TECHNICAL MEMORANDUM

OPERATIONAL CHANGES FOR THE KANSAS STATE UNIVERSITY WHEAT MODEL

Job Order 74-4863

AD 63-1347-4863-04

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National Aeronautics and Space Administration
LYNDON B. JOHNSON SPACE CENTER
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CONTENTS

FIGURES

1. SCOPE

The operational version of the Kansas State University (KSU) Yield System is now a load module which does not require recompiling before each execution. This was done by combining the KSU Main and Block Data programs into a new Main that reads the variable information from lead cards. Other changes include insertion of the variance model and changes to include the regional yields in the output.

2. APPLICABLE DOCUMENTS

2.1 Planting Date and Wheat Yield Models, Final Report for Period Feb 1975 - March 1977. Contract NAS 9-14533. A.M. Feyerherm, Dept of Statistics, KSU. Sept 1977.

2.2 Revision of the Wheat Yield Model (WHYMOD) Computer Program, A.M. Feyerherm, Dept of Statistics, KSU. July 1977.

2.3 Action Documentation 63-1557-4863-04, Modification of Kansas State University Model, July 19, 1977.

3. SYSTEM DESCRIPTION

Refer to document 1 under Applicable Document for the design of the KSU system.

3.1 HARDWARE DESCRIPTION

The programs and associated data files are resident on the IBM 360/195 complex near Suitland, Maryland.

3.2 SOFTWARE CHANGES TO KSU SYSTEM

3.2.1 PROGRAM MAIN

Main reads input variables from unit 2 and assigns constant information inline. This information had previously been assigned by Block Data. See attachment B for lead card input. The USDA reported yields are also input by cards when the variance model is run.

3.2.1.1 Linkages

MAIN calls WHYMOD

3.2.1.2 Interfaces

MAIN provides control information to WHYMOD and the necessary USDA reported yields for the VARIAN MODLE.

3.2.1.3 FLOWCHART

See Figure 3.2.1

3.2.1.4 Program Listing

See Attachment A

3.2.2 PROGRAM VARIAN

VARIAN estimates the variance of the Spring or Winter Wheat of the KSU Model. It uses USDA reported, yields against the KSU estimated yields.

3.2.2.1 Linkages

VARIAN is called by WHYMOD

3.2.2.2 Inputs

Inputs are USDA reported yields and the corresponding KSU estimated yields.

3.2.2.3 Outputs

Output is Estimated variance of the inputs. Refer to attachment D for output example.

