"AS-BUILT" DESIGN SPECIFICATION  JAN 24 1776
FOR THE
DIGITAL DERIVATION OF
DAILY AND MONTHLY DATA BASES
FROM SYNOPTIC OBSERVATIONS
OF TEMPERATURE AND PRECIPITATION FOR
THE PEOPLE'S REPUBLIC OF CHINA

Job Order 73-763
AD 63-1347-3763-54

Prepared By
Lockheed Electronics Company, Inc.
Systems and Services Division
Houston, Texas
Contract NAS 9-15200

For
EARTH OBSERVATIONS DIVISION
SPACE AND LIFE SCIENCES DIRECTORATE

National Aeronautics and Space Administration
LYNDON B. JOHNSON SPACE CENTER
Houston, Texas
December 1977

LEC- 11680
DOCUMENTATION DISTRIBUTION LIST

System: CCEA/Yield Estimation System (YES)

Title: "As-Built" Design Specification For The Digital Derivation of Daily and Monthly Data Bases From Synoptic Observations of Temperature and Precipitation For The People's Republic of China

Job Order: 74-963

Responsible Organization: Applications Software Section, 333-6311

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Job Order File
Technical Publications (5)
Data Research and Control (3)
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Job Order 73-753
AD 63-1347-3763-54

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LYNDON B. JOHNSON SPACE CENTER
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December 1977

LEC- 11680
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APPENDIX

| A. THE LEAST SQUARES INTERPOLATION ALGORITHM | A-1  |
| B. THE MONTHLY DATA BASES ALGORITHM          | B-1  |
| C. THE ANALYSIS OF VARIANCE PROCEDURE        | C-1  |
1. SCOPE

As an integral part of the Large Area Crop Inventory Experiment (LACIE) which is sponsored by the Department of Agriculture (USDA), the National Oceanic and Atmospheric Administration (NOAA) and the National Aeronautics and Space Administration (NASA), continued building of daily and monthly data bases to test various advanced wheat yield models is an active objective and goal. The People's Republic of China (PRC) is one of the largest agricultural countries in the world. Winter and spring wheat is one of its major crops; therefore, a knowledge of China's crop production is very important to the LACIE Project. The China data base consists of meteorological information in the form of daily precipitation and maximum and minimum temperatures and their monthly totals and averages, respectively, for about 95 weather stations covering the entire winter and spring wheat production area of China over the period 1965 through 1975. The daily and monthly meteorological information was built up from synoptic (4 or 8 times daily) weather observations available on magnetic tape from the National Climatic Center (N.C.C.) in Asheville, North Carolina.

There are three major sets of computer algorithms for building the China data base, that is: 1) the least squares interpolation; 2) modified version of the max-min program; and 3) the AOV procedure.

The least squares interpolation algorithm is used to generate input variables; the modified version of the max-min program is used to generate daily and monthly precipitation and max-min temperatures; the analysis of variance algorithm is used to carry out a simple statistical hypothesis test on the digital estimated data. The China data base is considered complete and unique. It may be the only one of this kind of meteorological data existing outside, or inside the People's Republic of China.
2. APPLICABLE DOCUMENTS

Action Documentation, (AD) 63-1347-3763-54, China Data Base, June 28, 1977

Job Order 73-763

3. System Description

CHINA SYNOPTIC DATA SOURCE

A total of 32 tapes were obtained by the Center for Climatic and
Environmental Assessment (CCEA) from the National Climatic Center (NCC)
in Asheville, North Carolina, covering World Meteorological Organization
(WMO) blocks, 53, 54, 57 and 58 in China for the years 1965 through 1975.
Data were contained in 3 tapes per year except for 1968 which has only
2 tapes. These tapes, containing synoptic data (i.e., 4-8 observations
per day) for all reporting weather stations within these blocks, are
recorded in NCC deck format 9685.

CHINA DATA BASE DESIGN

A total of 95 WMO weather stations providing uniform coverage of the
entire winter and spring wheat production area of China (see map on
page 3.3), was selected on the basis of relative reliability and con­
sistency of record. Daily precipitation and max-min temperatures are the
major meteorological variables generated for the 95 representative wea­
ther stations covering the entire winter and spring wheat production area
of China over the period from 1965 to 1975. Daily data were stored in the
magnetic tapes in the following format:

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<td>14 - 16</td>
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<tr>
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<td>Blank</td>
</tr>
<tr>
<td>23 - 26</td>
<td>Precipitation **</td>
</tr>
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</table>

* Temperatures are in whole degrees Fahrenheit with a leading minus
  sign if negative; missing temperature observations are denoted by 999.
** Precipitation is in hundredths of inches with no decimal points;
  missing precipitation is indicated by 9999. The above format is known
  as the Modified Kansas Format (as opposed to NCC Format).
Monthly data were generated by a separate computer program; output is available in hard copies containing the following information:

1. Station
2. Year
3. Month
4. Monthly average maximum temperature
5. Monthly average minimum temperature
6. Monthly total precipitation
7. Total number of observations
8. Number of missing observations
9. Total annual precipitation

This section describes the system software, Appendices A, B, and C contain detail flowcharts for subroutines used.
3.1 HARDWARE DESCRIPTION

All computer algorithms described in this document were written in standard FORTRAN language and will operate on any IMB 360/370 system with FORTRAN compiler and with 1600 BPI magnetic drive. They will also operate on mini-computer systems such as PDP 11/50 with FORTRAN compiler and 800 BPI with minor change.

3.2 SOFTWARE DESCRIPTION

3.2.1 THE DERIVATION OF INPUT VARIABLES

The least squares interpolation computer algorithm was designed to generate a complete set of monthly temperature ranges. The monthly average daily temperature ranges for each weather station are needed as input variables to the max-min program to generate the daily maximum and minimum temperatures for each month. The program consists of one main program and seven subroutines i.e., SUM, COR, LSTSQ, MEQSOl, GRAPH, STANDV AND MULTR, and one IBM built-in library routine, PLTSCT, which is used to plot the scatter diagram for the input data; the above subroutines can be found in computer literature and journals.

SUBROUTINE SUM

This subroutine is used to calculate the total of input observations such as $X$, $X^2$, and $Y$ and $Y^2$.

SUBROUTINE COR

This subroutine is used to calculate the correlation coefficient ($r$) of the input data, the correlation coefficient is used as a criterion to determine whether a straight line or a 2nd degree curve fits a given set of data; that is, if $|r| > 0.7$, a straight line should be fitted; otherwise, a higher degree curve is required.
SUBROUTINE LSTSQ

This subroutine is used to determine the best fitting equation by establishing the proper matrix equation \( AX = B \). For example, if a linear least squares equation is needed then,

\[
\begin{align*}
A &= \left( \begin{array}{cc}
N & \sum x_i \\
\sum x_i & \sum x_i^2
\end{array} \right) ; \\
X &= \left( \begin{array}{c}
C_1 \\
C_2
\end{array} \right) ; \\
B &= \left( \begin{array}{c}
\sum y_i \\
\sum x_i y_i
\end{array} \right)
\end{align*}
\]

where \( C_i \) are the coefficients of the least squares equation. For higher order least squares polynomials, the elements of different matrices will be changed automatically by this subroutine.

SUBROUTINE MEQSOL

This subroutine is used to solve the matrix equation \( AX = B \) which has been determined by the subroutine LSTSQ.

SUBROUTINE GRAPH

This subroutine is used to plot the least squares equation in the \( X - Y \) Plane.

