are averaged, and monthly means, maxima, and minima for each location are given.

The basic data for soil moisture and soil temperature are microampere readings obtained by using a Soiltest, Inc. soil moisture meter with soil moisture cell leads (wafers), and built-in thermistor units for soil temperature. The formulas used to convert these microampere data to soil temperature values and to corrected resistance values were obtained from the graphs given in the soil moisture meter manual (Soiltest, Inc., 1964) which is part of the testing kit. The equation with program statement numbers 250, 251, 303, and 350 were obtained by using a University of Illinois Computer Library Program for least square polynomial fit (DCS, UI, 1966) with points from the instruction manual graphs submitted as data. The equations for the straight line graphs in the instruction manual were computed manually and appear as statements 304 and 351. Statements 51 through 59 are the equations obtained from a least square polynomial fit of corrected resistance computations paired with gravimetric soil moisture measurements. These gravimetric measurements

MONTHLY SUMMARY OF METEOROLOGIC DATA, VET. MED. RESEARCH FARM, URBANA, ILLINOIS, MONTH 8 YEAR 1966

DATE	DAY OF YEAR	PRECIPITATION (MM) TOTAL PRECIP	PRECIP RAIN	PRECIP SNOW	SNOW FALL	SNOW COVER	DEW DURATION HR.	RELATIVE HUMIDITY WEATHER STATION MAX.	MIN.	WIND (KM) 1 METER	SURFACE	POTENTIAL EVAP MM	SOLAR RADIATION GMCAL/SQCM
1	213	10.41	10.41	.00	.00	.00	9.50	100	59	271.92	30.57	8.0	495.00
2	214	.00	.00	.00	.00	.00	10.50	94	64	210.78	64.36	10.2	576.00
3	215	.00	.00	.00	.00	.00	8.00	94	49	183.43	17.70	13.2	639.00
4	216	.00	.00	.00	.00	.00	11.50	81	34	20.92	3.22	.2	594.00
5	217	.00	.00	.00	.00	.00	9.75	97	80	24.13	1.61	14.4	495.00
6	218	.00	.00	.00	.00	.00	10.00	100	54	62.75	9.65	17.2	576.00
7	219	.51	.51	.00	.00	.00	13.25	100	65	157.68	17.70	18.2	450.00
8	220	3.56	3.56	.00	.00	.00	14.00	100	65	141.59	27.35	7.4	513.00
9	221	11.43	11.43	.00	.00	.00	5.00	100	61	104.58	14.48	8.4	549.00
10	222	17.02	17.02	.00	.00	.00	21.00	100	96	222.04	20.92	.0	126.00
11	223	.00	.00	.00	.00	.00	13.00	99	61	112.63	28.96	6.0	234.00
12	224	22.86	22.86	.00	.00	.00	6.00	100	56	125.50	1.61	11.1	585.00
13	225	3.05	3.05	.00	.00	.00	8.00	100	95	141.59	1.61	.2	171.00
14	226	1.27	1.27	.00	.00	.00	10.00	100	77	135.16	4.83	8.2	513.00
15	227	.51	.51	.00	.00	.00	14.00	100	77	217.21	22.53	8.8	450.00
16	228	.00	.00	.00	.00	.00	15.00	98	66	123.89	27.35	10.0	567.00
17	229	.00	.00	.00	.00	.00	13.50	98	61	96.54	3.22	7.4	405.00
18	230	7.11	7.11	.00	.00	.00	14.00	100	68	128.72	11.26	4.4	531.00
19	231	.00	.00	.00	.00	.00	7.00	99	72	152.85	4.83	6.0	459.00
20	232	.25	.25	.00	.00	.00	13.00	100	82	114.24	14.48	4.8	324.00
21	233	.51	.51	.00	.00	.00	13.00	100	76	244.57	35.40	7.0	432.00
22	234	.00	.00	.00	.00	.00	10.50	97	67	204.34	59.53	8.0	558.00
23	235	.00	.00	.00	.00	.00	11.50	95	58	168.94	49.88	7.6	585.00
24	236	.00	.00	.00	.00	.00	13.75	96	58	101.37	30.57	6.8	495.00
25	237	.00	.00	.00	.00	.00	12.75	96	58	93.32	30.57	8.0	468.00
26	238	.00	.00	.00	.00	.00	12.25	97	56	85.28	22.53	10.0	630.00
27	239	.00	.00	.00	.00	.00	12.50	98	60	75.62	12.87	8.4	549.00
28	240	.00	.00	.00	.00	.00	12.25	98	62	70.80	38.62	9.0	450.00
29	241	.00	.00	.00	.00	.00	13.25	98	64	48.27	9.65	12.6	450.00
30	242	.00	.00	.00	.00	.00	11.00	98	62	38.62	3.22	14.6	396.00
31	243	.00	.00	.00	.00	.00	12.50	98	61	43.44	1.61	16.0	855.00
TOTAL		78.49	78.49	.00	.00		365.25					272.1	15120.00
AVERAGE (TOTAL DAYS)		2.53	2.53	.00	.00	.00							
AVERAGE (RECORDED DAYS)							11.78	98	65	126.54	20.09	9.1	487.74

FIGURE 2. — Monthly summary of meteorologic data, page 1.