3.2.2.4 Flowchart

See Figures 3.2.2 through 3.2.8

3.2.2.5 Program Listing

See Attachment A

FIGURE 3.2.1- MAIN

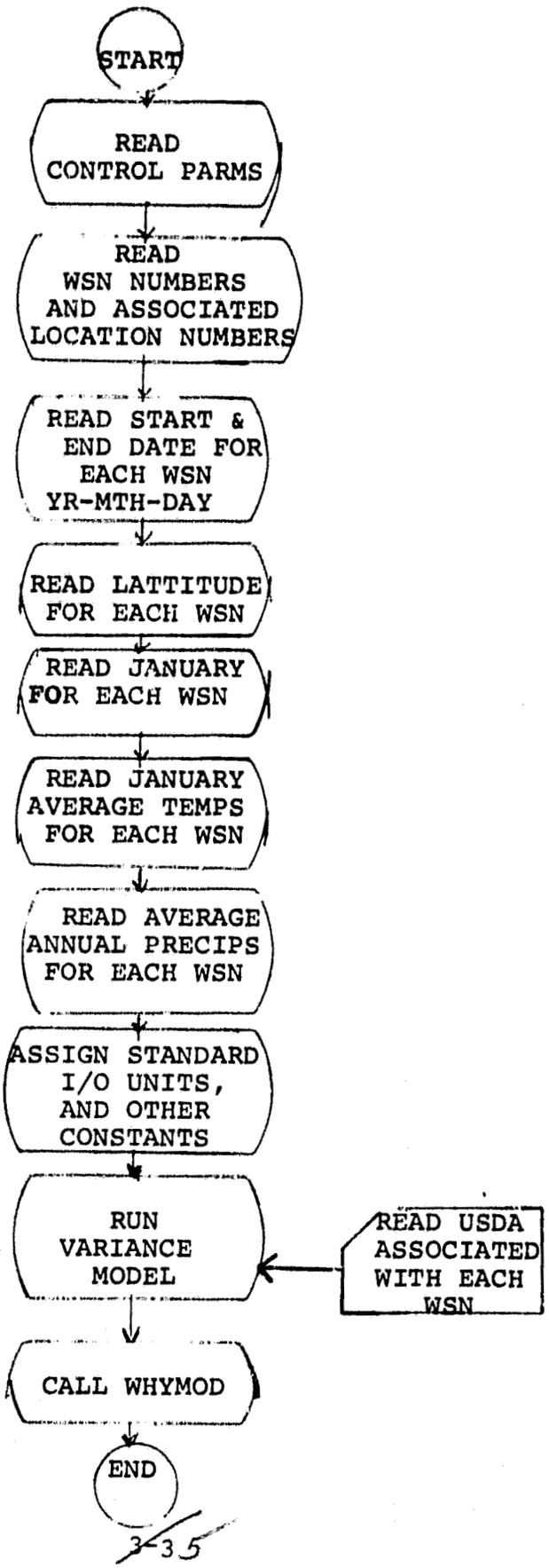


FIGURE 3.2.2

SUBROUTINE VARIAN

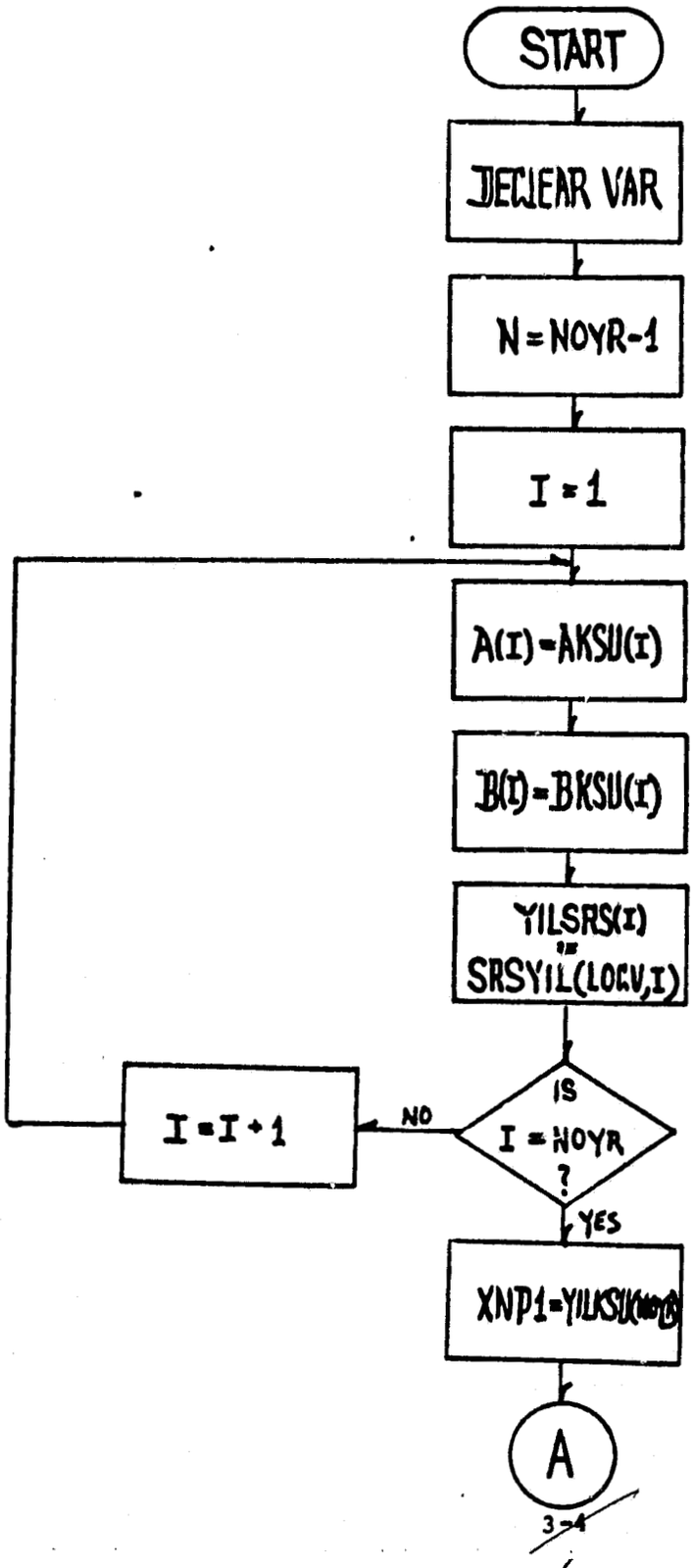


FIGURE 3.2.3