SUBROUTINE MULTR

This subroutine is used to calculate the multiple correlation coefficient (RMULT) which serves as the criterion to determine if a 2nd degree or higher order least squares equation is needed.

SUBROUTINE STANDV

This subroutine is used to calculate the standard deviation of a given set of data points; this subroutine is needed in the subroutine MULTR.

3.2.2. THE COMPUTATION ALGORITHMS

There are two major computer algorithms for building the China data bases. One for generating the daily data and the other for generating monthly data. All programs are written in standard FORTRAN language.
The computer program for daily data is a modified version of the max-min program which is basic to the non-linear statistical model developed by a research team at Kansas State University led by Dr. Arlin Feyerherm, Professor of Statistics. Complete information about the max-min program can be found in the "As-Built Design Specification for Historical Daily Data Bases for Testing Advanced Models", prepared by Buddy H. Jeun and K. Williams and published by the National Aeronautics and Space Administration (NASA), Lyndon B. Johnson Space Center, Houston, Texas 77058, April 1977.

In generating daily precipitation for the PRC, the precipitation amounts reported at synoptic hours 0600, 0900, 1200, and 1800 (GMT) were totaled. (When a similar application was carried out for the USSR only 0600 and 1800 (GMT) observations were summed). The reporting conventions differ region-to-region and must be verified locally by summing the data by day, month, and year. The computer algorithm that generates the monthly meteorological data, i.e., average maximum and minimum temperature and total precipitation, consists of one main routine and five subroutines, which are SORTMD, DMEAN, TOTAL, ANP and PBAR, and one built-in function, i.e., EXTERNAL SIGN, which is used to distinguish if the observation is blank or zero, since blank denotes a missing observation for maximum and minimum temperatures and for precipitation, the missing observation is denoted by 9999.

**SUBROUTINE SORTMD**

This subroutine is used to sort the daily observations by month; in doing so, for every station, the maximum and minimum of temperatures and precipitation for every month are sorted out.

**SUBROUTINE DMEAN**

This subroutine is used to calculate the average maximum and minimum temperatures for each month. At the same time, it also keeps track of the number of missing temperatures by the argument ICOUNT and KOUNT. In this subroutine, ICOUNT represents the number of missing observations for the maximum temperature and KOUNT represents the number of missing observations for the minimum temperature.
**SUBROUTINE TOTAL**

This subroutine is used to calculate the sum of a given set of observations. Input arguments are N, D, and output arguments are SUM and KNT, where N is the number of observations. D is an array of N observations. SUM is the total value of N observations, KNT is the number of missing observations.

**SUBROUTINE PBAR**

This subroutine is used to calculate the monthly total of precipitation to each station. Input argument PC is an array of N observations of precipitation. Output argument PAV is the monthly total of precipitation.

**SUBROUTINE ANP**

This subroutine is used to calculate the annual precipitation to each weather station. Input arguments are STATN, YEAR, N and VP; output arguments are BP and the missing observations are represented by ICOUNT.

**3.2.3. THE EVALUATION OF OUTPUT VALIDITY**

The analysis of variance. This analysis of variance computer algorithm was designed to test the reliability of the monthly data derived from the modified version of the max-min program. A few weather stations were selected for a study comparing the estimated means with PRC published means obtained from the USAF through the National Climatic Center at Asheville, North Carolina and other reliable records from the Hong Kong Royal Observatory and Chinese educational institutions obtained through personal correspondence. The six stations for which comparative monthly temperature data are available are shown on the map on page 3-9. They are confined to the more humid eastern portions of China but they do give a good temperature range north-south across the major wheat-producing area. The tables and graphs (page 3-10 through 3-21) include individual monthly average temperatures (EST) as summarized from the computed daily
max-min values alongside the most reliable check data (PUB) available. Whether the check data are true internal published amounts or "usually reliable" figures is not known. An analysis of variance (page 3-22 through 3-24) indicates that the estimated mean monthly temperatures are not significantly different from the available check data. The null hypothesis of the analysis of variance is tenable.

For precipitation, only four stations were supplied for comparison (pages 3-25 through 3-29). The WMO station numbers are the same as in daily source tapes but it is suspected the pairs of records compared may come from different, but proximate, rain gauges. Nevertheless, the monthly and annual precipitation totals compare favorably.
SELECTED WMO WEATHER STATIONS.

PEOPLE'S REPUBLIC OF CHINA

#54161 CHANG CHUN
#54511 PEKING
#54823 CHI NAN
#58238 NANKING
#58367 SHANGHAI
MONTHLY AVERAGE TEMPERATURE

CHI-NAN

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MONTHS

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# MONTHLY AVERAGE TEMPERATURE

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**Chang-Chun**

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3-16
# MONTHLY AVERAGE TEMPERATURE

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3-18
## MONTHLY AVERAGE TEMPERATURE

**SHANGHAI**

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## Analysis of Variance

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Where:
- P is the # of Groups
- N is the # of Observations
- R_i is the # of Observation per Group

\[
\text{TSS} = \sum_i \sum_j x_{ij}^2 - \left( \sum_i \sum_j x_{ij} \right)^2 / N
\]

\[
\text{BSS} = \sum_i \left( \sum_j x_{ij} \right)^2 / R_i - \left( \sum_i \sum_j x_{ij} \right)^2 / N
\]

\[
\text{WSS} = \sum_i \sum_j x_{ij}^2 - \sum_i \left( \sum_j x_{ij} \right)^2 / R_i
\]

i, j = 1, 2, 3, ..., N

Original page is of poor quality.
LOCKHEED  U.S. AIR FORCE  HONG KONG ROYAL

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SUM = 1815.79  SUMSQ = 103413.06

SUM OF GROUP(1) IS 597.95
SUM OF GROUP(2) IS 607.84
SUM OF GROUP(3) IS 610.00

**Analysis of Variance**

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Since Fcal < Ftab, so accept the hypothesis.
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<td>40.6</td>
<td>25.5</td>
</tr>
<tr>
<td>ANNUAL (mm)</td>
<td>577.7</td>
<td>593.4</td>
<td>295.4</td>
<td>320.7</td>
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<tr>
<td>TOTAL (in)</td>
<td>22.7</td>
<td>23.3</td>
<td>11.6</td>
<td>12.6</td>
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3-25
4. OPERATIONS

4.1 LEAST SQUARES INTERPOLATION

This program was designed to work on more than one data set which is denoted by a parameter NS.

Each data set contains XP and YP up to 100 observations as input data; in each card, punch XP in columns 2-6 and YP in columns 7-11, with one decimal point at column 5 and column 10 for XP and YP; respectively.

At the end of each data set punch a trailer card with -99.0000.0 in columns 2-11.

Example of a program setup:

// JOB CARD
//SS EXEC FCALCMGO, PARM.FORM = 'MAP'
//FORT•SYSIN DD * SOURCE PROGRAM OF LEAST SQUARES INTERPOLATION
//GO•SYSIN , DD * DATA CARDS
/*

4.2 THE MODIFIED MAX-MIN PROGRAM

The daily estimates of maximum and minimum air temperatures and the sum of precipitation measurements reported each day are obtained according to procedures described in "As-Built Design Specifications for Historical Daily Data Bases for Testing Advanced Models", AD 63-1347-4963-08 (JSC-12891, LEC-10572, April 1977).
4.3 THE MONTHLY DATA BASES ALGORITHM

This program needs no input data from cards; all its input variables are read in from the magnetic tape.

Daily data are stored in tapes by years, each file contains one year's daily data, each of 85-95 stations.