MONTHLY SUMMARY OF METEOROLOGIC DATA, VET. MED. RESEARCH FARM, URBANA, ILLINOIS, MONTH 8 YEAR 1966

DATE	DAY OF YEAR	TEMPERATURES (DEGREES CELSIUS)											
		WEATHER SHELTER			SOIL SURFACE						5 CM. BENEATH SOIL		
					UNDER 7-10 CM. GRASS			BARE GROUND			SURFACE UNDER GRASS		
		MAX.	MIN.	MEAN	MAX.	MIN.	MEAN	MAX.	MIN.	MEAN	MAX.	MIN.	MEAN
1	213	30.0	18.9	24.4	39.0	24.0	31.5	52.0	20.5	36.2	30.0	25.0	27.5
2	214	21.7	9.4	15.5	31.0	18.0	24.5	41.0	11.5	26.2	28.0	20.0	24.0
3	215	22.2	9.4	15.8	36.0	18.5	27.2	50.0	12.0	31.0	29.5	20.5	25.0
4	216	24.4	10.0	17.2	37.5	18.5	28.0	53.0	13.0	33.0	30.0	21.0	25.5
5	217	26.1	11.1	18.6	40.0	19.5	29.7	56.0	14.0	35.0	31.0	22.0	26.5
6	218	27.2	11.7	19.4	40.0	20.0	30.0	56.0	15.5	35.7	31.0	22.5	26.7
7	219	27.8	13.3	20.5	38.0	20.0	29.0	51.0	15.0	33.0	29.5	22.0	25.7
8	220	28.3	14.4	21.3	41.0	21.0	31.0	57.0	16.0	36.5	31.0	23.0	27.0
9	221	25.6	14.4	20.0	37.0	21.0	29.0	53.0	17.0	35.0	31.0	22.5	26.7
10	222	17.8	13.3	15.5	25.0	20.0	22.5	25.0	15.0	20.0	24.0	21.5	22.7
11	223	22.8	10.6	16.7	32.0	19.0	25.5	36.0	13.0	24.5	27.0	21.0	24.0
12	224	24.4	10.6	17.5	35.0	22.5	28.7	50.0	19.0	34.5	28.0	23.0	25.5
13	225	17.8	15.0	16.4	24.0	22.0	23.0	23.0	20.0	21.5	24.0	23.0	23.5
14	226	26.7	17.8	22.2	35.0	25.0	30.0	48.0	22.0	35.0	29.0	25.0	27.0
15	227	28.3	18.3	23.3	35.0	24.5	29.7	46.0	21.0	33.5	29.5	25.0	27.2
16	228	25.6	11.1	18.3	35.0	20.0	27.5	49.0	15.0	32.0	29.0	22.0	25.5
17	229	26.7	11.1	18.9	37.0	21.5	29.2	51.0	17.0	34.0	30.0	23.0	26.5
18	230	29.4	13.9	21.6	39.0	24.0	31.5	54.0	20.0	37.0	31.0	25.5	28.2
19	231	25.0	15.6	20.3	34.0	23.0	28.5	45.0	19.0	32.0	31.0	24.5	27.7
20	232	23.3	16.1	19.7	30.0	24.0	27.0	36.0	21.0	28.5	28.0	25.0	26.5
21	233	28.9	17.8	23.3	35.0	24.0	29.5	48.0	21.0	34.5	30.0	25.0	27.5
22	234	22.8	7.8	15.3	33.0	18.0	25.5	43.0	11.0	27.0	27.5	20.0	23.7
23	235	20.6	7.2	13.9	32.0	16.0	24.0	43.0	10.5	26.7	25.5	19.0	22.2
24	236	21.7	7.2	14.4	32.0	15.5	23.7	43.0	10.5	26.7	25.0	18.5	21.7
25	237	22.2	7.8	15.0	35.0	16.0	25.5	47.0	11.5	29.2	26.0	19.0	22.5
26	238	26.1	8.9	17.5	33.0	18.0	25.5	50.5	14.5	32.5	28.5	18.5	23.5
27	239	27.8	12.2	20.0	35.5	20.0	27.7	51.5	15.5	33.5	29.0	21.5	25.2
28	240	27.8	12.2	20.0	35.0	20.0	27.5	50.5	15.5	33.0	29.5	21.5	25.5
29	241	27.8	13.9	20.8	35.5	20.5	28.0	50.5	16.0	33.2	29.5	22.0	25.7
30	242	27.8	14.4	21.1	35.0	22.0	28.5	54.0	17.5	35.7	30.0	23.0	26.5
31	243	28.3	14.4	21.3	35.0	22.0	28.5	53.0	17.5	35.2	30.5	23.0	26.7
MEAN		25.3	12.6	18.9	34.7	20.6	27.7	47.3	16.0	31.7	28.8	22.2	25.5
EXTREMES		30.0	7.2		41.0	15.5		57.0	10.5		31.0	18.5	