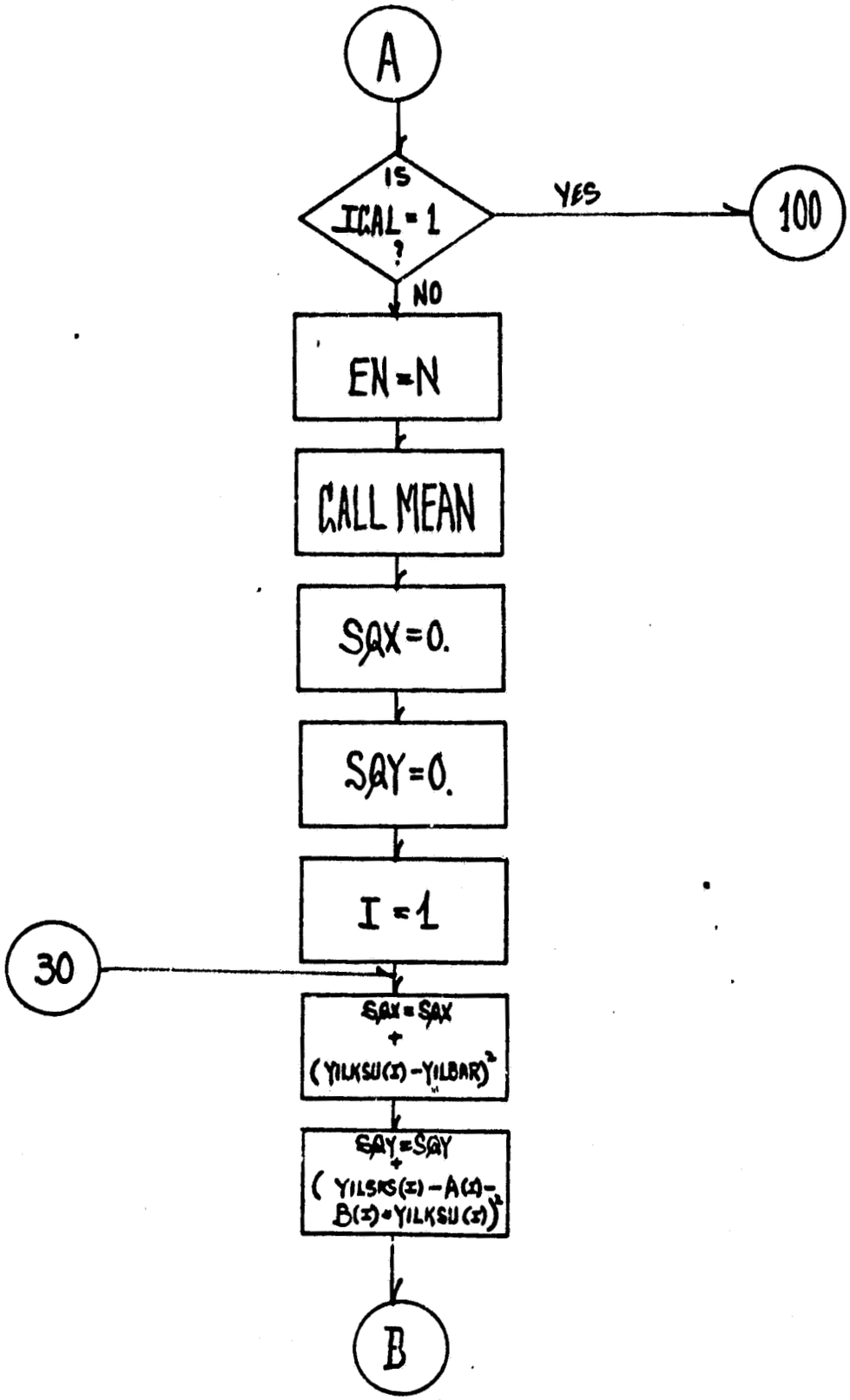

A
IS ICAL = 1 ?
YES
100
NO
EN=N
CALL MEAN
SQX=0.
SQY=0.
I=1
30
SQX=SQX + (YILKSU(I)-YILBAR)**2
SQY=SQY + (YILSKS(I)-A(I)-B(I)*YILKSU(I))**2
B

FIGURE 3.2.4

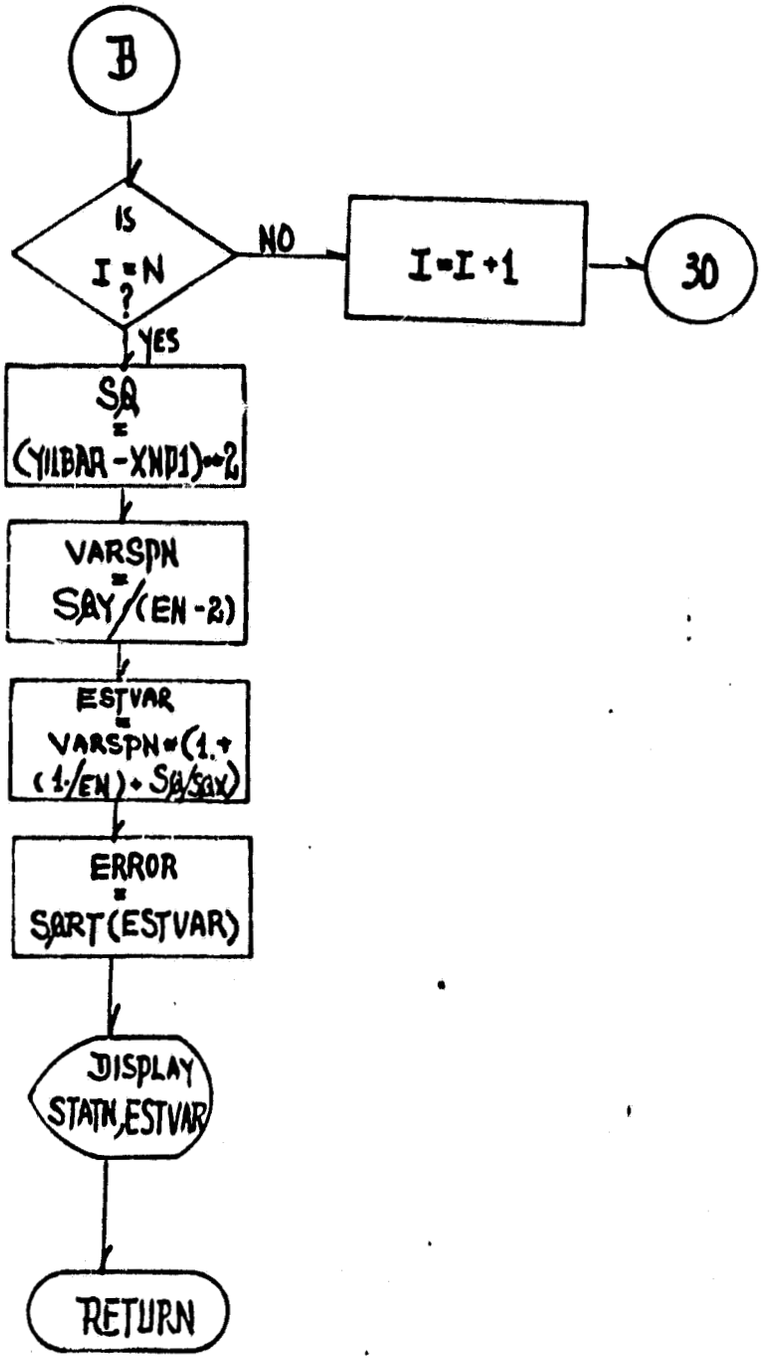
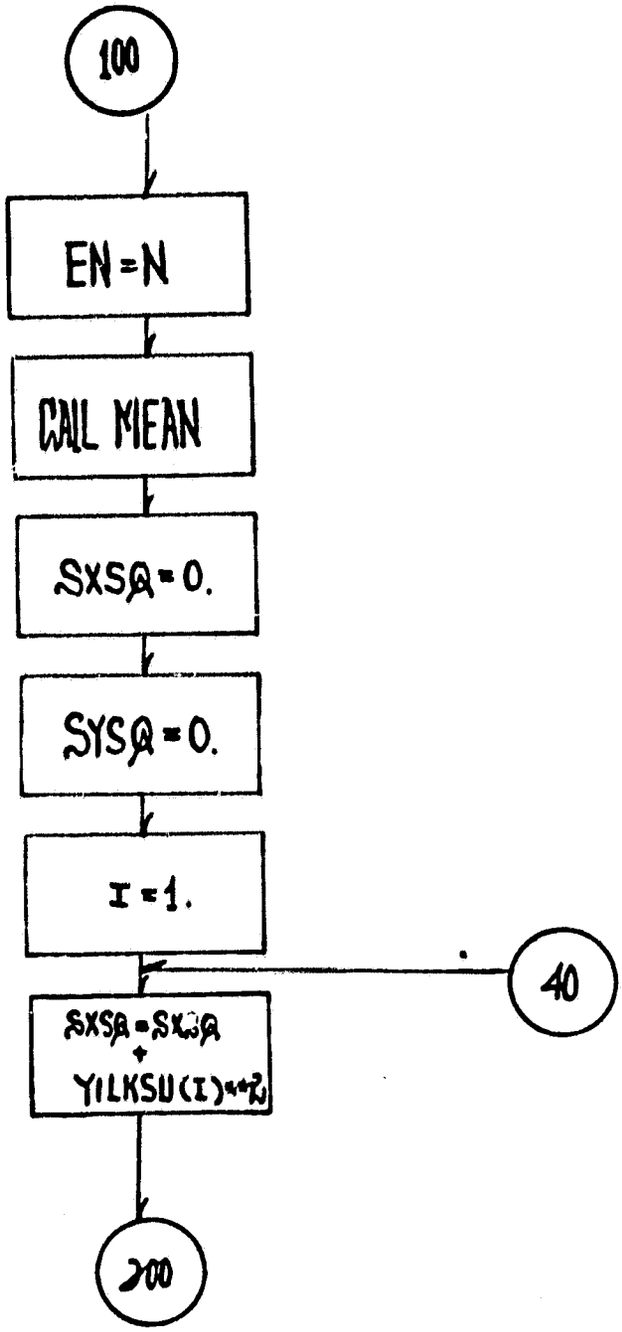

