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DECUS NO.	FOCAL8-69
TITLE	ANALYSIS OF VARIANCE
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SOURCE LANGUAGE	FOCAL

TITLE: ANALYSIS OF VARIANCE

ABSTRACT: This program is designed to solve the analysis of variance problem for the two-factor completely randomized design, and to table the results of the analysis in a form acceptable for publication in many scientific journals. Both the input and output formats are designed for simplicity and ease of operation.

An alternate form of the program makes possible the evaluation of either one-factor or two-factor designs.

OPERATION: Both forms of the program must be loaded without the extended functions. The following equations are used:

$$\begin{aligned}
 C \text{ (a calculated correction term)} & : \frac{(\sum^n \sum^a \sum^b y)^2}{nab} \\
 A \text{ (row variable)} & : \frac{\sum^a (\sum^n \sum^b y)^2}{nb} - C \\
 B \text{ (column variable)} & : \frac{\sum^b (\sum^n \sum^a y)^2}{na} - C \\
 AB \text{ (interaction)} & : \frac{\sum^a \sum^b (\sum^n y)^2}{n} - C - A - B \\
 T \text{ (total variance)} & : \sum^n \sum^a \sum^b y^2 - C \\
 S/AB \text{ (within cells variance)} & : T - C - A - B - AB
 \end{aligned}$$

The program is initiated by typing "GO" followed by a carriage return. The carriage return is the terminal character for all questions in the program. The program will then ask "N" which should be answered by the number of entries in each cell (the program is designed only for equal values in each cell, hence "N" is asked only one time). This is followed by questions of "No. of Rows" and "No. of Columns" which should be answered appropriately. Input is then made into the samples which are identified by a signed pair number of the following form: (R,C) where R=the row number of the sample, and C=the column number of the sample.

By responding with a 1 to either "No. of Rows" or "No. of Columns" in Format Two, the program performs a one factor analysis.

SPECIAL OPERATION: The following modifications to FOCAL (DEC-08-AJAD-PB) should be made in order for the input and output formats to retain their neat appearance.

1261/0200 : Eliminates printing of "="
1262/0200 : Eliminates printing of ":"

RESTRICTIONS: The maximum size of input into Format One is approximately 27 cells of data. The use of Format Two reduces this to approximately 20 cells. The number of entries within each cell (N) is for all practical purposes, unlimited.

The output format is set at %7.02, i.e., seven significant digits with two places to the right of the decimal point. There may be occasions when this will cause some loss of accuracy, and the format may be changed to floating point by modification of the appropriate statements in command section 3.0 in either program.

ANALYSIS OF VARIANCE-FORMAT ONE

C-FOCAL , 8/68

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Ø1.1Ø ERASE
Ø1.2Ø A "N      "P;A "NO. OF ROWS      "H
Ø1.21 A "NO. OF COLUMNS  "V,!!
Ø1.3Ø F  N=1,H;DO 4

Ø2.1Ø F  B=1,H;DO 7
Ø2.2Ø F  BB=1,V;S SS=BB-V;DO 9
02.25 F  B=1,H;S J1=E(B)+J1
Ø2.3Ø S  C=J1↑2/(H*V*P)
Ø2.35 F  B=1,H;S JJ=E(B)↑2+JJ
Ø2.4Ø S  V1= [JJ/(V*P)]-C
Ø2.45 F  BB=1,V;S J2=EE(BB)↑2+J2
Ø2.5Ø S  V2=[J2/(H*P)]-C
Ø2.65 F  U=1,H*V;S L=A(U)↑2+L
Ø2.7Ø S  V3=[L/P]-C-V1-V2
Ø2.75 F  J=1,R;S J3=G(J)+J3
Ø2.81 S  T=J3-C
Ø2.9Ø S  ER=T-V1-V2-V3

Ø3.1Ø T  !!!, "ANALYSIS OF VARIANCE TABLE",!!!
Ø3.2Ø T  "SOURCE      SS      DF      MS      F",!!
Ø3.3Ø T  %7.Ø2 TOTAL  "T, (H*V*P)-1,!!
Ø3.4Ø T  "ROWS      ",V1, H-1, V1/(H-1), (V1/(H-1))/<ER/[H*V*(P-1)]>,!!
Ø3.5Ø T  "COLUMNS  ",V2, V-1, V2/(V-1), (V2/(V-1))/<ER/[H*V*(P-1)]>,!!
Ø3.6Ø T  "R X C      ",V3, (H-1)*(V-1), V3/<(H-1)*(V-1)>
Ø3.65 T  (V3/<(H-1)*(V-1)>)/<ER/[H*V*(P-1)]>,!!
Ø3.7Ø T  "ERROR VAR ",ER,[ H*V*(P-1)], ER/<H*V*(P-1)>,!!
Ø3.8Ø QUIT

Ø4.1Ø F  O=1,V;S R=R+1;DO 5

Ø5.1Ø T  %1, "SAMPLE ("N, ", "O, ")",!
Ø5.2Ø F  Q=1,P;DO 6

Ø6.1Ø A  X(R);S A(R)=X(R)+A(R);S G(R)=X(R)↑2+G(R)