Example of a program setup:

// JOB CARD
/* SETUP TAPE = 1 */
//SS EXEC FTG1CLG, PARM.FORT = 'MAP'
// FORT.SYSIN DD *
SOURCE PROGRAM OF THE MONTHLY DATA BASES ALGORITHM
//LKD.SYSIN DD *
INCLUDE BMDSUB (BMD2992)
//LKD.BMDSUB DD DSN=SYS2.BMDLOAD, DISP = SHR
//GO.FT 09F001 DD DSN=CH68A,
// UNIT=TAPE, VOL=, RETAIN, SER = X06121),
// DCB=(RECFM=FB, LBECL=26, BLKSIZE=7800, DEN=4),
// LABEL =(44,,IN),
// DISP=OLD, SHR)
//GO.FT10FOO1 DD DSN=CH68B
// UNIT = TAPE, VOL= SER = X06121,
// DCB= (RECFM = FB, LBECL = 26, BLKSIZE=7800, DEN=4),
// LABEL = (45,,IN)
// DISP = (OLD, KEKP)
//GO.SYSIN DD
/* */
4.4 THE ANALYSIS OF VARIANCE ALGORITHM

Twelve input cards (one for each month) are required for running the program. Each card contains three estimates of the monthly mean temperature based on the KSU algorithm output, the "published" values obtained through NCC from ETAC for years available and period of record means obtained from various Chinese publications. These values are located as follows:

Columns 1-5 contains KSU estimates
    " 7-11 " ETAC record
    " 13-18 " period of record means

and each field contains two digits, i.e., one decimal point punched in columns 3, 9, and 15, for KSU, ETAC and period of record means.

Example of a program setup:

// JOB CARD
//SS EXEC FTGICLG, PARM. FORT == 'MAP'
//FORT*SYSIN DD' * 
//SOURCE PROGRAM OF AOV ALGORITHM
//GO*SYSIN DD * 
//DATA CARD
/*
//
5. ACKNOWLEDGEMENT:

The contribution of the University of Missouri-Columbia, in furnishing computer time for the derivation of these data bases is gratefully acknowledged. Without the cooperation of Dr. Wayne L. Decker, Chairman of the Department of Atmospheric Sciences, University of Missouri-Columbia, this data-source would have been much later in making its appearance.
APPENDIX A

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EXAMPLE OF PROGRAM OUTPUT FROM THE LEAST SQUARES INTERPOLATIONS ALGORITHM

- A 2nd DEGREE CURVE A-40
- A 3rd DEGREE CURVE A-41
LEAST SQUARES INTERPOLATION

START

DECLARE VAR

NS=28

K=1

I=1

READ IN DATA X(P)

I=I+1

is X(P+2)=-99?

YES

A=1

NO
% of element is
NE = I - 1

I = 1

XSR(i) = XP(i) * * R

XCUB(i) = XP(i) * * 3

I = I + 1

is I = NE?

CALL SUM

PRINT SX, SY, SXB, SYB, SXA, SYA

ORIGINAL PAGE IS OF POOR QUALITY
CALL COR

PRINT CORR COEF

IS

IFI < 0.7

NO

\[
\text{ANNEW} = \frac{SXS8 + SY - SX * SY}{R^2}
\]

\[
\text{BNEW} = \frac{EN + SY - SX * R}{R^2}
\]

\[
\text{DNEW} = \frac{EN + SX8 - SX * R}{R^2}
\]

\[
\text{A1} = \frac{\text{ANNEW}}{\text{DNEW}}
\]
\text{E}

\text{NEW}

\text{E}

\text{NEW}

XMIN = 0.

XMAX = 26.

DALTAX = 1.

X = XMIN

Y = A1 + B1 * X

PRINT X, Y

\text{E}

\text{O}
CALL GRAPH

X = X + DALTA.X

IS

X > XMAX?

YES

WRITE 'X-AXIS'

K = K + 1

NO

IS

K = NS?

YES

STOP

END

NO

X = X + DALTA.X

60

690
\[ B_3 = \frac{C_3 \times \text{SD DIY}}{\text{DIY}} \]

\[ B_1 = \frac{C_1 \times \text{SDX}}{\text{DIY}} \]

\[ B_1 = \frac{C_1 \times \text{SDX}}{\text{DIY}} \]

\[ B_3 = \frac{C_3 \times \text{SDX}}{\text{DIY}} \]
$S^2 = (SY*BL + RXY + RY - R)^2$

$RZ = START(SZ)$

$NC = 4$

CALL LSTSA

CALL MULTIR

CALL STANDV

$BL = \frac{(C(12) \times SDX)}{SDY}$

103
\[ B_2 = \frac{(q_3 + SDW_A)}{SDW} \]

\[ B_3 = \frac{(q_3 + SDW_C)}{SDW} \]

\[ R_3 = \text{SART}(S3) \]

\[ R_3 = R_3 > R_3 \]

\[ \text{CALL PLTST} \]
CALL LSTSQA

PRINT POLYN EQUATN

XMIN = 1.

XMAX = 20

DLTAX = 1.

X = XMIN

\[ Y = \frac{C(0) + C(1)X + C(3)X^3}{C(2) + C(4)X^2} \]

105 

61

ORIGINAL PAGE IS OF POOR QUALITY
CALL GRAPH
PRINT X, Y
X = X + DALTAX

IS X > XMAX?

PRINT 'X-AXIS'

IS K = NS?

K = K + 1

LO
500

PRINT C1, C2, C3

JDeltaX = 0
XMIN = 1
X = XMIN

XMAX = B6

Y = C1 + C2 * X + C3 * X

PRINT X, Y

X = X + DeltaX

600

ORIGINAL PAGE IS OF POOR QUALITY
IN THIS PROGRAM, ALL YOU HAVE TO DO IS TO FIT A SET OF DATA PTS TO THE COMPUTER, AND THE COMPUTER WILL RETURN A BEST FIT LEAST SQ EQUATION FOR YOUR DATA PTS, AND THAT RESULTING EQUATION IS INDEED THE BEST FIT IN THE STATISTICAL SENSE, AND THE RESULTING EQUATION IS USE FOR INTERPOLATION.

THIS PROGRAM CONSISTING OF ONE MAIN PROGRAM AND SEVEN SUBROUTINE SUBPROGRAMS, THAT IS SUBROUTINE SUM, COR, LSTSQ, MEQSOl AND GRAPH AND STANDV, MULTR.

SUBROUTINE SUM IS USE TO FIND ALL SUMS FOR X AND Y
SUBROUTINE COR IS USE TO FIND THE COR. COEFF
SUBROUTINE LSTSQ IS USE TO FIND THE N DEG EQUATION
SUBROUTINE MEQSOl IS USE TO SOLVE THE N*N SYSTEM OF EQUATION
SUBROUTINE GRAPH IS USE TO OUTPUT THE DATA IN THE FORM OF A STRAIGHT LINE OR A CURVE
SUBROUTINE STANDV IS USE TO CALCULATE THE STANDARD DEVIATION OF A GIVEN SET OF DATA PTS
SUBROUTINE MULTR IS USE TO FIND THE MULTIPLE CORRELATION COEFF.
THE CRITERIA TO DETERMINE WHICH ONE IS THE BEST FIT IS ACCORDING TO THE VALUE OF THE MULTIPLE CORRELATION COEFF.
THE HIGHEST VALUE OF MULTIPLE R IS CONSIDER AS THE BEST FIT.

