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| DECUS NO. | 12-38B |
| TITLE | HISTOGRAM AND TWO-FACTOR ANALYSIS OF VARIANCE |
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| SOURCE LANGUAGE | FOCAL-12 |

# HISTOGRAM AND TWO-FACTOR ANALYSIS OF VARIANCE

DECUS Program Library Write-up DECUS NO. 12-38B

Hardware Requirements: PDP-12A, two TUS5 tape units, 8K memory.

Language: Focal-12

The Program: Performs three primary functions which may be executed singly or in any desired combination i.e., data storage, histogram construction, and analysis of variance computation. Accepts integer data entered via teletype and stores these data on LINC tape using the FOCAL-12-DIAL index. Displays minimum, second smallest, second largest, and maximum values of the data array. Displays a histogram of the integers on request using the PDP-12 scope. Computes a two-factor analysis of variance for a completely randomized, repeated measures, or mixed design if requested. This program package is composed of the following program segments: $2ANOVA, $3HSTGM, $4INT, $5GPH, %TFAV, %STFAV, %MD, %4MD, %RM, %5RM, %CR, and %6CR. The package will handle a maximum of 6ØØ numbers at one time and the largest number of intervals that the histogram may have is 95.

Operation: Place the LINC tape containing FOCAL-12 and the program package on unit Ø. Place a second LINC tape containing DIAL on unit 1. Call DIAL, load FOCAL-12, then type "L G,$2ANOVA,Ø". The space bar is the terminal character for all lines in the program package. Unless otherwise indicated it should be typed after responding to each question in the programs. For any questions requiring a yes or no answer, the correct response is either "Y" or "N" (followed by striking the space bar). After the program has been executed once, on following runs the display REPLACE? will appear on the scope whenever the program is updating data files contained in the DIAL library. When this question flashes on the screen respond by typing "R" (and nothing else-no terminal character is needed here). The program will continue to be executed.

$2ANOVA:

NO. LEVELS OF A=: (response varies according to design of experiment)
a) with data from a two-factor repeated measures design (c.f. Meyers, Fundamentals of Experimental Design, p. 17Ø), respond with the number of levels of the treatment variable A i.e., the number of times that a subject was tested under the first treatment condition. It is necessary that this number be equal for all subjects.
b) with data from a two-factor completely randomized design (c.f. Meyers, pp. 81-82), respond with the number of levels of the treatment variable A-the first treatment variable.
c) with data from a mixed design (c.f. Meyers, p. 174), respond with the number of levels of the between-subjects variable A.
d) for all other designs respond with a number that is a factor of the total number of data points to be entered i.e., if 5Ø numbers are to be entered the response could be 5, then the responses to the next two questions would be either 2 and 5, or 5 and 2. The product of the

$2ANOVA (con't):
numbers given as answers to the first three questions must equal the total number of data points to be entered.

NO. LEVELS OF B=: (response depends upon experimental design)
a) with data from a two-factor repeated measures design respond with the number of levels of the treatment variable B i.e., the number of times that a subject was tested under the second treatment condition. It is necessary that this number be equal for all subjects.
b) with data from a two-factor completely randomized design respond with the number of levels of the treatment variable B, the second treatment variable.
c) with data from a mixed design, respond with the number of levels of the within-subjects variable B i.e., the number of times that a subject was tested under this variable.
d) for all other designs respond with that number which, when multiplied with the numbers given in response to the first and third questions, will equal the total number of data points to be entered on tape or brought down from storage.

HOW MANY SUBJECTS?: (response depends upon experimental design)
a) for a two-factor repeated measures design, respond with the total number of subjects tested.
b) for a two-factor completely randomized design, respond with the number of subjects tested at one AB combination i.e., the number of subjects in one group (it is assumed that N is equal for each of the AB groups)
c) for a mixed design, respond with the number of subjects tested at one of the levels of the between-subjects variable A.
d) for other designs respond with the third factor, which when multiplied with the numbers given as responses to the first two questions, will equal the total number of data points to be entered on tape or brought down from storage.