B
IS I = N ?
NO
I=I+1
30
YES
SQ = (YILBAR - XNP1)**2
VARSPN = SQY/(EN-2)
ESTVAR = VARSPN*(1.+(1./EN)+SQ/SQX)
ERROR = SQRT(ESTVAR)
DISPLAY STATN, ESTVAR
RETURN

FIGURE 3.2.5



FGIURE 3.2.6

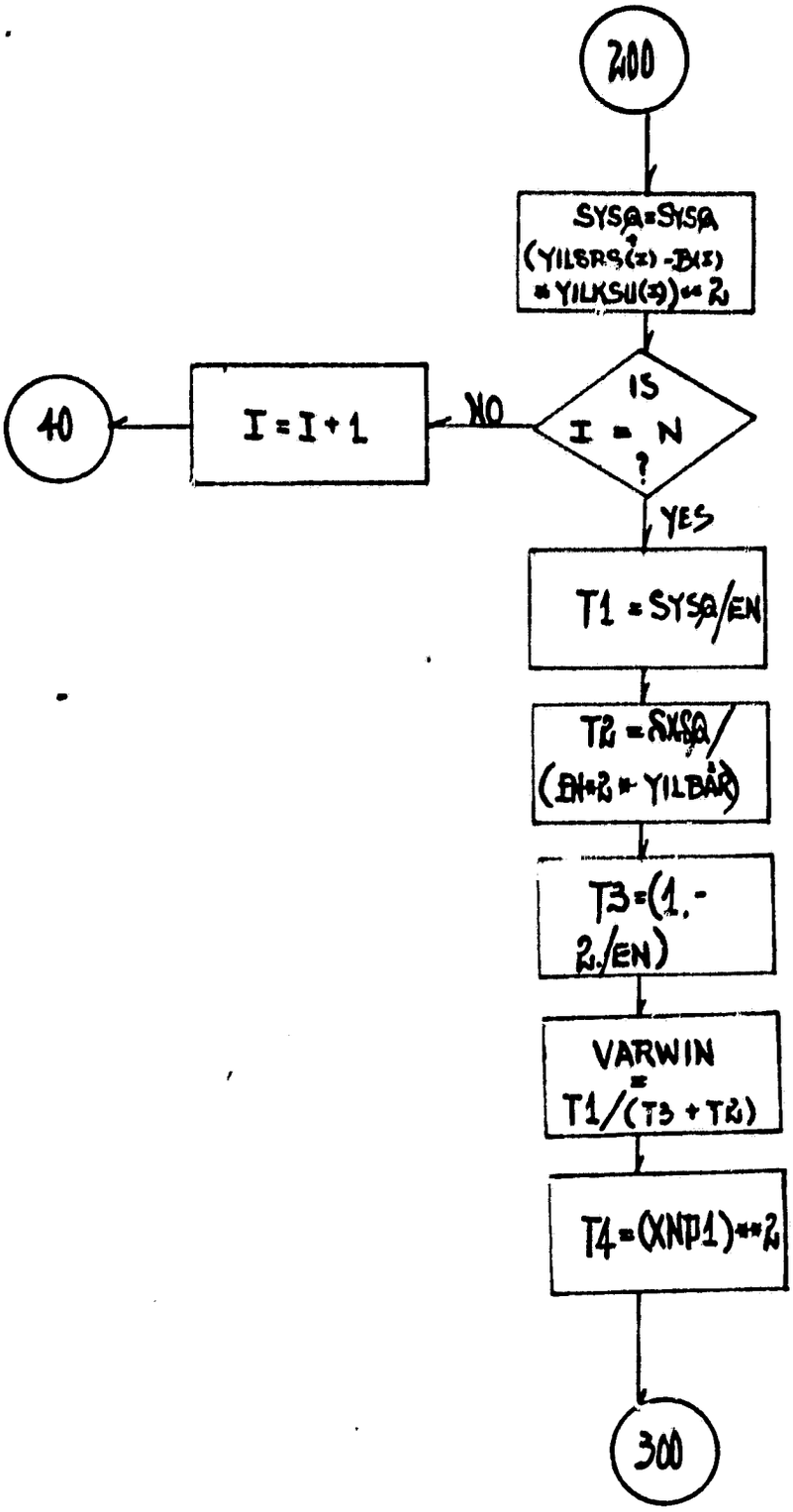

200
SYSQ=SYSQ
(YILSRS(I) -B(I)
*YILKSU(I))**2
IS
I = N
?
NO
I=I+1
40
YES
T1 = SYSQ/EN
T2 = SXSQ/
(EN*B**2 * YILBAR)
T3=(1.-
2./EN)
VARWIN
=
T1/(T3 + T2)
T4=(XNP1)**2
300