REAL XP(100), YP(100), XL(200), YL(200), RES(100)
COMMON/AREA1/SX, SY, SXSQ, SYSQ, SXYS, AREA2/C(25), A(25, 25), B(25)
REAL XSQ(100), XCUB(100)

NS=28

NS IS THE NUMBER OF THE DATA SET TO BE FIT INTO THE REGRESSION LINE

K=1

WRITE(6, 20)K

HEADING FOR INPUT DATA


DO 11 I=1, 100

READ(5, 3) XP(I), YP(I)

3 FORMAT(1X, 2F5.1)

IF (XP(I)*FQ.-99.0) GO TO 222

WRITE(6, 66) XP(I), YP(I)

11 CONTINUE.

222 NE=I-1

DO 50 I=1, NE

XSQ(I)=XP(I)**2

XCUB(I)=XP(I)**3

50 CONTINUE

WRITE(6, 66) XP(I), YP(I)

66 FORMAT(56X, F5.2, 5X, F5.2)

CONTINUE.

111 CONTINUE.

WRITE(6, 7) 

7 FORMAT('THE RESULT OF CALCULATIONS ARE:', // '20X, 27(*_')/)

WRITE(6, 6) NE
C SINCE X AND Y ARE HIGHLY CORRELATED, SO FIT A STRAIGHT LINE

C THE COEFF IS R={F5.2/}

R=ABS(R).LT.7 GO TO 444

ANEW=SXSQ*SY-SX*SXY
BNEW=EN*SXY-SX*SY
DENEW=EN*SXSQ-SX*2
AI=ANEW/DENEW
BI=BNEW/DENEW

C A STRAIGHT LINE IS Y=AI+BI*X

C FIND A HIGHER DEGREE EQUATION BY THE LEAST SQ METHOD

NC=3
CALL PLTSTC(XP,YP,XL,YL,NE,100,2,
+ 36H THE MONTHS
+ 36H THE MONTHLY TEMP RANGE
+)

CALL LSTSQ(XP,YP,NE,NC)
CALL MULTR(NE,XP,YP,RXY)
CALL MULTR(NE,XSQ,YP,RX SQY)
C1=C(1)
C2=C(2)
C3=C(3)
C AFTER CALL THE 2ND DEGREE POLYN
CALL STANDV(NE,XP,SDX)
CALL STANDV(NE,YP,SDY)
CALL STANDV(NE,XSQ,SDX SQ)
B(I)=C(I)*SD(I)/SDY
B1=(C2*SDX)/SDY
B2=(C3*SDXSQ)/SDY
C THE MULTIPLE R FOR 2ND DEGREE IS:
S2=ABS(RXY*B1+RX SQY*B2)
R2=SQR(T(S2))
NC=4
CALL LSTSQ(XP,YP,NE,NC)
CALL MULTR(NE,XCUB,YP,RXCUBY)
C AFTER CALL THE 3RD DEGREE POLYN:
CALL STANDV(NE,XCUB,SDXCUB)
B1=(C(2)*SDX)/SDY
FORTRAN IV G1 RELEASE 2.0  
MAIN DATE = 77321 00/54/57  

0069 \[ B2 = (C(3) * SDXSQ)/SDY \]
0070 \[ B3 = (C(4) * SDXCUB)/SDY \]
0071 \[ C \]  
0072 \[ S3 = (RXY*B1 + RXSQY*B1 + RXCYB*#3) \]
0073 \[ R3 = SORT(S3) \]
0074 IF(R2 GT R3) GO TO 500
0075 \[ CALL PLSCT(XP,YP,XP,YP,NE,NC) \]
0076 WRITE(6,25)(I#C(I),I=1,NC)
0077 \[ WRITE(6,26)(I#C(I),I=1,NC) \]
0078 \[ WRITE(6,27)(I#C(I),I=1,NC) \]
0079 \[ CALL LSTSQ(XP,YP,NE,NC) \]
0080 WRITE(6,28)(I#C(I),I=1,NC)
0081 \[ CALL LSTSQ(XP,YP,NE,NC) \]
0082 \[ WRITE(6,29)(I#C(I),I=1,NC) \]
0083 \[ WRITE(6,30)(I#C(I),I=1,NC) \]
0084 \[ WRITE(6,31)(I#C(I),I=1,NC) \]
0085 \[ WRITE(6,32)(I#C(I),I=1,NC) \]
0086 \[ WRITE(6,33)(I#C(I),I=1,NC) \]
0087 \[ WRITE(6,34)(I#C(I),I=1,NC) \]
0088 \[ WRITE(6,35)(I#C(I),I=1,NC) \]
0089 \[ WRITE(6,36)(I#C(I),I=1,NC) \]
0090 \[ WRITE(6,37)(I#C(I),I=1,NC) \]
0091 \[ WRITE(6,38)(I#C(I),I=1,NC) \]
0092 \[ WRITE(6,39)(I#C(I),I=1,NC) \]
0093 \[ WRITE(6,40)(I#C(I),I=1,NC) \]
0094 \[ WRITE(6,41)(I#C(I),I=1,NC) \]
0095 \[ WRITE(6,42)(I#C(I),I=1,NC) \]
0096 \[ WRITE(6,43)(I#C(I),I=1,NC) \]
0097 \[ WRITE(6,44)(I#C(I),I=1,NC) \]
0098 \[ WRITE(6,45)(I#C(I),I=1,NC) \]
0099 \[ WRITE(6,46)(I#C(I),I=1,NC) \]
0100 \[ WRITE(6,47)(I#C(I),I=1,NC) \]
0101 \[ WRITE(6,48)(I#C(I),I=1,NC) \]
0102 \[ WRITE(6,49)(I#C(I),I=1,NC) \]
0103 \[ WRITE(6,50)(I#C(I),I=1,NC) \]
0104 \[ WRITE(6,51)(I#C(I),I=1,NC) \]
0105 \[ WRITE(6,52)(I#C(I),I=1,NC) \]
0106 \[ WRITE(6,53)(I#C(I),I=1,NC) \]
0107 \[ WRITE(6,54)(I#C(I),I=1,NC) \]
0108 \[ WRITE(6,55)(I#C(I),I=1,NC) \]
0109 \[ WRITE(6,56)(I#C(I),I=1,NC) \]
0110 \[ WRITE(6,57)(I#C(I),I=1,NC) \]
0111 \[ WRITE(6,58)(I#C(I),I=1,NC) \]
0112 \[ WRITE(6,59)(I#C(I),I=1,NC) \]
0113 \[ WRITE(6,60)(I#C(I),I=1,NC) \]
0114 \[ WRITE(6,61)(I#C(I),I=1,NC) \]
0115 \[ WRITE(6,62)(I#C(I),I=1,NC) \]
GO TO 9
690 STOP
END
SUBROUTINE SUM

START

INITIALIZATION

I = 1

SIX = SX + X(I)

SXSA = SXSA + X(I)^2

SYSA = SYSA + Y(I)^2

SXY = SXY + X(I) * Y(I)

I = I + 1

IF I = N

RETURN

END
SUBROUTINE SUM(NE, X, Y)
COMMON/AREA1/SX, SY, SXSQ, SYSQ, SXY

IN THIS SUBROUTINE SUM, THE INPUT DATA ARE NE, X, Y AND THE OUTPUT ARGUMENTS ARE SX, SY, SXSQ, SYSQ, SXY. ALL VALUES FOR THE SUMS ARE CALCULATED IN THIS SUBROUTINE.