ARE DATA ON TAPE?:
"Y" response causes computer to locate and display on the scope data previously stored on LINC tape, eight numbers at a time. The display will be unchanged until the operator has checked it for errors and has typed line feed to advance the display. If any errors are discovered in the data list at this time, the ordinal position of these entries should be recorded so that later modification may be made.
"N" response will make and open a 10 block data file on unit 1. The scope will clear and a colon (:) will appear on the screen after which the first number in the data array should be typed followed by the terminal character. Colons will continue to appear on the scope as long as more data are to be entered. (Remember to type the terminator after each entry.)
The order in which the data are entered is determined by the experimental design.
a) for a two-factor repeated measures design--enter the data from one subject at a time in the following manner.
Assume 2 subjects (S) are tested at each of 3 levels of treatment condition B while being tested at each of 2 levels of treatment of treatment condition A. The data matrix would be constructed in this fashion:

$2ANOVA (con't):

| | $A_1$ | | | $A_2$ | | |
|---|---|---|---|---|---|---|
| | $B_1$ | $B_2$ | $B_3$ | $B_1$ | $B_2$ | $B_3$ |
| $S_1$ | | | | | | |
| $S_2$ | | | | | | |

These 12 scores are to be entered in this order:

| | | | |
|---|---|---|---|
| first: | $S_1A_1B_1$ | seventh: | $S_2A_1B_1$ |
| second: | $S_1A_1B_2$ | eighth: | $S_2A_1B_2$ |
| third: | $S_1A_1B_3$ | ninth: | $S_2A_1B_3$ |
| fourth: | $S_1A_2B_1$ | tenth: | $S_2A_2B_1$ |
| fifth: | $S_1A_2B_2$ | eleventh: | $S_2A_2B_2$ |
| sixth: | $S_1A_2B_3$ | twelfth: | $S_2A_2B_3$ |

b) for a two-factor completely randomized design--enter the data from the first subject in each of the treatment groups, then from the second subject in each group and so on until the scores from the last subject in each group have been entered. Assume 12 subjects (S) are randomly assigned to the different combinations of 3 levels of treatment B with 2 levels of treatment A. There will be 6 treatment groups with 2 different subjects in each group.

| | $A_1$ | | | $A_2$ | | |
|---|---|---|---|---|---|---|
| | $B_1$ | $B_2$ | $B_3$ | $B_1$ | $B_2$ | $B_3$ |
| | $S_1$ | $S_3$ | $S_5$ | $S_7$ | $S_9$ | $S_{11}$ |
| | $S_2$ | $S_4$ | $S_6$ | $S_8$ | $S_{10}$ | $S_{12}$ |

These 12 scores must be entered in this order:

| | | | |
|---|---|---|---|
| first: | $S_1A_1B_1$ | seventh: | $S_2A_1B_1$ |
| second: | $S_3A_1B_2$ | eighth: | $S_4A_1B_2$ |
| third: | $S_5A_1B_3$ | ninth: | $S_6A_1B_3$ |
| fourth: | $S_7A_2B_1$ | tenth: | $S_8A_2B_1$ |
| fifth | $S_9A_2B_2$ | eleventh: | $S_{10}A_2B_2$ |
| sixth: | $S_{11}A_2B_3$ | twelfth: | $S_{12}A_2B_3$ |

c) for a mixed design--enter all the scores from the first subjects at each of the levels of the between-subjects variable A, then all the scores from the second subjects at each of the levels of A and so on until the scores from the last subjects at all levels of A have been entered. Assume 4 subjects are randomly assigned to be tested at one of two of the levels of A (the between-subjects variable) while being tested at all three levels of B (the within-subjects variable).