FIGURE 3. — Monthly summary of meteorologic data, page 2.

MONTHLY SUMMARY OF METEOROLOGIC DATA, VET. MED. RESEARCH FARM, URBANA, ILLINOIS, MONTH 8 YEAR 1966

SOIL MOISTURE AND SOIL TEMPERATURE (PERCENT AND DEGREES CELSIUS , 0800 A. M.)

DATE	DAY OF YEAR	CENTIMETERS BELOW SOIL SURFACE 2.5		7.5		15.0		22.5		30.0		45.0		60.0		75.0		90.0	
		S M	S T	S M	S T	S M	S T	S M	S T	S M	S T	S M	S T	S M	S T	S M	S T	S M	S T
1	213	15.8	37.8	14.5	37.3	15.1	40.9	18.7	43.8	15.2	21.2	18.4	18.9	22.3	19.7	24.4	34.8	25.2	37.0
2	214	17.3	37.8	14.6	37.3	15.0	37.2	18.9	38.8	15.4	20.6	18.4	18.3	21.9	19.7	24.0	34.0	25.3	36.2
3	215	17.5	37.0	14.7	36.5	14.7	40.9	18.5	42.7	19.7	21.8	18.4	18.9	21.8	20.3	23.6	35.5	25.4	37.0
4	216	16.4	37.0	14.5	36.5	14.7	39.9	28.5	40.6	20.6	19.9	18.4	18.9	21.9	19.7	23.5	34.0	25.5	35.5
5	217	15.8	37.0	14.3	36.5	14.3	42.0	17.5	43.8	15.4	20.6	18.1	18.3	21.3	20.3	23.1	34.8	25.9	37.0
6	218	15.4	37.0	14.1	36.5	14.2	42.0	19.2	43.8	14.8	21.2	17.6	18.9	21.0	20.3	22.7	36.3	25.9	37.8
7	219	15.1	37.8	13.9	37.3	14.1	40.9	16.8	42.7	14.5	20.6	17.0	18.9	20.9	19.7	22.6	34.0	26.1	36.2
8	220	14.8	37.8	13.7	37.3	14.0	39.9	16.3	42.7	14.2	19.9	16.7	18.3	20.2	19.7	22.2	34.8	26.2	35.5
9	221	15.1	37.0	13.8	36.5	14.1	39.9	16.2	40.6	14.2	19.9	16.7	18.3	20.3	19.1	22.1	33.3	26.2	35.5
10	222	25.8	37.0	14.9	37.3	13.8	43.1	15.9	43.8	14.0	20.6	16.6	18.9	19.8	19.7	21.7	35.5	26.2	37.8
11	223	23.1	36.2	23.1	35.7	18.7	39.9	16.1	40.6	14.3	19.4	17.2	17.1	20.1	19.1	21.9	33.3	26.2	35.5
12	224	20.8	36.2	20.2	35.7	17.7	31.7	16.3	33.1	15.1	19.9	17.0	18.3	20.0	19.7	23.2	19.3	26.1	20.1
13	225	20.1	20.6	17.2	35.7	15.6	33.9	16.2	31.6	12.5	33.2	16.6	18.9	19.9	18.5	23.2	19.3	26.1	20.1
14	226	20.1	37.0	17.6	36.5	15.9	32.4	17.2	33.1	20.7	19.9	18.8	17.7	19.8	19.1	24.0	19.3	25.8	20.7
15	227	17.2	38.6	15.1	37.3	14.5	33.2	15.7	34.6	14.0	20.6	16.7	18.3	19.8	19.1	22.9	19.3	26.2	20.1
16	228	16.6	37.8	14.6	37.3	14.7	32.4	15.6	33.8	15.4	20.6	17.0	18.3	20.0	19.1	22.9	19.3	26.2	19.6
17	229	16.5	37.8	14.2	37.3	14.2	33.2	15.4	33.8	14.5	20.6	16.7	19.5	19.8	19.7	22.8	19.3	26.2	20.7
18	230	15.7	37.8	14.0	37.3	14.1	33.2	15.2	33.8	15.0	20.6	16.6	18.9	19.6	19.7	22.8	19.3	24.9	20.1
19	231	16.0	38.6	13.8	39.0	13.9	33.9	14.9	34.6	15.1	21.8	16.6	18.9	19.6	19.7	22.6	19.3	26.1	20.7
20	232	16.2	37.8	13.9	37.3	14.0	33.9	14.9	33.8	15.5	21.8	16.6	18.9	19.6	19.7	22.6	19.3	26.0	20.7
21	233	15.4	38.6	13.9	38.1	14.0	33.2	14.7	33.8	14.5	20.6	16.6	18.9	19.6	19.7	22.5	19.3	26.0	20.7
22	234	15.2	37.8	13.8	37.3	13.9	32.4	14.7	33.1	15.4	20.6	22.3	18.3	24.4	19.7	22.3	19.3	25.8	20.1
23	235	15.0	37.0	13.7	36.5	13.8	33.2	14.4	34.6	14.5	20.6	15.9	18.9	19.2	19.7	22.1	19.9	25.6	21.3
24	236	15.0	34.7	13.7	35.0	13.8	30.9	14.4	32.3	13.8	19.4	15.8	18.3	19.0	19.7	22.0	19.3	25.5	20.7
25	237	14.6	35.5	13.6	35.7	13.8	31.7	14.1	34.6	13.1	19.9	15.5	18.3	18.5	19.7	22.2	19.9	25.2	21.3
26	238	14.6	34.7	13.5	35.0	13.7	30.9	14.1	31.6	13.4	18.8	15.5	17.1	18.6	19.1	21.8	18.1	25.3	19.6
27	239	14.0	36.2	13.4	35.0	13.6	32.4	13.9	33.1	13.3	19.4	14.7	17.7	18.3	19.1	21.5	19.3	24.9	20.1
28	240	14.0	36.2	13.4	35.7	13.6	31.7	13.8	33.1	13.9	17.1	14.8	17.1	18.2	18.5	21.6	18.1	24.9	19.6
29	241	13.4	37.8	13.3	36.5	13.6	31.7	13.8	32.3	12.7	19.4	14.1	17.1	17.4	19.1	21.2	18.7	24.7	19.6
30	242	13.3	37.8	13.2	37.3	13.5	32.4	13.6	33.8	12.5	19.9	14.1	17.1	17.0	19.1	21.0	19.3	24.4	20.1
31	243	13.4	37.0	13.2	36.5	13.5	31.7	13.6	32.3	12.5	19.9	13.9	17.7	17.0	19.1	21.0	19.3	24.5	19.0
	MEAN	16.4	36.6	14.7	36.7	14.5	35.4	16.1	36.5	14.8	20.6	16.8	18.3	19.9	19.5	22.5	24.7	25.6	26.0
	MAXIMUM	25.8	38.6	23.1	39.0	18.7	43.1	28.5	43.8	20.7	33.2	22.3	19.5	24.4	20.3	24.4	36.3	26.2	37.8
	MINIMUM	13.3	20.6	13.2	35.0	13.5	30.9	13.6	31.6	12.5	17.1	13.9	17.1	17.0	18.5	21.0	18.1	24.4	19.0