FIGURE 3.2.7

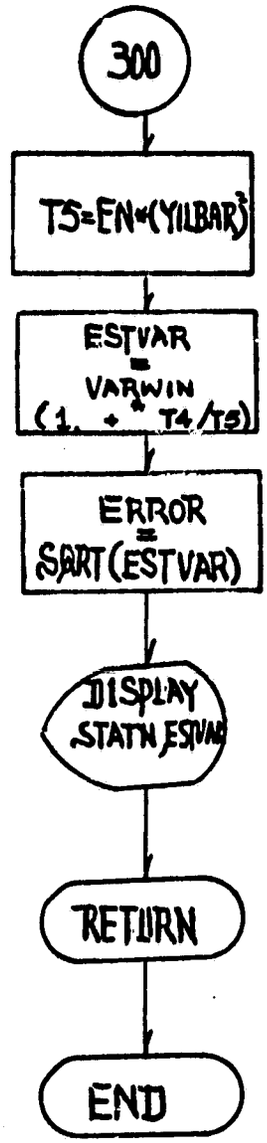
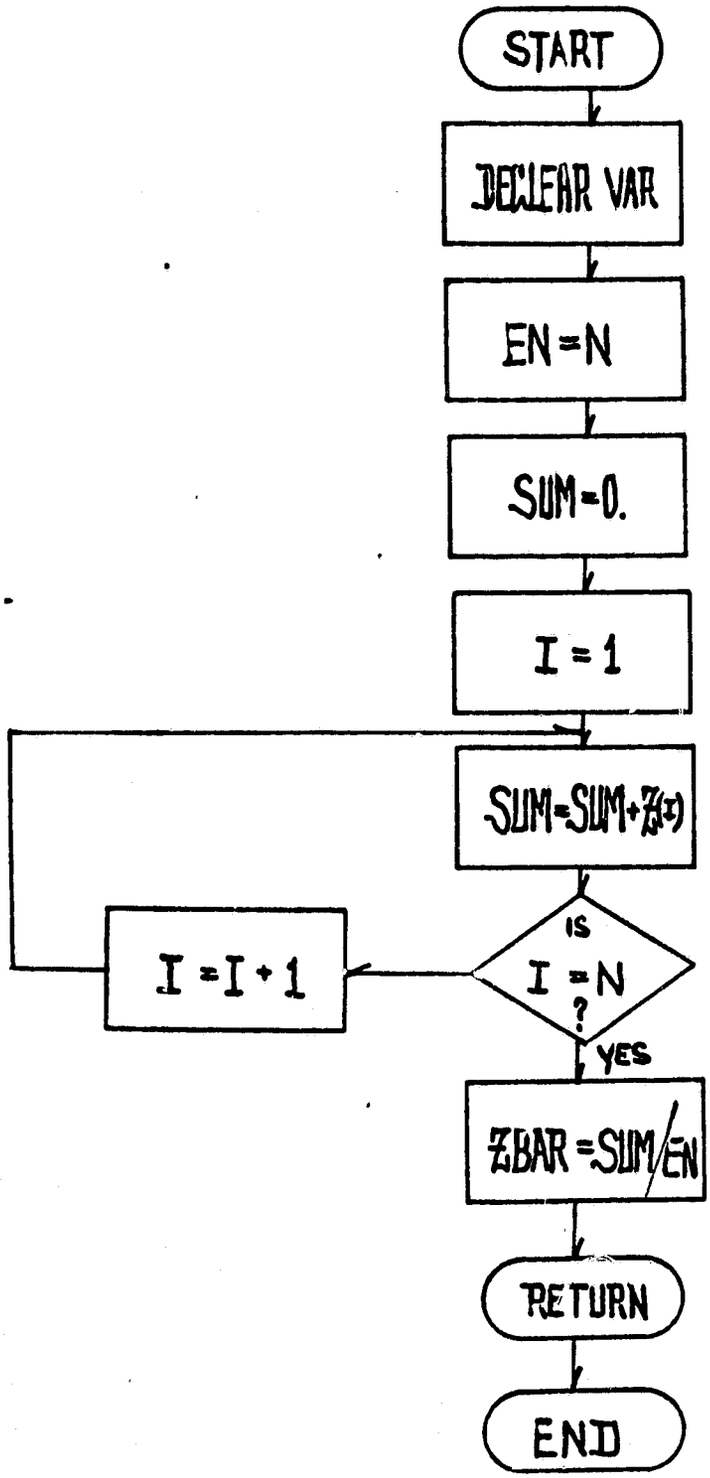

300
T5=EN*(YILBAR)
ESTVAR = VARWIN (1. + T4/T5)
ERROR = SQRT(ESTVAR)
DISPLAY STATN ESTVAR
RETURN
END

FIGURE 3.2.8

SUBROUTINE MEAN



3.2.3 OTHER PROGRAMS WITH MINOR CHANGES

This section describes minor changes to other subroutines. Program changes were made in each of three subroutines: WHYMOD, ESTYLD and OUTPUT. These changes were made to accomplish two basic purposes: change the regional yield estimation from a single multiplier form to a linear equation to provide interfacing with the variance calculation subroutine.