| | $A_1$ | | |
|---|---|---|---|
| | $B_1$ | $B_2$ | $B_3$ |
| $S_1$ | | | |
| $S_2$ | | | |

| | $A_2$ | | |
|---|---|---|---|
| | $B_1$ | $B_2$ | $B_3$ |
| $S_3$ | | | |
| $S_4$ | | | |

These 12 scores must be entered in this order:

| | | | |
|---|---|---|---|
| first: | $S_1A_1B_1$ | seventh: | $S_3A_1B_1$ |
| second: | $S_1A_1B_2$ | eighth: | $S_3A_1B_2$ |
| third: | $S_1A_1B_3$ | ninth: | $S_3A_1B_3$ |
| fourth: | $S_3A_2B_1$ | tenth: | $S_4A_2B_1$ |
| fifth: | $S_3A_2B_2$ | eleventh: | $S_4A_2B_2$ |
| sixth: | $S_3A_2B_3$ | twelfth: | $S_4A_2B_3$ |

S2ANOVA (con't)

d) all other designs--the order of entry is immaterial. After all data have been entered they will be displayed on the scope so that they may be checked for orders during entry as described above.

TYIE "C" TO CONTINUE: Indicates the end of a data list. "C" response will cause the program to continue.

MODIFY DATA?:

"N" response causes computer to by-pass the correction sequence and begin computing the minimum, maximum, second largest, and second smallest values in the data array.

"Y" response initiates the correction process.

GIVE NO. OF INCORRECT ENTRY: respond with the ordinal position (x) of the incorrect entry in the data list.

FØ(X)=_____The existing value of the $x^{th}$ number in the data array (FØ) is displayed.

NEW VALUE=: respond with the correct value of FØ(X).

MODIFICATION COMPLETE?:

"N" response indicates that more corrections are to be made and displays GIVE NO. OF INCORRECT ENTRY: again, which begins the correction sequence.

"Y" response will display the data array on the scope once more for a final check. After typing "C" to continue, a response of "N" to MODIFY DATA?: causes the program to go on with a corrected data list.

MIN=_____the value of the smallest number in the data array.
S2=_____the value of the second smallest number in the data array.
MAX=_____the value of the largest number in the data array.
M2=_____the value of the second largest number in the data array.

WANT A HISTOGRAM?:

"N" response indicates that the data are not to be displayed as a histogram.

"Y" response will initiate the histogram sequence of the program package. It will take 12 minutes for the computer to generate a histogram from an array of 6ØØ numbers with values ranging from Ø to 2Ø47 with 95 intervals. With less data and/or fewer intervals, the process is more rapid.

ANALYZE DATA?: This is displayed at this point only if an "N" response was given to WANT A HISTOGRAM?:.

"N" response will cause the program to halt.

"Y" response will cause the computer to skip the histogram segments and initiate the first computations for the analysis of variance.

S3HSTGM:

Initiated by a "Y" response to WANT A HISTOGRAM?:
HISTOGRAM

S3HSTGM (con't):

CHOOSE UPPER BOUNDARY

MAX=_____the value of the largest number in the data array.

NEXT MAX=_____the value of the second largest number in the array.

UB /=MAX the upper boundary selected must not exceed MAX.

UB=: respond with the value selected as the histogram's upper boundary.

CHOOSE LOWER BOUNDARY

MIN=_____the value of the smallest number in the data array.

NEXT MIN=_____the value of the second smallest number in the array.

LB /=MIN the lower boundary selected must not be less than MIN.

LB=: respond with the value selected as the histogram's lower boundary.