FIGURE 4. — Monthly summary of meteorologic data, page 3.

were obtained weekly during the summer months for each soil depth lead, ranging from 1 inch to 36 inches, over a period of two years, and were used to correlate the soil moisture resistance with the soil in which the cells were placed.

Anyone who uses the soil temperature-soil moisture portion of the program will find it necessary to revise 3 major items. The values of the coefficients for the 9 wafers are included in the program starting with statement number 247. These values vary with the wafers used. Statements 250, 303, and 350 describe the graph which is peculiar to each ammeter and may need to be changed if the curve supplied varies significantly from the formulas given here. The corrected resistance-soil moisture formulas, statements 51 through 59, need to be determined for the particular soil in which the cells are placed.

The calculation and tabulation of other data, such as wind, snow, humidity, and dew duration, are quite readily understood from the input data sheet and the output summary tables.

Acknowledgments

This investigation was supported by National Institutes of Health Research Grant AI-06197 and Training Grant AI-00033.

Present address of second author: Department of Zoology, Brigham Young University, Provo, Utah.

Literature Cited

A General Program for the Least Square Polynomial Fit. February 23, 1966, 7094 Library Routine E2-UOI-LSQ3-99-SR. Mimeo. Department of Computer Science, Graduate College, University of Illinois, Urbana.

Andersen, F. L. and N. D. Levine. 1967. Methods and problems in microenvironmental measurements. Ill. Vet. 10(2):10-17.

Fortran II Programming. August, 1963. IBM 7090/7094 programming systems. IBM Systems Reference Library. File No. 7090-25. Form C28-6054-4. International Business Machines Corporation, Data Processing Division, White Plains, New York.