DIMENSION X(100), Y(100)

SX = 0.0
SY = 0.0
SXSQ = 0.0
SYSQ = 0.0
SKY = 0.0

DO 10 I = 1, NE
  SX = SX + X(I)
  SY = SY + Y(I)
  SXSQ = SXSQ + X(I)**2
  SYSQ = SYSQ + Y(I)**2
  SXY = SXY + X(I)*Y(I)
10 CONTINUE

RETURN
END
SUBROUTINE LSTSQ

START

DECLARE VAR

I = 1

B(I) = 0.

K = 1

10

IS

X(K) = 0 AND I = 1

NO

B(I) = B(I) + X(K) =+ (z-1) Y(K)

X(K) = 1

A
SUBROUTINE LSTSQ(X,Y,N,M)
COMMON/AREA2/C(25),A(25,25),B(25)

LEAST SQUARE CURVE FITTING
TO FIT N GIVEN POINTS X(N),Y(N) BY A POLYNOMIAL OF
M-1 DEGREE, SUM C(I)*X***(I-1) FOR I=1 TO I=M
C(M) IS THE OUTPUT COEFF ARRAY
NEEDS SUBROUTINE MEQSOL TO SOLVE FOR AC=B

REAL X(100),Y(100)
DO 7 I=1,M
B(I)=0.0
5 DO 6 K=1,N
B(I)=B(I)+X(K)***(I-1)*Y(K)
6 CONTINUE
DO 7 J=1,M
A(I,J)=0.0
7 IF((X(K)EQ.0.0)AND,(I+J)EQ.2)X(K)=1.0
A(I,J)=A(I,J)+X(K)***(I+J-2)
CALL MEQSOL(M)
RETURN
END
SUBROUTINE MEASOL

START

DECLARE VAR

I = 1

M(0) = J

AMAX = A(0)

J = 2

is

\|A(30)\| > \|AMAX\|

NO  YES

J = J + 1

A

A-24
A

\[ A_{\text{MAX}} = A(i, j) \]

\[ M(i) = J \]

\[ \text{WRITE 'NO SOLN'} \]

\[ \text{YES} \]

\[ \text{is} \]

\[ \text{AMAX = 0?} \]

\[ \text{NO} \]

\[ J = 1 \]

\[ A(i, j) = A(i, j) / A_{\text{MAX}} \]

\[ \text{is} \]

\[ I = N? \]

\[ I = I + 1 \]

\[ B(i) = B(i) / A_{\text{MAX}} \]

B

A-25
\[ B \]

\[ \text{IP} = 1 \]

\[ \text{IS } \text{IP} = 0 \]?

\[ \text{NO} \]

\[ \text{NMM} = M(x) \]

\[ \text{RESULT} = A_{\text{INT}} \]

\[ J = 1 \]

\[ \text{IS } J = \text{MIN} \]?

\[ \text{NO} \]

\[ A(x_{p}, x) = \frac{A(x_{p}, x - 1) + A(x_{p}, x + 1)}{2} \]

\[ \text{YES} \]

\[ A(x_{p}, x) = 0 \]

\[ A \]
SUBROUTINE MEQSOL(N)
COMMON/X(25),A(25,25),B(25)

THIS SUBROUTINE MEQSOL IS USE TO SOLVE THE MATRIX EQUATION AX=B OF
IN THIS PARTICULAR CASE, N IS 4, AND THE RESULT IS RETURNED TO
THE MAIN PROGRAM BY THE LABEL COMMON X(25). IF HIGHER ORDER MATRIX
EQUATION IS NEEDED TO BE SOLVE, THEN THE VALUE OF N HAVE TO BE
CHANGE

INTEGER M(25)

DO 9 I=1,N
M(I)=1
DO 2 J=2,N
IF(ABS(A(I,J))-ABS(AMAX)) 2,2,1
1 AMAX=A(I,J)
M(I)=J
2 CONTINUE
DO 4 J=1,N
4 A(I,J)=A(I,J)/AMAX
B(I)=B(I)/AMAX
DO 9 IP=1,N
IF(IP-I)5,9,5
5 MMM=M(I)
ZMULT=A(IP,MMM)
DO 8 J=1,N
6 A(IP,J)=0.0
7 A(IP,J)=A(IP,J)-ZMULT*A(I,J)
8 CONTINUE
9 CONTINUE
DO 95 I=1,N
95 X(M(I))=B(I)
GO TO 8.
DO 26 IP=1,N
26 B(IP)=B(IP)-ZMULT*B(I)
CONTINUE
9 CONTINUE
WRITE(6,99)
99 FORMAT(12H NO SOLUTION)
RETURN
END
SUBROUTINE MULTR

START

INITIALIZATION

I = 1

Sx = Sx + X(i)

Sy = Sy + Y(i)

Sxy = Sxy + X(i)*Y(i)

Sxsq = Sxsq + X(i)^2

sysq = sysq + Y(i)^2

A
A

\text{IS} \quad I = N? \quad \text{NO} \rightarrow I = I + 1

\text{YES}

A = \text{EN} * \text{SXY} - \text{SX} * \text{YY}

B = \text{SORT}(\text{EN} * \text{SXYA} \quad \text{SX} * \text{YY} + B)

C = \text{SORT}(\text{EN} * \text{SYBA} \quad \text{SX} * \text{YY} + B)

\text{RMULT} = \frac{A}{B} * C

\text{return}

\text{END}
SUBROUTINE MULTR(N,X,Y,RMULT)

* THIS SUBROUTINE MULTR IS USE TO CALCULATE THE MULTIPLE
  CORRELATION COEFF R AND DENOTED THAT BY THE OUTPUT PARAMETER
  MULTR AND THE FORMULA IS R=SQRT(SUME OF R(I,Y)*B(J)),
  WHERE B(J) IS THE STANDARDIZE REGRESSION COEFF AND THE
  UNSTANDARDIZE REGRESSION COEFF IS R=SD(J)/SD(Y)*B(J)

REAL X(100),Y(100)

EN=N
SX=0.0
SY=0.0
SXY=0.0
SX0=0.0
SYS0=0.0

DO 100 I=1,N
SX=SX+X(I)
SY=SY+Y(I)
SXY=SXY+X(I)*Y(I)
SX0=SX0+X(I)**2
SYS0=SYS0+Y(I)**2

A=(EN*SXY-(SX)*(SY)) **
B=SQRT(EN*SX0-(SX)**2) **
C=SQRT(EN*SYS0-(SY)**2)
RMULT=(A/(B*C))

RETURN
END
SUBROUTINE GRAPH

START

DECLARE VAR

DATA = INSTR(8,IASTR,8)

J = ABS(Y)

RETURN YES

IS J > 81

I = 1

A
SUBROUTINE GRAPH(Y)
DIMENSION IP(81)
DATA IASTR/**'/, IBLNK/**'/
J=ABS(Y)
IF(J>81)500,500,600
500 DO 333 I=1,81
IP(I)=IBLNK
333 CONTINUE
IP(J)=IASTR
WRITE(6,51)IP
51 FORMAT(+'+',38X,'1',81A1)
RETURN
END
SUBROUTINE COR

START

DECLVAR VAR

EN=NE

RNEW = EN*SYX-SX*SY

DENEWY = EN*SYS-SY*SY

R= RNEW/ SART(DENEWY+ DENEWY)

RETURN

END

A-35
SUBROUTINE COR(NE, R)
COMMON/ARFA1/SX, SY, SXSQ, SYSQ, SXY

IN THIS SUBROUTINE COR, THE INPUT ARGUMENTS ARE NE, SX, SY, SXSQ, SYSQ, SXY; AND THE OUTPUT ARGUMENT IS R; THE COR. COEFF IS RETURN TO THE MAIN PROGRAM BY R.