HOW MANY INTERVALS?: Enter the number of intervals that the histogram is to contain. Since the program handles only integer data, the programmer is cautioned not to request a number of intervals greater than UL-LB. This will prevent distortion of the histogram which would result from asking how many integers fall in intervals not containing any integers. In any case, the number of intervals must not exceed 95. One or two of the intervals may be overflow intervals depending upon the values selected for UL and LE. That is, if the programmer requests 8Ø intervals and chooses for UB and LB, MAX and MIN respectively he will have a histogram that consists of 8Ø equal intervals. However, if UB is less than MAX, the uppermost interval will be an overflow interval of width MAX-UE. The remaining 79 intervals will be equally spaced between MIN (which=LL in this particular instance) and UB. Similarily, if LB is greater than MIN (and UL=MAX), the lowermost interval will be an overflow interval of width LB-MIN. The remaining 79 intervals will be equally spaced between LB and MAX (UB). If both UB is less than MAX and LE is greater than MIN, there will be an overflow interval at each end of the histogram with 78 equally spaced intervals falling between UL and LB.

If the programmer chooses a lower boundary which is smaller than MIN and/or an upper boundary which is larger than MAX he will be given the message(s): LB IS TOO SMALL

LB / = (MIN) LB cannot be less than MIN.

LB=: Enter a new value for LB.

and/or:

UB IS TOO LARGE

UB /=(MAX) UL cannot be greater than MAX.

UB=: Enter a new value for UB.

When the values of UB and LB are within the proper range, the next program in the package will be initiated automatically.

S4INT:

Initiated by S3HSTGM. This segment functions to compute and display on the scope the uppermost boundaries (the X-coordinates) of the intervals in the histogram. The locations of the X-coordinates are computed by dividing the range between UL and LB by the number of intervals desired (less any overflow intervals). If the display of the values of the X-coordinates fills the scope before all coordinates have been shown, advance the display by typing line feed.

TYPE "C" TO CONTINUE: Indicates the end of the listing of coordinates. "C" response will cause the program to continue and intiiate the next program segment.

S5GPH:

Initiated by S4INT. This segment functions to compute the Y-coordinates for the histogram and display the completed graph on the scope. The Y-coordinates represent the number of points falling at or below the X values for each interval.

ANALYZE DATA?:

"N" response brings the program to a halt.

"Y" response will initiate the next sequence which computes a standard one-factor analysis of variance.

%TFAV:

This segment is initiated by a "Y" response to the question ANALYZE DATA? in either the S2ANOVA or S5GPH program segments. It functions to calculate preliminary sums and sums of squares to be used in the computation of sums of squares, mean squares and F-ratios for the analysis of variance. The summations performed by this segment are:

$\sum_{N}\sum_{A}\sum_{B} Y^2$

$\sum_{N}\sum_{A}\sum_{B} Y$

$\sum_{N}\sum_{B} Y$

$\sum_{B} Y$

$\sum_{A} Y$

%STFAV:

Initiated by %TFAV, this segment completes the computation of the preliminary sums for the analysis of variance. These summations are:

$\sum_{N}\sum_{A} Y$

$\sum_{N} Y$

$\sum_{A}\sum_{B} Y$

SPECIFY DESIGN displayed after completion of summations.

1=MIXED DESIGN

2=REPEATED MEASURES

3=COMPLETELY RANDOMIZED

DESIGN NO.=: respond with the number corresponding to the design that conforms to your data.

%MD:

Initiated by a response of "2" to DESIGN NO.=: in %STFAV. This segment computes the analysis of variance for a two-factor repeated measures design. It computes the F ratios for the treatment conditions (A and B) and their interaction (AB). The formulae employed are described in Meyers, p. 171.

% 4MD:
Initiated by %MD. This segment prints out a table with the results of the analysis of variance listing the sources of variance (SV), degrees of freedom (DF), sums of squares (SS), mean squares (MS), and F ratios.

%RM:
Initiated by a response of "2" to DESIGN NO.=: in %STFAV. This segment computes the analysis of variance for two-factor repeated measures design. It computed the F ratios for the treatment conditions (A and B) and their interaction (AB). The formulae employed are described in Meyers, p. 171.

% 5RM:
Initiated by %RM, this segment prints out a table containing the results of the analysis of variance listing the sources of variance (SV), degrees of freedom (DF), sums of squares (SS), mean squares (MS), and F ratios.