Soil Moisture Meter, Model MC-300A and soil cells, institution manual. 1964. Bulletin C172-64. Soiltest, Inc., Evanston, Illinois.

Manuscript received May 23, 1968.

APPENDIX

The Program:

```
$       FASTRAN
$       GO
C       METEOROLOGIC DATA PROCESSING PROGRAM ,   C Z R PROJECT LED BY
C       FERRON L ANDERSEN , PROGRAMMER- J.KENT MITCHELL   6/8/65
C       THE FOLLOWING SECTION IS THE MAIN PROGRAM WHICH READS DATA,
C       COMPUTES CARD DATA, AND CONTROLS THE MONTH SUBROUTINE
        DIMENSION  A(13),C1(40,12),C2(40,12),CDY(40),LDAY(13),LEAP(13),C1T
       1(12),C4(40,18),COEE(10),IST(10),DN1(12),DN2(12),C2T(12),CT(12),ST(
       210),SM(10),C4T(18),C4N(18),C4X(18)
        COMMON A,KDY,KMO,KYR,KDYZ,KMOZ,KYRZ,C1,C2,CDY,LDAY,LEAP,C1T,C4,COE
       1E,IST,DN1,DN2,C2T,CT,C4T,C4N,C4X
        RIT 7,90,LDAY,LEAP
    90  FORMAT (26I3)
        KDYT=1
        KMOT=12
        KYRT=35
        KDYZ=1
        KMOZ=12
        KYRZ=35
        DO 1860 K=1,12
        DN1(K)=0.0
        DN2(K)=0.0
        C2T(K)=0.0
  1860  C1T(K)=0.0
        DO 3860 J=1,40
        DO 3861 K=1,12
        C1(J,K)=0.0
        C2(J,K)=0.0
  3861  CONTINUE
        DO 3860 K=1,18
        C4(J,K)=0.0
        C4T(K)=0.0
        C4X(K)=-100.0
        C4N(K)=100.0
  3860  CONTINUE
        DO 9 J=1,10,3
     9  CT(J)=-100.0
        DO 10 J=2,11,3
    10  CT(J)=100.0
     1  RIT 7,50,KDY,KMO,KYR,NC,(A(N),N=1,13)
    50  FORMAT (5X,4I2,2X,13F5.0)
     4  IF (KMO-KMOT)5,6,5
     5  CALL MONTH
        KMOT=KMO
     6  KMOZ=KMO
        KYRZ=KYR
        GO TO (100,200,300,400),NC
   400  GO TO 1
C       THIS SECTION PROCESSES THE DATA ON CARD 1
C            THE FOLLOWING COMPUTES THE PRECIPITATION DATA
   100  C1(KDY,1)=(A(1)+A(2))*25.4
```

```
      C1(KDY,2)=A(1)*25.4
      C1(KDY,3)=A(2)*25.4
      C1(KDY,4)=A(3)*25.4
C     THE FOLLOWING COMPUTES SNOW COVER DATA
      C1(KDY,5)=A(4)*25.4
C          THE FOLLOWING COMPUTES TEMPERATURE DATA
      C2(KDY,1)=A(5)
      C2(KDY,2)=A(6)
      C2(KDY,3)=(A(5)+A(6))/2.0
      C2(KDY,4)=A(7)
      C2(KDY,5)=A(8)
      C2(KDY,6)=(A(7)+A(8))/2.0
      C2(KDY,7)=A(9)
      C2(KDY,8)=A(10)
      C2(KDY,9)=(A(9)+A(10))/2.0
      C2(KDY,10)=A(11)
      C2(KDY,11)=A(12)
      C2(KDY,12)=(A(11)+A(12))/2.0
C          THE FOLLOWING LISTS THE DEW DURATION DATA
      C1(KDY,6)=A(13)
      GO TO 1
C          THIS SECTION PROCESSES THE DATA ON CARD 2
C          THE FOLLOWING COMPUTES THE WIND DATA
  200 C1(KDY,9)=A(1)*1.609
      C1(KDY,10)=A(2)*1.609
C          THE FOLLOWING LISTS THE RELATIVE HUMIDITY DATA
      C1(KDY,7)=A(3)
      C1(KDY,8)=A(4)
C          THE FOLLOWING COMPUTES THE SOIL TEMPERATURE DATA
  247 COEE(1)=0.95
      COEE(2)=0.97
      COEE(3)=1.08
      COEE(4)=1.05
      COEE(5)=0.98
      COEE(6)=1.03
      COEE(7)=0.99
      COEE(8)=1.01
      COEE(9)=0.92
      DO 230 M=1,9
      X=COEE(M)
      Y=ELOG(X)
      COEE(M)=Y/2.3025851
  230 CONTINUE
      N=4
      DO 204 M=1,9
      N=N+1
      IF (A(N))284,284,220
  284 I=M*2
      C4(KDY,I)=A(N)
      IST(M)=2
      GO TO 204
  220 X=A(N)/100.0