EN = FLOAT(NE)
RNEW = EN*SXY - SX*SY
DENEWX = EN*SXSQ - SX**2
DENEWY = EN*SYSQ - SY**2
R = RNEW/SQRT(DENEWX*DENEWY)
RETURN
END
SUBROUTINE STANDV

START

DECLARE VAR

EN = N

SZ = 0.

SZSA = 0.

I = 1

SZ = SZ + Z(I)

A
\[ S = S + Z(0) \]

\[ I = I + 1 \]

\[ A = \frac{E + S - S^2}{E(E - 1)} \]

\[ B = \text{sort}(B) \]

\[ \text{STDV} = \text{sort}(B) \]

RETURN

END
SUBROUTINE STANDV(N,Z,STDV)

THIS SUBROUTINE IS USE TO CALCULATE THE STANDARD DEVIATION OF A GIVEN SET OF DATA PTS AND DENOTED THAT BY THE OUTPUT PARAMETER STDV

REAL Z(100)
EN=N
SZ=0.0
SZZQ=0.0
DO 200 I=1,N
SZ=SZ+Z(I)
SZZQ=SZZQ+Z(I)**2
CONTINUE
A=(EN*SZZQ-SZ**2)
B=A/(EN*(EN-1.0))
STDV=SQR(T(B))
RETURN
END
LEAST SQ INTERPOLATION PLOT

THE MONTHLY TEMP RANGE

THE MONTHS

( X 10** 0 )

1.000 3.000 5.000 7.000 9.000 11.000 13.000 15.000 17.000
THE MONTHLY TEMP RANGE

( x.10** -0 )

( x.10** 0 )

THE MONTHS
# APPENDIX B

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ESTIMATION OF MONTHLY MAX AND MIN TEMPERATURES AND PRECIPITATION FOR THE ENTIRE WHEAT PRODUCTION AREA OF THE PEOPLE'S REPUBLIC OF CHINA

START
EXTERNAL DATA
DECLAR VAR
HEADING1
N=1
READ INPUT DATA
A

50
VS(N) = STATN
V.Y(N) = YEAR
V.N(N) = MONTH
V.D(N) = DAY
V.P(N) = PRECIP

IS

D_MAX = BLANK

YES

D_MAX = 999

NO

V.D_MAX = D_MAX
End of the main program
EXTERNAL SIGN

INTEGER VS(600), VM(600), VD(600), VMAX(600), VDMIN(600),
& VP(600), STATN, YEAR, MONTH, DAY, DMAX, DMIN, PRECIP

INTEGER N1(6), N2(2), N7(2), N4(3), N5(3), N6(3), N7(3)

INTEGER STN1, YR1, RF

REAL RMAX, RMIN

DO 500 IN=1,10

READ(IN,20) N1, N2, N7, N4, N5, N6, N7

20 FORMAT(6I1,2A1,2A1,3A1,1X,3A1,3A1,3X,3A1)

N=1

EC READ(IN,40,END=499) STAN, YEAR, MONTH, DAY, CMAX, CMIN, PRECIP, RMAX,

& RMIN

VS(N)=STATN

VM(N)=YEAR

VD(N)=DAY

VP(N)=PRECIP

IF((CMAX.EQ.C) .AND. (SIGN(1.0, IAX).NE.-1.0)) CMAX=999

VMAX(N)=DMAX

IF((DMIN.EQ.C) .AND. (SIGN(1.0, FMIN).NE.-1.0)) CMIN=999

VDMIN(N)=DMIN

M1=VS(N)

M2=VD(N)

M3=VM(N)

M4=VP(N)

IF(((M1.EQ.12).AND.(M2.EQ.31)).AND.((N3.LE.N4))) GO TO 200

N=N+1

GO TO 10

20 CALL SCRN(1, VS, VM, VD, VMAX, VDMIN, STN1, YR1, VP, PIBAR)

CALL ANP(STN1, YR1, VP, PIBAR)

CLEAR ALL STORAGE FCR NEXT STATION

DO 300 I=1, N

VS(I)=C

VM(I)=C

VD(I)=C

VP(I)=C

300 CONTINUE

GO TO 10

400 REWIND IN

500 CONTINUE

STOP

CFLG $LBC$K

END
A

IS 13N

YES

HEADING

CALL PBAR

DISPLAY

MONTHLY
TEMP & PRECIP

RETURN

END

I=I+1

10
C THIS SLBROTFN IS TO STORE THE 12 MONTHS OBSERVATIONS FOR
C EACH STATION


REAL BV1,BV2,BV3,BV4,BV5,BV6,BV7,BV8,BV9,BV10,BV11,BV12,
+BV13,BV14,BV15,BV16,BV17,BV18,BV19,BV20,BV21,BV22,
+BV23,BV24,BV25,BV26,BV27,BV28,BV29,BV30,BV31,BV32,
+BV33,BV34,BV35,BV36,BV37,BV38,BV39,BV40,BV41,BV42,
+BV43,BV44,BV45,BV46,BV47,BV48,BV49,BV50,BV51,BV52,
+BV53,BV54,BV55,BV56,BV57,BV58,BV59,BV60,BV61,BV62,
+BV63,BV64,BV65,BV66,BV67,BV68,BV69,BV70,BV71,BV72,
+BV73,BV74,BV75,BV76,BV77,BV78,BV79,BV80,BV81,BV82,
+BV83,BV84,BV85,BV86,BV87,BV88,BV89,BV90,BV91,BV92,
+BV93,BV94,BV95,BV96,BV97,BV98,BV99,BV100,BV101,BV102,
+BV103,BV104,BV105,BV106,BV107,BV108,BV109,BV110,BV111,
+BV112,BV113,BV114,BV115,BV116,BV117,BV118,BV119,BV120,
+BV121,BV122,BV123,BV124,BV125,BV126,BV127,BV128,BV129,
+BV130,BV131,BV132,BV133,BV134,BV135,BV136,BV137,BV138,
+BV139,BV140,BV141,BV142,BV143,BV144,BV145,BV146,BV147,
+BV148,BV149,BV150,BV151,BV152,BV153,BV154,BV155,BV156,
+BV157,BV158,BV159,BV160,BV161,BV162,BV163,BV164,BV165,
+BV166,BV167,BV168,BV169,BV170,BV171,BV172,BV173,BV174,
+BV175,BV176,BV177,BV178,BV179,BV180,BV181,BV182,BV183,
+BV184,BV185,BV186,BV187,BV188,BV189,BV190,BV191,BV192,
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+BV202,BV203,BV204,BV205,BV206,BV207,BV208,BV209,BV210,
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+BV229,BV230,BV231,BV232,BV233,BV234,BV235,BV236,BV237,
+BV238,BV239,BV240,BV241,BV242,BV243,BV244,BV245,BV246,
+BV247,BV248,BV249,BV250,BV251,BV252,BV253,BV254,BV255,
+BV256,BV257,BV258,BV259,BV260,BV261,BV262,BV263,BV264,
+BV265,BV266,BV267,BV268,BV269,BV270,BV271,BV272,BV273,
+BV274,BV275,BV276,BV277,BV278,BV279,BV280,BV281,BV282,
+BV283,BV284,BV285,BV286,BV287,BV288,BV289,BV290,BV291,
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+BV526,BV527,BV528,BV529,BV530,BV531,BV532,BV533,BV534,
+BV535,BV536,BV537,BV538,BV539,BV540,BV541,BV542,BV543,
+BV544,BV545,BV546,BV547,BV548,BV549,BV550,BV551,BV552,
0044  -  MAR=VM(I)
0045    YR=Y(I)
0046    STN=VS(I)
0047      GO TO ICC
0048
0049   4  I4=I4+1
0050      P4(I4)=VP(I)
0051      DX4(I4)=VDMAX(I)
0052      DN4(I4)=VDMIN(I)
0053      DA(I4)=VD(I)
0054      APR=VM(I)
0055    YR4=VV(1)
0056    STN4=VS(I)
0057      GO TO ICC
0058
0059   5  IE=IE+1
0060      PE(IE)=VP(I)
0061      DXE(IE)=VDMAX(I)
0062      DNE(IE)=VDMIN(I)
0063      DE(IE)=VD(I)
0064      MAY=VM(I)
0065    YRE=VV(I)
0066    STN5=VS(I)
0067      GO TO ICC
0068
0069   6  IE=IE+1
0070      PE(IE)=VP(I)
0071      DXE(IE)=VDMAX(I)
0072      DNE(IE)=VDMIN(I)
0073      DE(IE)=VD(I)
0074      JUN=VM(I)
0075    YRE=VV(I)
0076    STN6=VS(I)
0077      GO TO ICC
0078
0079   7  I7=I7+1
0080      P7(I7)=VP(I)
0081      DX7(I7)=VDMAX(I)
0082      D7(I7)=VDMIN(I)
0083      D7(I7)=VD(I)
0084      JUL=VM(I)
0085    YR7=VV(I)
0086    STN7=VS(I)
0087      GO TO ICC
0088
0089   8  IE=IE+1
0090      PE(IE)=VP(I)
0091      DXE(IE)=VDMAX(I)
0092      DNE(IE)=VDMIN(I)
0093      DE(IE)=VD(I)
0094      AUG=VM(I)
0095      YRE=VV(I)
0096    STN8=VS(I)
0097      GO TO ICC
0098
0099   9  IS=IS+1
0100      PS(IS)=VP(I)
0101      DXS(IS)=VDMAX(I)
0102      DNS(IS)=VDMIN(I)
0103      D5(IS)=VD(I)
0104      SEP=VM(I)
0105    YRS=VV(I)
STNG = VS(I)
GO TO ICC