%CR:
Initiated by a response of "3" to DESIGN NO.=: in %STFAV. This segment computes the analysis of variance for a two-factor completely randomized design. It computes F ratios for the treatment conditions (A and B) and and their interaction (AB). Formulae employed are described in Meyers, p. 87.

% 6CR:
Initiated by %CR, this segment prints out a table containing the results of the analysis of variance listing the sources of variance (SV), degrees of freedom (DF), sums of squares (SS), mean squares (MS), and F ratios.

```
*L S,$2ANOVA,0
*W
C FOCAL-12

01.01 O S;A "NO. LEVELS OF A="NA,!,"NO.LEVELS OF B="NB,!
01.02 A "HOW MANY SUBJECTS?"NS,!;S TNS=NA*NB*NS
01.11 A "ARE DATA ON TAPE?"ANS;O C;I (ANS-0Y)2.01,2.05,2.01

02.01 L M,10,D3,1;L O,F3,I,D3,1;F J=1,TNS;A F3(J)
02.04 GOTO 2.06
02.05 L O,F3,I,D3,1
02.06 O C;T !;F J=1,TNS;T J," ",F3(J),!!!!
02.07 A "TYPE 'C' TO CONTINUE"C;O C
02.09 A "MODIFY DATA?"W;O C;I (W-0Y)2.20,2.10,2.20
02.10 A "GIVE NO. OF INCORRECT ENTRY"X,!;T "F3(",X,")=",F3(X),!
02.11 A "NEW VALUE="Z,!;S F3(X)=Z;O C
02.12 A "MODIFICATION COMPLETE?"X,!;I (X-0N)2.06,2.10,2.06
02.20 S MAX=F3(1);S M2=1;S MIN=F3(1);S S2=2047;F K=2,TNS;D 3
02.24 GOTO 4.01

03.10 I (MAX-F3(K))3.14,3.16,3.16
03.14 S M2=MAX;S MAX=F3(K);GOTO 3.26
03.16 I (F3(K)-MIN)3.17,3.22,3.22
03.17 I (M2-MIN)3.18,3.20,3.20
03.18 S M2=F3(K);GOTO 3.20
03.20 S S2=MIN;S MIN=F3(K);R
03.22 I (M2-F3(K))3.24,3.26,3.26
03.24 S M2=F3(K);GOTO 3.26
03.26 I (F3(K)-S2)3.28,3.28;R
03.28 S S2=F3(K);R

04.01 T "MIN=",MIN,!,"S2=",S2,!,"MAX=",MAX,!,"M2=",M2,"
04.02 L M,2,D4,1
04.12 L O,F4,F,D4,1;S F4(1)=MAX;S F4(2)=M2;S F4(3)=MIN;S F4(4)=S2
04.13 S F4(5)=NS;S F4(6)=NA;S F4(7)=TNS;S F4(8)=NB;L C,F4;L C,F3
04.22 T !!;A "WANT A HISTOGRAM?"ANS,!;O C;I (ANS-0Y)4.24,4.26,4.24
04.24 A "ANALYZE DATA?"Q;O C;I (Q-0Y)4.28,4.27,4.28
04.26 L G,$3HSTGM,0
04.27 L G,%TFAV,0
04.28 O T;O C;Q
*
```

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 L L,$3HSTGM,0
*W
C FOCAL-12