Ø7.1Ø F  D=1,V;S S=S+1;S E(B)=A(S)+E(B)

Ø9.1Ø F  DD=1,H;S SS=SS+V;S EE(BB)=A(SS)+EE(BB)
*
```

30
N 8
NO. OF ROWS 2
NO. OF COLUMNS 3

SAMPLE (1, 1)

7
33
26
27
21
6
14
19

SAMPLE (1, 2)

6
11
11
18
14
18
19
14

SAMPLE (1, 3)

9
12
6
24
7
10
1

SAMPLE (2, 1)

42
25
8
28
30
22
17
32

SAMPLE (2, 2)

28
6
1
15
9
15
2
37

SAMPLE (2, 3)

13

18

23

1

3

4

6

2

ANALYSIS OF VARIANCE TABLE

SOURCE	SS	DF	MS	F
TOTAL	4987.91	47.00		
ROWS	40.33	1.00	40.33	0.49
COLUMNS	1387.04	2.00	693.52	8.49
R X C	127.54	2.00	63.77	0.78
ERROR VAR	3433.00	42.00	81.74	

*

ANALYSIS OF VARIANCE-FORMAT TWO

C-FOCAL , 8/68

```

Ø1.1Ø ERASE
Ø1.2Ø A "N      "P;A "NO. OF ROWS      "H
Ø1.21 A "NO. OF COLUMNS "V,!!
Ø1.3Ø F  N=1,H;DO 4

Ø2.1Ø F  B=1,H;DO 7
Ø2.2Ø F  BB=1,V;S SS=BB-V;DO 9
Ø2.25 F  B=1,H;S J1=E(B)+J1
Ø2.3Ø S  C=J1↑2/(H*V*P)
Ø2.35 F  B=1,H;S JJ=E(B)↑2+JJ
Ø2.4Ø S  V1=[JJ/(V*P)]-C
Ø2.45 F  BB=1,V;S J2=EE(BB)↑2+J2
Ø2.5Ø S  V2=[J2/(H*P)]-C
Ø2.65 F  U=1,H*V;S L=A(U)↑2+L
Ø2.7Ø S  V3=[L/P]-C-V1-V2
Ø2.75 F  J=1,R;S J3=G(J)+J3
Ø2.81 S  T=J3-C
Ø2.9Ø S  ER=T-V1-V2-V3

Ø3.1Ø T  !!!!, "ANALYSIS OF VARIANCE TABLE",!!!
Ø3.2Ø T  "SOURCE      SS      DF      MS      F",!!
Ø3.3Ø T  %7.Ø2 "TOTAL      "T, (H*V*P)-1,!!
Ø3.35 IF  (H-1) 3.4,3.5,3.4
Ø3.4Ø T  "ROWS      ",V1, H-1, V1/(H-1), (V1/(H-1))/<ER/[H*V*(P-1)]>,!!
Ø3.45 IF  (V-1) 3.5,3.7,3.5
Ø3.5Ø T  "COLUMNS "V2, V-1, V2/(V-1), (V2/(V-1))/<ER/[H*V*(P-1)]>,!!
Ø3.55 IF  ((H-1)*(V-1)) 3.6,3.7,3.6
Ø3.6Ø T  "R X C      ",V3, (H-1)*(V-1), V3/<(H-1)*(V-1)>
Ø3.65 T  (V3/<(H-1)*(V-1)>)/<ER/[H*V*(P-1)]>,!!
Ø3.7Ø T  "ERROR VAR ",ER, [H*V*(P-1)], ER/<H*V*(P-1)>,!!
Ø3.8Ø QUIT

Ø4.1Ø F  O=1,V;S R=R+1;DO 5

Ø5.1Ø T  %1, "SAMPLE ("N, ", ", O, ")",!
Ø5.2Ø F  Q=1,P;DO 6

Ø6.1Ø A  X(R);S A(R)=X(R)+A(R);S G(R)=X(R)↑2+G(R)

Ø7.1Ø F  D=1,V;S S=S+1;S E(B)=A(S)+E(B)

Ø9.1Ø F  DD=1,H;S SS=SS+V;S EE(BB)=A(SS)+EE(BB)

```

*

*GO

N 8

NO. OF ROWS 1

NO. OF COLUMNS 5

SAMPLE (1, 1)

5.8

5.1

5.7

5.9

5.6

5.4

5.3

5.2

SAMPLE (1, 2)

6.0

6.1

6.6

6.5

5.9

5.9

6.4

6.3

SAMPLE (1, 3)

6.3

5.5

5.7

6.∅

6.1

6.2

5.8

5.6

SAMPLE (1, 4)

6.4

6.4

6.5

6.1

6.6

5.9

6.7

6.∅

SAMPLE (1, 5)

5.7

5.9

6.5

6.3

6.2

6.4

6.∅

6.3

ANALYSIS OF VARIANCE TABLE

SOURCE	SS	DF	MS	F
TOTAL	6.33	39.00		
COLUMNS	3.48	4.00	0.87	10.72
ERROR VAR	2.84	35.00	0.08	

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