Subroutine WHYMOD, the general control routine for the model was modified for both of the above reasons. Statements were added to input the slope and intercept coefficients for the linear regional yield estimation equation and transfer these values to both the yield estimation subroutine (ESTYLD) and the variance estimation subroutine (VARIAN). Counters and a common block were added to save each year's regional yield estimate for transfer to the variance routine as each location is processed. Finally, a call to the variance subroutine was added so that this calculation will be made at the end of processing each location.

Subroutine ESTYLD, in which the estimated yields are computed, was modified to accept the slope and intercept coefficients (refer to Attachment C for lead card change) from WHYMOD. They are used in a linear equation to calculate the estimated regional (i.e. CRD) yields from the local WAC (weather and cultural practices component) values obtained from individual weather station data. These estimates are then transferred to WHYMOD for use by the variance routine. Both the WAC and regional yield estimates are also transferred to subroutine OUTPUT for printing.

Subroutine OUTPUT which controls and formats most printed and punched output from the model has been modified to print both the WAC and regional yields for each year as each location is processed. A sample of the format of the new output is given in attachment B. Modifications were thus made so that subroutine OUTPUT would accept both these yield estimates from subroutine ESTYLD.

ATTACHMENT A

PROGRAM LISTINGS

MAIN

```
      REAL LOCLAT,LOCANP,LOCLAT
      COMMON /VARDAT/ICAL,ISY,[illegible],LOCV,MKSU(20),MKSU(20),
     1               ILKSU(20),SKSYIL(79,20)
      COMMON /LOCTME/MAXMSN,LOCNOS(79),IMSNO(79),ISTDTY(79),ISTDTM(79),
     1 ISTDTD(79),IENDTY(79),IENDTM(79),IENDTD(79),LOCJAT(79),
     2 LOCANP(79),LOCLAT(79)
      COMMON /IOPARM/IFORSP,ICALCE,MODEL,IPRTAV,IPRWRV,IPUSMC,IPUWRV,
     1 IPUEST
      COMMON /CLOCK/FMULT,ISTAGE,CLKACC,CLKDAY,ICLKOP,NOFCLV,
     1 CLKVLS(10),ICLKOT(10)
      COMMON /MLCOM/MOACCD(12),MODDAY(12)
      COMMON /UNITNO/IW,IR,IERRS,IPU
      READ(2,5) ICALCE,MODEL,IPRTAV,IPRWRV,IPUSMC,IPUWRV,IPUEST,
     1 KUNIT,ICAL,MAXMSN
    5 FORMAT(9I1,I3)
      IPRM = 1
      IF (ICALCE.LT.0.OR.ICALCE.GT.1) GOTO 9000
      IPRM = 2
      IF (MODEL.LT.1.OR.MODEL.GT.2) GOTO 9000
      IPRM = 3
      IF (IPRTAV.LT.0.OR.IPRTAV.GT.1) GOTO 9000
      IPRM = 4
      IF (IPRWRV.LT.0.OR.IPRWRV.GT.1) GOTO 9000
      IPRM = 5
      IF (IPUSMC.LT.0.OR.IPUSMC.GT.3) GOTO 9000
      IPRM = 6
      IF (IPUWRV.LT.0.OR.IPUWRV.GT.1) GOTO 9000
      IPRM = 7
      IF (IPUEST.LT.0.OR.IPUEST.GT.1) GOTO 9000
      IPRM = 9
      IF(ICAL .LT. 0 .OR. ICAL .GT. 2) GO TO 9000
      IPRM = 10
      IF (MAXMSN.LT.1.OR.MAXMSN.GT.79) GOTO 9000
      DO 10 I = 1,79
        LOCNOS(I)=0
        IMSNO(I)=0
        ISTDTY(I)=0
        ISTDTM(I)=0
        ISTDTD(I)=0
        IENDTY(I)=0
        IENDTM(I)=1
        IENDTD(I)=0
        LOCJAT(I)=0.0
        LOCANP(I)=0.0
        LOCLAT(I)=0.0
   10 CONTINUE
      READ(2,7)(IMSNO(I),I=1,MAXMSN)
    7 FORMAT(10I7)
      READ(2,8)(LOCNOS(I),I=1,MAXMSN)
    8 FORMAT(18I4)
      READ(2,9)(ISTDTY(I),I=1,MAXMSN)
    9 FORMAT(24I3)
      READ(2,9)(ISTDTM(I),I=1,MAXMSN)
      READ(2,9)(ISTDTD(I),I=1,MAXMSN)
      READ(2,9)(IENDTY(I),I=1,MAXMSN)
      READ(2,9)(IENDTM(I),I=1,MAXMSN)
      READ(2,9)(IENDTD(I),I=1,MAXMSN)
      READ(2,11)(LOCLAT(I),I=1,MAXMSN)
   11 FORMAT(12F6.2)
      READ(2,11)(LOCJAT(I),I=1,MAXMSN)
      READ(2,11)(LOCANP(I),I=1,MAXMSN)
      IF (KUNIT.EQ.0) GOTO 20
      READ(2,3) [illegible],IFPMS,I[illegible]
                                     TO  GT. 79) GO TO 9010
```