03.10 L 0,F4,F,D4,1
03.13 S MAX=F4(1);S M2=F4(2);S MIN=F4(3);S S2=F4(4);S F4(2)=F4(8)
03.18 0 S;T "HISTOGRAM",!,"CHOOSE UPPER BOUNDARY",!
03.19 T "MAX=",MAX,!,"NEXT MAX=",M2,!!
03.22 T "UB</=",MAX,!,"UB=";A UB;0 C
03.24 T "CHOOSE LOWER BOUNDARY",!
03.25 T "MIN=",MIN,!,"NEXT MIN=",S2,!!
03.29 T "LB>/=",MIN,!,"LB=";A LB;0 C
03.30 A "HOW MANY INTERVALS ?",B;0 C;S F4(11)=B
03.40 S NBI=(B-2);S F4(8)=NBI
03.43 I (UB-MAX)3.52,3.46,3.49
03.46 S NBI=NBI+1;S F4(8)=NBI;GOTO 3.52
03.49 T "UB IS TOO LARGE",!,;DO 3.22
03.50 GOTO 3.43
03.52 I (MIN-LB)3.60,3.55,3.58
03.55 S NBI=NBI+1;S F4(8)=NBI;GOTO 3.60
03.58 T "LB IS TOO SMALL",!,;DO 3.29
03.59 GOTO 3.52
03.60 S IR=UB-LB;S II=IR/NBI;S F4(9)=II;I (MIN-LB)3.69,3.66;GOTO 3.72
03.66 S X(1)=MIN+II;GOTO 3.72
03.69 S X(1)=LB
03.72 S F4(10)=X(1);L C,F4;L G,$4INT,0
*
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```
 L L,$4INT,0
*W
C FOCAL-12

03.60 0 C;L 0,F4,F,D4,1;S II=F4(9);S MAX=F4(1);S X(1)=F4(10)
03.72 S B=F4(11);F J=2,B;S X(J)=X(J-1)+II
03.75 S X(B)=MAX;0 S;F J=1,B;T "X(",J,")=",X(J),!!
03.79 A "TYPE 'C' TO CONTINUE"C;S F4(8)=J+7;F I=1,B;S F4(8+I)=X(I)
03.83 L C,F4;L G,$5GPH,0
*
```

```
 L L,$5GPH,0
*W
C FOCAL-12

01.09 O C;L O,F4,F,D4,1;L O,F3,I,D3,1
01.13 S MAX=F4(1);S TNS=F4(7);S B=F4(8);S F4(8)=F4(2);F K=1,TNS;D 2.47
01.20 GOTO 3.51

02.47 F J=9,B;D 2.48
02.48 I (F3(K)-F4(J))2.49,2.49;R
02.49 S V(J)=V(J)+1;S J=B

03.51 F K=9,B;D 3.58
03.57 GOTO 3.83
03.58 F J=1,(V(K)+1);D 3.60
03.60 O S;S H=FDIS(F4(K)/MAX,J/TNS)
03.83 L C,F4;L C,F3;A "ANALYZE DATA?"RSP;O T;O C
03.91 I (RSP-0Y)3.92,3.94,3.92
03.92 Q
03.94 L G,%TFAV,0
*
```

```
 L L,%TFAV,0
*W
C FOCAL-12

01.10 L O,F4,F,D4,1;L O,F3,I,D3,1
01.15 S NN=F4(5);S B=F4(6);S M=F4(8);S X=0;S P=0;S F4(2)=F4(8);S R=1
01.20 F J=1,NN;D 1.35
01.30 GOTO 1.70
01.35 F K=1,B;S X=X+1;I (P-M*NN*R)1.40,1.37,1.40
01.37 S R=R+1;GOTO 1.40
01.40 F L=1,M;S P=P+1;D 1.45
01.45 S DS=DS+F3(P);S DQ=DQ+F3(P)↑2;D 1.50
01.50 S AS(R)=AS(R)+F3(P);S AN(X)=AN(X)+F3(P);D 1.55
01.55 S BN(P-(R-1)*NN*M)=BN(P-(R-1)*NN*M)+F3(P)
01.70 S F4(8)=DS;S F4(9)=DQ;F T=10,(B+9);S F4(T)=AS(T-9)
01.80 F U=T,(T+M*NN-1);S F4(U)=BN((U-T)+1)
01.95 F T=U,(U+B*NN-1);S F4(T)=AN((T-U)+1)