1C I1C = I1C + 1
PIC(I1C) = VP(I)
DX1C(I1C) = VDMA > I
DN1C(I1C) = VDMIN(I)
D1C(I1C) = VDI(I)

11 I11 = I11 + 1
P11(I11) = VP(I)
DX11(I11) = VDMA > I
DN11(I11) = VDMIN(I)
D11(I11) = VDI(I)

12 I12 = I12 + 1
P12(I12) = VP(I)
DX12(I12) = VDMA > I
DN12(I12) = VDMIN(I)
D12(I12) = VDI(I)

12 CONTINUE

50 FORMAT(2X, 'THE MONTHLY MAX AND MIN TEMP TABLE:
*2X, 'MONTH', 5X, 'MAX TEMP', 10X, 'MIN TEMP', 10X, 'PRECIP', 
*2X, 'E(')
CALL DMEAN(DX1, DN1, D1, JAN, YR1, STN1, T1, EN1)
CALL DMEAN(DX2, DN2, D2, FEB, YR2, STN2, T2, EN2)
CALL DMEAN(DX3, DN3, D3, MAR, YR3, STN3, T3, EN3)
CALL DMEAN(DX4, DN4, D4, APR, YR4, STN4, T4, EN4)
CALL DMEAN(DX5, DN5, D5, MAY, YR5, STN5, T5, EN5)
CALL DMEAN(DX6, DN6, D6, JUN, YR6, STN6, T6, EN6)
CALL DMEAN(DX7, DN7, D7, JUL, YR7, STN7, T7, EN7)
CALL DMEAN(DX8, DN8, D8, AUG, YR8, STN8, T8, EN8)
CALL DMEAN(DX9, DN9, D9, SEP, YR9, STN9, T9, EN9)
CALL DMEAN(DX10, DN10, D10, OCT, YR10, STN10, T10, EN10)
CALL DMEAN(DX11, DN11, D11, NOV, YR11, STN11, T11, EN11)
CALL DMEAN(DX12, DN12, D12, DEC, YR12, STN12, T12, EN12)
CALL PBAR(P1, I1, PBAR1)
CALL PBAR(P2, I2, PBAR2)
CALL PBAR(P3, I3, PBAR3)
CALL PBAR(P4, I4, PBAR4)
CALL PBAR(P5, I5, PBAR5)
CALL PBAR(P6, I6, PBAR6)
CALL PBAR(P7, I7, PBAR7)
CALL PBAR(P8, I8, PBAR8)
CALL PBAR(P9, I9, PBAR9)
CALL PBAR(P10, I10, PBAR10)
CALL PBAR(P11, I11, PBAR11)
CALL PEAR(P12,I12,F12BAR)
WRITE(6,E2) STA1, YR1
E2 FORMAT(3X,'STATIC A',I5,' IN 19',I2)
WRITE(6,E1) JAN, BN1, BN14, F1EAR,
   @FEB, BN2, BN28, P2BAR,
   @MAR, BN3, BN39, P3BAR,
   @APR, BN4, BN49, P4BAR,
   @MAY, BN5, BN59, P5BAR,
   @JUN, BN6, BN69, P6BAR,
   @JUL, BN7, BN79, P7BAR,
   @AUG, BN8, BN89, P8BAR,
   @SEP, BN9, BN99, P9BAR,
   @OCT, BN10, BN109, P10BAR,
   @NOV, BN11, BN119, P11BAR,
   @DEC, BN12, BN129, P12BAR
E1 FORMAT(2X,I4,F12,2,10X,F10,2,10X,IA)
RETURN
DEBLG SLBCHK
END
SUBROUTINE DMEAN

START

DECLARE VAR

CALL TOTAL

EN = N - ICOUNT

IS EN .EQ. 0

YES

EN = 1.0

NO

MAXBAR = SMAX / EN

CALL TOTAL

END
A

EM = N-KOUNT

IS EM EQ 0

YES

EM = 1.0

NO

MINBAR = \frac{SMIN}{EM}

RETURN

END
C THIS SUBROUTINE IS USED TO CALCULATE THE MONTHLY MAX, MIN TEMP

SUBROUTINE MEAN(DX,DX,YR,STN,MAXBAR,MINBAR)
INTEGER DX(5C),DX(50),NEN,YR,STA
INTEGER D(5C)
REAL MAXBAR,MINBAR
CALL TOTAL(N,MAXS,DX,ICCLNT)

EN=N-ICCLNT
0007 IF(EN.EQ.0.0)EN=1.0
0008 MAXBAR=MAX/EN
0009 CALL TOTAL(N,MIN,DX,KCLNT)
0010 EM=N-KOLNT
0011 IF(EM.EQ.0.0)EN=1.0
0012 MINBAR=MIN/EN
0013 RETURN
0014 DEBLC SLBCHK
0015 END
SUBROUTINE TOTAL

START

DECLARE VAR

INITIALIZATION

K = 1

IF DEG = 999

YES

KNT = KNT + 1

NO

SUM = SUM + DEG

K = K + 1

IF K = N

YES

RETURN

END

NO

B-19
SLBROL TINE TOTAL(A, SLM, DZ, KNT)