  250 Y=5.198222-5.3602392*X+8.4944908*X**2+1.5319932*X**3-30.141324*X**
```

```
     14+48.404556*X**5-35.559542*X**6+12.763019*X**7-1.8107367*X**8
      Y=Y+COEE(M)
  251 V =6.6425621 -3.8361934 *Y +0.99996156 *Y **2 -0.15570077 *Y **3
     1 +0.010272893 *Y **4
      ST(M)=((V*100.0-32.0)*5.0)/9.0
      I=M*2
      C4(KDY,I)=ST(M)
      IST(M)=1
  204 CONTINUE
      GO TO 1
C          THIS SECTION PROCESSES THE DATA ON CARD 3
C          THE FOLLOWING COMPUTES THE EVAPORATION AND SOLAR RADIATION
C     DATA
  300 C1(KDY,11)=A(1)
      C1(KDY,12)=A(2)*900.0
C          THE FOLLOWING COMPUTES THE SOIL MOISTURE DATA
      N=4
      DO 301 M=1,9
      N=N+1
      IF (A(N))320,320,321
  320 I=M*2-1
      C4(KDY,I)=A(N)
      GO TO 301
  321 LL=IST(M)
      GO TO (5321,5322),LL
 5322 I=M*2-1
      C4(KDY,I)=A(N)
      GO TO 301
 5321 X=A(N)/100.0
      IF (X-90.0)303,302,302
  303 Y=5.198222-5.3602392*X+8.4944908*X**2+1.5319932*X**3-30.141324*X**
     14+48.404556*X**5-35.559542*X**6+12.763019*X**7-1.8107367*X**8
      GO TO 304
  302 X=X-90.0
  350 Y=6.2300594-6.3183331*X+14.141023*X**2-18.53311*X**3+12.955208*X**
     14-4.5519551*X**5+0.63068734*X**6
  304 Z=19.6672-2.8096*Y
      TFA=ST(M)*1.8+32.0
  351 V =7.0 +0.01428 *(TFA -60.0) -(0.3565 +0.0008 *(TFA -60.0)) *Z
      GO TO (51,52,53,54,55,56,57,58,59),M
   51 SM(M)= 152.32435 -100.18720*V +26.117317 *V**2 -2.3733765 *V**3
      GO TO 22
   52 SM(M)= 66.341936 -22.163397*V +2.7940253 *V**2 -0.11024337 *V**3
      GO TO 22
   53 SM(M)= 93.889043 -44.061439*V +7.9730356 *V**2 -0.47993947 *V**3
      GO TO 22
   54 SM(M)= 88.216981 -44.752830*V +9.7633048 *V**2 -0.79095782 *V**3
      GO TO 22
   55 SM(M)= 111.46129 -73.612518*V +21.859611 *V**2 -2.2701934 *V**3
      GO TO 22
   56 SM(M)= 121.4559  -92.47035 *V +30.059332 *V**2 -3.3267269 *V**3
      GO TO 22
   57 SM(M)= 139.46608 -110.22338*V +35.539901*V**2 -3.8253506*V**3
```

```
      GO TO 22
   58 SM(M)= 11.931366 +11.093733*V -1.8405329 *V**2 -0.057838565 *V**3
      GO TO 22
   59 SM(M)= 228.89604 -191.243 *V  +59.019853 *V**2 -5.9828745 *V**3
   22 I=M*2-1
      C4(KDY,I)=SM(M)
  301 CONTINUE
      GO TO 1
      END
```

```
$       FASTRAN
$       GO
        SUBROUTINE MONTH
C           THIS SUBROUTINE COMPUTES THE MONTHLY AVERAGES AND OUTPUTS THE
C       MONTHLY SUMMARY
        DIMENSION  A(13),C1(40,12),C2(40,12),CDY(40),LDAY(13),LEAP(13),C1T
       1(12),C4(40,18),COEE(10),IST(10),DN1(12),DN2(12),C2T(12),CT(12),ST(
       210),SM(10),C4T(18),C4N(18),C4X(18)
        COMMON A,KDY,KMO,KYR,KDYZ,KMOZ,KYRZ,C1,C2,CDY,LDAY,LEAP,C1T,C4,COE
       1E,IST,DN1,DN2,C2T,CT,C4T,C4N,C4X
        LYR=KYRZ
 1705   IF (LYR)1702,1703,1704
 1704   LYR=LYR-4
        GO TO 1705
 1702   KB1=LDAY(KMOZ)
        KB2=LDAY(KMOZ+1)
        N=KB2-KB1
        XN=N
        GO TO 1706
 1703   KB1=LEAP(KMOZ)
        KB2=LEAP(KMOZ+1)
        N=KB2-KB1
        XN=N
 1706   WOT 6,1750,KMOZ,KYRZ
 1750   FORMAT (1H1/////   20X,
       1 54H      MONTHLY SUMMARY OF METEOROLOGIC DATA, VET. MED. R,
       2 38HESEARCH FARM, URBANA, ILLINOIS, MONTH ,I2, 9H  YEAR 19,I2//)