02.20 S F4(7)=T;L C,F3;L C,F4;L G,%STFAV,0
*
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```
*L L,%STFAV,0
*W
C FOCAL-12

01.10 L 0,F4,F,D4,1;L 0,F3,I,D3,1
01.15 S T=F4(7);S NN=F4(5);S B=F4(6);S M=F4(2);S X=0;S P=0;S R=1
01.20 F J=1,NN;D 1.35
01.30 GOTO 1.80
01.35 F K=1,B;S X=X+1;I (P-M*NN*R)1.40,1.37,1.40
01.37 S R=R+1;GOTO 1.40
01.40 F L=1,M;S P=P+1;D 1.58
01.58 S BS(L)=BS(L)+F3(P);D 1.60
01.60 S N(X-(R-1)*NN)=N(X-(R-1)*NN)+F3(P);D 1.65
01.65 S AB(L+(R-1)*M)=AB(L+(R-1)*M)+F3(P)
01.80 F U=T,(T+M-1);S F4(U)=BS((U-T)+1)
01.85 F T=U,(U+B*M-1);S F4(T)=AB((T-U)+1)
01.90 F U=T,(T+NN-1);S F4(U)=N((U-T)+1)

02.20 L C,F3;L C,F4;O S;T "SPECIFY DESIGN",!!,"1=MIXED DESIGN",!
02.25 T "2=REPEATED MEASURES",!,"3=COMPLETELY RANDOMIZED",!
02.30 A "DESIGN NO.="T;O C;I (T-2)2.35,2.40,2.45
02.35 L G,%MD,0
02.40 L G,%RM,0
02.45 L G,%CR,0
*
```

```
 L L,%MD,0
*W
C FOCAL-12

01.10 L 0,F4,F,D4,1;S DS=F4(8);S DQ=F4(9);S B=F4(6);S M=F4(2)
01.15 S NS=F4(5);F T=10,(B+9);S QA=QA+F4(T)↑2
01.20 F T=(B+M*NS+10),(B+M*NS+B*NS+9);S QNA=QNA+F4(T)↑2
01.25 F U=T,(T+M-1);S QB=QB+F4(U)↑2
01.30 F T=U,(U+B*M-1);S QX=QX+F4(T)↑2
01.35 S C=DS↑2/(B*M*NS);S F4(1)=B*M*NS-1;S F4(3)=B*NS-1
01.40 S F4(5)=B-1;S F4(9)=B*(NS-1);S F4(12)=B*NS*(M-1)
01.43 S F4(14)=M-1;S F4(4)=QNA/M-C
01.45 S F4(18)=(B-1)*(M-1);S F4(22)=B*(NS-1)*(M-1);S F4(2)=DQ-C
01.50 S F4(13)=F4(2)-F4(4);S F4(6)=QA/M*NS-C;S F4(10)=F4(4)-F4(6)
01.55 S F4(15)=QB/B*NS-C;S F4(19)=QX/NS-C-F4(6)-F4(15)
01.57 S F4(23)=F4(13)-F4(15)-F4(19);S F4(7)=F4(6)/F4(5)
01.60 S F4(11)=F4(10)/F4(9);S F4(16)=F4(15)/F4(14)
01.63 S F4(20)=F4(19)/F4(18);S F4(24)=F4(23)/F4(22)
01.65 S F4(8)=F4(7)/F4(11);S F4(17)=F4(16)/F4(24)
01.70 S F4(21)=F4(20)/F4(24);L C,F4;L G,%4MD,0
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*L L,%4MD,0
*W
C FOCAL-12