INTEGER DZ(EC)
KNT=C
SLM=C

DO 1CC K=1, A
IF(DZ(K) .EQ. 5555) GC 1CC 200
SLM=SLM+DZ(K)
GO TO 1CC

2CC KNT=KNT+1
CONTINUE
RETURN
DEBUG SLBCHK
END
SUBROUTINE AND

START

DECLARE VAR

INITIALIZATION

I = 1

IF (F34.4L, 9999) THEN
  NC
ELSE
  L = L + V(p(x))

A

40

10

YES
C THIS SUBROUTINE IS LEE LC FIND THE ANNUAL PRECIF OF EACH STATION

INTEGER STATN,YEAR,VP(600),BP

L=0
ICOLNT=0
DO 1CC I=1,N
IF(VP(I).EQ.0.5S55) GC TO 200
L=L+VP(I)
GO TO 1CC
CONTINUE
2CC ICOLNT=ICOLNT+1
CONTINUE
BP=L
WRITE(6,2C)ICOLNT,STATN,YEAR,BP
30 FORMAT(3C,*TOTAL # OF OBSERVATIONS='/,18,/
3C,* OF MISSING OBSERVATIONS='/,18,/
3C,* OF STATION ',16,' IN THE YEAR ','14,/
3C,* THE ANNUAL PRECIF IS ',16)
RETURN
DEBLG SLBCHK
SUBROUTINE PBAR

START

INITIALIZATION

I = 1

IF P(C(0)) = 9999

YES

GO TO 20

NO

IS = IS + P(C(0))

GOTO A

20
A

I = I + 1

NO

IS I = N

YES

EN = N

PA'I' = IS

RETURN

END

ORIGINAL PAGE IS OF POOR QUALITY
SUBROUTINE PBAR(PC,N,PAV)

 INTEGER PC(N),PAV

 IS=0
 DO 1C I=1,N
 IF(PC(I).EQ.9999) GC TC 10
 IS=IS+PC(I)
 CONTINUE

 EN=N
 PAV=IS
 RETURN
 DEBLG $L\&CCHK
 END
APPENDIX C

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ORIGINAL PAGE IS OF POOR QUALITY
THE ANALYSIS OF VARIANCE

START

INITIALIZATION

\( I = 1 \)

\( NO = NO + P(x) \)

\( I = I + 1 \)

\( IS \ I = N \) 

YES

\( I = 1 \)

NO

STOP
F

NOM1 = (NO - 1)

BMS = BSS/FLAT(NOM1)

HMS = WSS/FLAT(NOM1)

F_cal = BMS / HMS

PRINT HEADING

is Fmax > Fcal

PRINT ACCEPTING MESSAGE

PRINT REJECTING MESSAGE

STOP

END
**LEVEL 21.8 (JUN 74) OS/360 FORTRAN**

**COMPILER OPTIONS**
- NAME = MAIN
- OPT = 00
- LINEDNT = 55
- SIZE = 0000K
- SOURCE = NOEDIC, NOELE, LOAD, MAP, NOEDIT, ID, XREF

---

*************** THE AOV ANALYSIS ***************

*************** BUNNY H JEUN ***************

---

```fortran
C

*********** THE AOV ANALYSIS ***********

ISN 0002 REAL X(100,100), T(100), G(100)

ISN 0003 INTEGER R(100)

ISN 0004 FTA0=6.93

ISN 0005 R(1)=12

ISN 0006 R(2)=12

ISN 0007 R(3)=12

ISN 0008 M=12

ISN 0009 N=3

ISN 0010 NG=3

ISN 0011 NO=0

ISN 0012 DO 100 I=1,NG

ISN 0013 NO=NO+R(I)

ISN 0014 100 CONTINUE

ISN 0015 READ(S10)(X(I,J),J=1,N)

ISN 0016 10 FORMAT(5(F5.2,1X))

ISN 0017 CONTINUE

ISN 0018 WRITE(b,98)

ISN 0019 FORMAT('NOW 1 I=1,M 

ISN 0020 WRITE(6,9)CX(I,J)J=1,N)

ISN 0021 9 FORMAT(43X,F10.2,2X,F1.2,2X,F13.3)

ISN 0022 11 CONTINUE

ISN 0023 SUM=0.0

ISN 0024 SUMSQ=0.0

ISN 0025 DO 200 J=1,NG

ISN 0026 M=R(J)

ISN 0027 DO 200 I=1,M

ISN 0028 SUM=SUM+X(I,J)

ISN 0029 SUMSQ=SUMSQ+X(I,J)**2

ISN 0030 200 CONTINUE

ISN 0031 TSS=(SUMSQ-SUM/ENO)

ISN 0032 WRITE (6,105) SUM,SUMSQ

ISN 0033 105 FORMAT(2OX,'SUM',F10.2,2X,'SUMSQ:',F10.2,2X)

ISN 0034 DO 300 J=1,M

ISN 0035 T(J)=T(J)+X(I,J)

ISN 0036 END

C

C THE AOV ANALYSIS
C
C IS THE
C
C ENO NO IS THE # OF OBSERVATIONS
C
C NO IS THE # OF GROUP

C

C
```

---

**ORIGINAL PAGE IS OF POOR QUALITY**
ISN 0043  300 CONTINUE
ISN 0044    DO 12 I=1,NG
ISN 0045    WRITE(6,106)I,T(I)
ISN 0046    106 FORMAT(20X,'SUM OF GROUP','I',13,' I IS ',F10.2/)
ISN 0047    12 CONTINUE
ISN 0048    SUMGSO=0.0
ISN 0049    DO 400 I=1,NG
ISN 0050      E=R(I)
ISN 0051    400 CONTINUE
ISN 0052    SUMGSO=SUMGSO*T(I)**2/E
ISN 0053    CONTINUE
ISN 0054    WSS=TSS-RSS
ISN 0055    NGM1=NG-1
ISN 0056    NGM1 IS THE DEGREE OF FREEDOM FOR THE WITHIN THE GROUP
ISN 0057    NOMNG=NG-NG
ISN 0058    NOMNG IS THE DEGREE OF FREEDOM FOR WITHIN THE GROUP
ISN 0059    BMS=BSS/FLOAT(NGM1)
ISN 0060    WMS=WSS/FLOAT(NOMNG)
ISN 0061    FCAL=BMS/WMS
ISN 0062    WRITE(6,20)
ISN 0063    20 FORMAT(55X,'ANALYSIS OF VARIANCE'/
      +50X,'DEGREE OF ',7X,'SUM OF '/
      +26X,'SOURCE OF VARIATION',5X,'FREEDOM',5X,'SQUARE',5X,'/
      +26X,'MEAN SQUARE',5X,'F RATIO'/
      +26X,75(' !')/
ISN 0064    21 FORMAT(25X,'BETWEEN GROUP',12X,'I',13,'X',F13.3,5X,F10.3/
      +25X,'WITHIN GROUPS',12X,'I',13,'X',F13.3,5X,F10.3/
      +25X,'TOTAL',20X,'I',13,'X',F13.3/
      +25X,77(' !')/)
ISN 0065    IF (FCAL.GT.FTAB) GO TO 101
ISN 0066    WRITE(6,23)
ISN 0067    23 FORMAT(50X,'SINCE FCAL>FTAB,SO ACCEPT THE HYPOTHESIS')
ISN 0068    24 FORMAT(30X,'SINCE FCAL<FTAB,SO REJECT THE HYPOTHESIS')
ISN 0069    600 STOP
ISN 0070  END