        WOT 6,2750
 2750   FORMAT (10X,     10H----------,
       4 54H---------------- - ------    ------- ------ -      -----,
       5 56H---------------- - ------    ------- ------ -      -------/
       6             10X,10H        DAY,
       7 54H                PRECIPITATION (MM)                    DEW  ,
       8 54H RELATIVE HUMIDITY        WIND        POTENTIAL    SOLAR )
        WOT 6,1770
 1770   FORMAT (10X,     10H DATE  OF ,
       1 54H ---------------- --------    ------- -------- DURATION ,
       2 56H  WEATHER STATION          (KM)          EVAP     RADIATION /
       3             10X,10H       YEAR,
       4  53H    TOTAL    PRECIP    PRECIP     SNOW      SNOW           ,
       5 54H  ----------------  -----------------                      /
       6             10X,           10X,
       7  53H  PRECIP     RAIN      SNOW      FALL     COVER        HR.,
       8  56H     MAX.      MIN.    1 METER  SURFACE      MM    GMCAL/SQCM)
        WOT 6,1771
 1771   FORMAT (10X,     10H ---- ----,
       1 54H -------  -------  -------  -------  -------  - -----  ,
       2 56H -------  -------  -------  -------  -----  -  - -------  //)
        DO 1707 J=1,N
        CDY(J)=KB1+J
        IF (C1(J,6)-99.0)1901,1900,1900
 1900   C1(J,6)=-0.0
        GO TO 1902
```

```
1901 DN1(6)=DN1(6)+1.0
1902 DO 1708 K=1,5
     IF (C1(J,K))1709,1709,1708
1709 C1(J,K)=0.0
1708 CONTINUE
     DO 2708 K=1,12
2708 C1T(K)=C1T(K)+C1(J,K)
     WOT 6,1751,J,CDY(J),(C1(J,K),K=1,12)
1751 FORMAT ( 9X,I5,F6.0,F8.2,5F9.2,2F9.0,2F9.2,F9.1,F10.2)
     DO 1707  L=7,12
     IF (C1(J,L))4801,4801,4802
4801 C1(J,L)=0.0
     GO TO 1707
4802 DN1(L)=DN1(L)+1.0
1707 CONTINUE
     WOT 6,1752,(C1T(L),L=1,4),C1T(6),C1T(11),C1T(12)
1752 FORMAT (1H0,13X,5HTOTAL,4F9.2,9X,F9.2,36X,F9.1,F10.2)
     DO 1800 L=1,5
     C1T(L)=C1T(L)/XN
1800 CONTINUE
     DO 4820  L=6,12
     IF (DN1(L))4810,4810,4811
4810 C1T(L)=0.0
     GO TO 4820
4811 C1T(L)= C1T(L)/DN1(L)
4820 CONTINUE
     WOT 6,1753,(C1T(L),L=1,12)
1753 FORMAT (1H0,11X,7HAVERAGE,5F9.2/                                  9X,12H(TOTA
    1L DAYS)//12X,7HAVERAGE,45X,F9.2,2F9.0,2F9.2,F9.1,F10.2/9X,15H(RECO
    2RDED DAYS))
     WOT 6,1750,KMOZ,KYRZ
     WOT 6,1754
1754 FORMAT (57X,
    2       33HTEMPERATURES (DEGREES CELSIUS)   /10X,118H---------- ----
    3--------     -------- - ------  -------- -- --- -     ----- *- ----
    4--------  - -------- - ------  ------/
    5             10X,10H       DAY,
    6 54H       WEATHER SHELTER                                  SOIL S,
    7 54HURFACE                                5 CM. BENEATH SOIL     )
     WOT 6,1780
1780 FORMAT (     10X,10H DATE  OF ,
    1 54H                                  UNDER 7-10 CM. GRASS    ,
    2 54H         BARE GROUND              SURFACE UNDER GRASS     /
    3             10X,10H       YEAR,
    4 54H ---------------- - -------  -------- -- --- -      ---- ,
    5 54H ---------------- - -------  ------- ------ -      ---- /
    6             10X,          10X,