ORIGINAL PAGE IS
OF POOR QUALITY

```
      IF (I<.LT.1.OR.I>.GT.99) GOTO 9010
      I2=1
      IF (I**5.LT.1.OR.I**5.GT.99) GOTO 9010
      I3=4
      IF (I**3.LT.1.OR.I**3.GT.99) GOTO 9010
      GOTO 30
   20 IR=5
      IW=6
      IERRS=4
      IPR=7
   30 MDACCD(1)=0
      MDACCD(2)=31
      MDACCD(3)=59
      MDACCD(4)=90
      MDACCD(5)=120
      MDACCD(6)=151
      MDACCD(7)=181
      MDACCD(8)=212
      MDACCD(9)=243
      MDACCD(10)=273
      MDACCD(11)=304
      MDACCD(12)=334
      MONDAY(1)=31
      MONDAY(2)=28
      MONDAY(3)=31
      MONDAY(4)=30
      MONDAY(5)=31
      MONDAY(6)=30
      MONDAY(7)=31
      MONDAY(8)=31
      MONDAY(9)=30
      MONDAY(10)=31
      MONDAY(11)=30
      MONDAY(12)=31
      NOFCLV=9
      CLKVLS(1)=0.0
      CLKVLS(2)=1.0
      CLKVLS(3)=1.5
      CLKVLS(4)=2.0
      CLKVLS(5)=2.5
      CLKVLS(6)=3.0
      CLKVLS(7)=3.5
      CLKVLS(8)=4.0
      CLKVLS(9)=5.0
      CLKVLS(10)=0.0
      IF(ICAL .EQ. 0) GO TO 35
      READ(2,31) NOYR,NDYR
   31 FORMAT(14,X,I2)
   32 FORMAT(I2,11(1)(X,F4.1))
   33 FORMAT(5X,10(X,F4.1))
         DO 34 K = 1,MAXMSN
         READ(2,32)NOCRD,(SRSYTL(K,KK),KK=1,10)
         IF(NOCRD .NE. K) GO TO 9005
         IF(NDYR .GT. 10) READ(2,33) (SRSYTL(K,KJ),KJ=11,NDYR)
   34    CONTINUE
   35 IF (ICALCF.EQ.1) GOTO 40
      IPUEST=0
      IPRTAV=0
   40 CALL SHY400
      GOTO 9999
 9000 WRITE(5,6) IPR
    6 FORMAT(' *** INVALID INPUT PARAMETER #',I3,
     1   ' ON INPUT UNIT FT02F001')
      GOTO 9999
 9005 WRITE(5,33)
```

```
      GO TO 9999
 6010 WRITE (6,13) IPRT
   13 FORMAT(' *** INVALID INPUT UNIT NUMBER SPECIFIED FOR UNIT #',I3)
 9999 STOP
      END
```

VARIAN

```
      SUBROUTINE VARIAN
C
C     ****************************************
C     ******** THE VARIANCE COMPUTATION ********
C     ********          FOR           ********
C     ******** THE SPRING & WINTER WHEAT ******
C     ********          OF            ********
C     ********       KSU MODEL        ********
C     ********          BY            ********
C     ********     BUDDY H JEUD       ********
C     ****************************************
C
C     THIS SUBROUTINE IS USE TO ESTIMATE THE VARIANCE OF THE SPRING
C     & WINTER WHEAT OF KSU MODEL
C     PROGRAM PARAMETERS,
C     N IS THE # OF YEARS OVER WHICH MAP IS DETERMINED
C     A IS THE INTERCEP OF THE PREDICTION  EQUATION
C     B IS THE SLOPE OF THE PREDICTION EQUATION OR THE VALUE OF THE
C     MAP FOR THE YIELD STRATA
C     YILSRS IS THE USDA REPORED YIELD
C     YILKSU IS THE KSU ESTIMATED YIELD
C     XNPI IS THE KSU ESTIMATED YIELD FOR THE CURRENT YEAR
C     ESTVAR IS THE ESTIMATED VARIABLE
C     ICAL IS THE MODEL OPTIONAL VALUE I.E. SPRING WHEAT IS 2.WINTER
C     WHEAT IS 1
C     YILMAR IS THE MEAN OF THE ESTIMATED YIELD
C
      COMMON /LOCINF/NAASN,LOCNOS(79),IYSSO(79),ISTDTY(79),ISTDTM(79),
     1 ISTUTD(79),IENDTY(79),IENDTM(79),IENDTD(79),LOCJAT(79),
     2 LOCANP(79),LOCLAT(79)
      COMMON /VARDAT/ICAL,INYR,NOYR,LOCV,AKSU(20),BKSU(20),
     1                YILKSU(20),SRSYIL(79,20)
      REAL A(20),B(20),YILSRS(20)
      N=NOYR-1
      DO 102 I=1,NOYR
      A(I)=AKSU(I)
      B(I)=BKSU(I)
      YILSRS(I)=SRSYIL(LOCV,I)
  102 CONTINUE
      XNPI=YILKSU(NOYR)
      IF(ICAL.EQ.1) GO TO 100
C     THE FOLLOWING SECTION IS FOR THE SPRING MODEL
      FN=N
      CALL MEAN(N,YILKSU,YILMAR)
      SOX=0.0
      SOY=0.0
      DO 200 I=1,N
      SOX=SOX+(YILKSU(I)-YILMAR)**2
      SOY=SOY+(YILSRS(I)-A(I)-B(I)*YILKSU(I))**2
  200 CONTINUE
      SO=(YILMAR-XNPI)**2
      VARSPN=SOY/(FN-2.)
      ESTVAR=VARSPN*((1./FN)+(SO/SOX))
      ERROR=SQRT(ESTVAR)
      WRITE(6,30)STATE,ESTVAR,ERROR
      WRITE(6,75) YILMAR,SOX,SOY,SO,VARSPN,ESTVAR
   75 FORMAT(//20X,'YILMAR = ',F4.2/
     *20X,'SOX = ',F4.2/
     *20X,'SOY = ',F4.2/
     *20X,'SO= ',F8.2/
     *20X,'VARSPN = ',F5.2/
     *20X,'ESTVAR = ',F8.2///)
      RETURN
```

```
      END
C     THE FOLLOWING SECTION IS FOR SINTEX MODEL
      CALL MEAN (N,YILKSU,YILBAR)
      SXSQ=0.0
      SYSQ=0.0
      DO 300 I=1,N
      SXSQ=SXSQ+YILKSU(I)**2
      SYSQ=SYSQ+(YILKS(I)-B(I)*YILKSU(I))**2
  300 CONTINUE
      T1=(SYSQ/FN)
      T2=SXSQ/((FN**2)*(YILBAR**2))
      T3=(1.-(2./FN))
      VARWIN=T1/(T3+T2)
      T4=(XL,P1)**2
      T5=FN*(YILBAR**2)
      ESTVAR=VARWIN*(1.+T4/T5)
      ERROR=SQRT(ESTVAR)
      WRITE(6,30) STATE,ESTVAR,ERROR
   30 FORMAT(//5X,'FOR STATE ',A3/54X,'THE ESTIMATED VARIANCE IS ',
     @F6.2/51X,'THE ERROR OF ESTIMATION IS ',F5.2//)
      WRITE(6,76) YILBAR,SXSQ,SYSQ,T1,T2,T3,T4,T5,VARWIN,ESTVAR
   76 FORMAT(//20X,'YILBAR = ',F6.2/
     @20X,'SXSQ = ',F6.2/
     @20X,'SYSQ = ',F6.2/
     @20X,'T1 = ',F6.2/
     @20X,'T2 = ',F6.2/
     @20X,'T3 = ',F6.2/
     @20X,'T4 = ',F6.2/
     @20X,'T5 = ',F6.2/
     @20X,'VARWIN = ',F6.2/
     @20X,'ESTVAR = ',F6.2//)
      RETURN
      END
      SUBROUTINE MEAN(N,Z,ZBAR)
C     THIS SUBPROGRAM WAS PREPARED BY BUDDY H JUN
C     'S SUBROUTINE IS USE TO CALCULATE THE AVERAGE OF A GIVEN
C     ESTIMATED YIELD OVER A PERIOD OF N YEAR
      REAL Z(20),ZBAR
      INTEGER N
      FN=N
      SUM=0.0
      DO 400 I=1,N
      SUM=SUM+Z(I)
  400 CONTINUE
      ZBAR=SUM/FN
      RETURN
      END
```