    7  53H     MAX.      MIN.      MEAN      MAX.      MIN.      MEAN,
    8  53H     MAX.      MIN.      MEAN      MAX,      MIN.      MEAN)
     WOT 6,1781
1781 FORMAT (     10X,10H ---- ----,
    1 54H -------  -------  -------  -------  -------  - ----- ,
    2 54H -------  -------  -------  -------  -------  - ----- //)
```

```
      DO 1710 J=1,N
      DO 1713 K=1,12
      IF (C2(J,K)-999.0)1711,1712,1712
1712  C2(J,K)=0.0
      GO TO 1714
1711  DN2(K)=DN2(K)+1.0
1714  C2T(K)=C2T(K)+C2(J,K)
1713  CONTINUE
      WOT 6,1755,J,CDY(J),(C2(J,K),K=1,12)
1755  FORMAT (9X,I5,F6.0,F8.1,11F9.1)
      DO 109 K=1,10,3
      IF (C2(J,K)-CT(K))109,109,108
 108  CT(K)=C2(J,K)
 109  CONTINUE
      DO 111 K=2,11,3
      IF (C2(J,K)-CT(K))110,111,111
 110  CT(K)=C2(J,K)
 111  CONTINUE
1710  CONTINUE
      DO  4830 K=1,12
      IF (DN2(K))4831,4831,4832
4831  C2T(K)=0.0
      GO TO 4830
4832  C2T(K)=C2T(K)/DN2(K)
4830  CONTINUE
      WOT 6,1756,(C2T(K),K=1,12),CT(1),CT(2),CT(4),CT(5),CT(7),CT(8),
     1CT(10),CT(11)
1756  FORMAT (1H0,14X,4HMEAN,12F9.1//11X,8HEXTREMES,4(2F9.1,9X))
      WOT 6,1750,KMOZ,KYRZ
      WOT 6,3004
3004  FORMAT  (30X,80HSOIL MOISTURE AND SOIL TEMPERATURE  (PERCENT AND D
     1EGREES CELSIUS  ,  0800 A. M.)/  10X,   118H---------- ----------
     2------ -     -----   - --- -   ---- -- -- ---       --- -  -  ---
     3--------  - ----------/ 10X,     10H       DAY,
     4 60H                                    CENTIMETERS BELOW SOIL SU,
     5 48HRFACE                                /
     6 10X, 10H DATE  OF ,
     7 60H     2.5         7.5         15.0         22.5         30.0     ,
     8 48H    45.0         60.0         75.0         90.0     )
      WOT 6,3005
3005  FORMAT (10X,    10H       YEAR,
     1 60H ---------- --- - -----   --------  ----- -      ------*- --,
     2 48H ---------- --- ------- - --------- ----- -     /
     3  20X,
     4 60H   S M   S T   S M   S T   S M   S T   S M   S T   S M   S T,
     5 48H   S M   S T   S M   S T   S M   S T   S M   S T/
     6 10X, 10H ---- ----,
     7 60H ----- ----- ----- -----   --- ----- ----- - -   ----- -- --,
     8 48H ----- ----- ----- -----   --- ----- ----- - -  //)
      DO 3006 J=1,N
      DO 4100 K=1,18
      C4T(K)=C4T(K)+C4(J,K)
4100  CONTINUE
```

```
      WOT 6,3007,J,CDY(J),(C4(J,K),K=1,18)
3007 FORMAT (9X,I5,F6.0,18F6.1)
3006 CONTINUE
      DO 4103 K=1,18
      C4T(K)=C4T(K)/XN
4103 CONTINUE
      WOT 6,4600,(C4T(K),K=1,18)
4600 FORMAT (1H0,15X,4HMEAN,18F6.1)
      DO 4104 K=1,18
      DO 4104 J=1,N
      IF (C4X(K)-C4(J,K))4150,4150,4151
4150 C4X(K)=C4(J,K)
4151 IF (C4N(K)-C4(J,K))4104,4104,4153
4153 C4N(K)=C4(J,K)
4104 CONTINUE
      WOT 6,4601,(C4X(K),K=1,18)
4601 FORMAT (1H0,12X,7HMAXIMUM,18F6.1)
      WOT 6,4602,(C4N(K),K=1,18)
4602 FORMAT (1H0,12X,7HMINIMUM,18F6.1)
      DO 4105 K=1,18
      C4T(K)=0.0
      C4N(K)=100.0
      C4X(K)=-100.0
4105 CONTINUE
      DO 1850 K=1,12
      DN1(K)=0.0
      DN2(K)=0.0
      C2T(K)=0.0
1850 C1T(K)=0.0
      DO 742 J=1,10,3
 742 CT(J)=-100.0
      DO 743 J=2,11,3
 743 CT(J)=100.0
      RETURN
      END
```