A-5

ATTACHMENT B

NEW LEAD CARDS READ BY MAIN

ATTACHMENT B

CARD 1 Values used for all locations being processed in a single computer run:

COL 1: Estimated yields ICALCE

= 0 Do not compute. Use input data card 8A.

= 1 Compute yields. Use input data card 8B.

= 2 Compute weather components. Use input data card 8B.

COL 2: Model for Estimated yields MODEL

= 1 Fall planted wheat model

= 2 Spring planted wheat model

COL 3: Printing of Average weather related variable values IPRTAV

= 0 Do not print

= 1 Do print

COL 4: Printing of weather related variables and estimated yields or weather components IPRWRV

= 0 Do not print

= 1 Do print

COL 5: Punching of soil moisture budget contents IPUSMC

= 0 Do not punch

= 1 Punch at planting does

= 2 Punch at break day.

= 3 Punch both days

COL 6: Punching of weather related variables IAUWRV

= 0 Do not punch
= 1 Punch all weather related variables
= 2 Punch # days/stage and
Precipitation/stage only

COL 7: Punching of estimated yields or weather components IPUEST

= 0 Do not punch
= 1 Punch estimated yields
= 2 Punch weather components

COL 8: Standard I/O Units KUNIT

= 0 Default to standard values
4 for errors
5 for reads
6 for writes
7 for punching

= 1 Lead card assigns values.

COL 9: Variance Model Flag ICAL

= 0 No Variance
= 1 Winter model
= 2 Spring model

Cols 10-12 Total number of locations to be processed MAXWSN

Card 2 Weather Station Numbers in order as on data tape.
IWSNO(I), I = 1, MAXWSN
Multiple cards with 10I7 format.

Card 3 Program location numbers in same order as weather station numbers. (users assigned)
LOCNOS(I), I = 1, MAXWSN
Multiple cards with 18I4 format.

Cards 4-9 are starting and ending dates for tape records in order by Weather Station. Each type card can have multiple card input with 24I3 formats.

Card 4 Starting Years
ISTDTY (I), I = 1, MAXWSN

Card 5 Starting Months
ISTDTM (I), I = 1, MAXWSN

Card 6 Starting Days
ISTDTD (I), I = 1, MAXWSN

Card 7 Ending Years
IENDDTY (I), I = 1, MAXWSN

Card 8 Ending Months
IENDTM (I) I = 1, MAXWSN

Card 9 Ending Days
IENDTD (I), I = 1, MAXWSN

Card 10 Location Latitude in correspondence with location numbers
LOCLAT (I), I = 1, MAXWSN
Multiple cards with 12F6.2 format.

Card 11 January Average Temperatures in correspondence with location numbers.
LOCJAT (I), I = 1, MAXWSN
Same format as card 10.

Card 12 Average Annual Precipitation in correspondence with location numbers.
LOCANP (I), I = 1, MAXWSN
Same format as card 10.

If the variance model is run the following cards are necessary.

Card 13 The beginning processing year and the number of years to process (minimum 10 yrs)
INYR, NOYR
Format (I4, X, I2)

Card Sets 14 USDA data for each crop reporting district (CRD) desiring a comparison with KSU data. Must be in order to relate to WSN's.

Card 1 NOCRD (CRD order from 1 Tø MAXWSN)
SRSYIL (NOCRD, I), I-1,10. Ten years of USDA yield data Format (I2,eX,10(X,F4,1))

Card 2 Used only if more than 10 years of data are tested (max-20)
SRSYIL(NOCRD,I), I=11,NOYR. Over 10 years of USDA data
Format (5X,10(X,F4.1)

ATTACHMENT C

MODIFIED LEAD CARD FOR STOP-INTERCEPT INPUT

Refer to document 2 under Applicable Documents section.

Add to lead card 8B the following input.

COLUMNS 69-73: INTERCEPT for regional yield equation (punch decimal). When a Management and productivity factor, MAP, is used these columns will contain 0.0

COLUMNS 75-79: SLOPE for regional yield equation (punch decimal). When a MAP factor is used input in the columns instead of COLUMNS 59-62.