01.10 L 0,F4,F,D4,1;S AF=F4(8);S SADF=F4(9);S AQ=F4(6);S TS=F4(2)
01.15 S ADF=F4(5);S TDF=F4(1);S BTDF=F4(3);S BETS=F4(4);S AMS=F4(7)
01.20 S EAS=F4(10);S EBMS=F4(11);S WDF=F4(12);S WS=F4(13)
01.25 S BDF=F4(14);S BQ=F4(15);S BMS=F4(16);S BF=F4(17)
01.30 S DFAB=F4(18);S XQ=F4(19);S XMS=F4(20);S XF=F4(21)
01.35 S WEDF=F4(22);S EWQ=F4(23);S MSEW=F4(24);O T
01.75 T !!,"    SV          DF          SS          MS            F"
01.80 T !!," TOTAL   ",TDF,"   ",TS,!!
01.83 T "   BET'N S",BTDF,"   ",BE
01.85 T !,"    A     ",ADF,"   ",AQ,"   ",AMS,"   ",AF,!
01.90 T "    S/A   ",SADF,"   ",EAS,"   ",EBMS,!!
01.95 T "   WTH'N S",WDF,"   ",WS,!

02.10 T "    B     ",BDF,"   ",BQ,"   ",BMS,"   ",BF,!
02.15 T "    AB    ",DFAB,"   ",XQ,"   ",XMS,"   ",XF,!
02.20 T "    SB/A  ",WEDF,"   ",EWQ,"   ",MSEW,!!;L C,F4;Q
*
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 L L,%RM,0
*W
C FOCAL-12

01.10 L 0,F4,F,D4,1;S DS=F4(8);S DQ=F4(9);S B=F4(6);S M=F4(2)
01.15 S NS=F4(5);F T=10,(B+9);S QA=QA+F4(T)↑2
01.20 F U=T,(T+NS*M-1);S QG=QG+F4(U)↑2
01.25 F T=U,(U+B*NS-1);S QH=QH+F4(T)↑2
01.30 F U=T,(T+M-1);S QB=QB+F4(U)↑2
01.35 F T=U,(U+M*B-1);S QX=QX+F4(T)↑2
01.40 F U=T,(T+NS-1);S QS=QS+F4(U)↑2
01.45 S F4(1)=B*M*NS-1;S C=DS↑2/B*M*NS;S F4(2)=DQ-C
01.50 S F4(3)=B-1;S F4(4)=QA/M*NS-C;S F4(7)=M-1;S F4(8)=QB/B*NS-C
01.55 S F4(11)=NS-1;S F4(12)=QS/B*M-C;S F4(13)=(B-1)*(M-1)
01.60 S F4(14)=QX/NS-C-F4(8)-F4(4);S F4(17)=(B-1)*(NS-1)
01.65 S F4(18)=QH/M-C-F4(4)-F4(12);S F4(20)=(M-1)*(NS-1)
01.70 S F4(21)=QG/B-C-F4(8)-F4(12);S F4(23)=F4(20)*F4(3)
01.75 S F4(24)=F4(2)-F4(4)-F4(8)-F4(12)-F4(14)-F4(18)-F4(21)
01.80 S F4(25)=F4(24)/F4(23);S F4(22)=F4(21)/F4(20)
01.85 S F4(19)=F4(18)/F4(17);S F4(15)=F4(14)/F4(13)
01.90 S F4(16)=F4(15)/F4(25);S F4(9)=F4(8)/F4(7)
01.95 S F4(10)=F4(9)/F4(22);S F4(5)=F4(4)/F4(3)

02.10 S F4(6)=F4(5)/F4(19);L C,F4;L G,%5RM,0
*
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```
 L L,%5RM,0
*W
C FOCAL-12

01.05 L 0,F4,F,D4,1
01.10 S TDF=F4(1);S TS=F4(2);S ADF=F4(3);S AQ=F4(4);S AMS=F4(5)
01.15 S AF=F4(6);S BDF=F4(7);S BQ=F4(8);S BMS=F4(9);S BF=F4(10)
01.20 S SDF=F4(11);S SQ=F4(12);S DFAB=F4(13);S XQ=F4(14);S XMS=F4(15)
01.25 S XF=F4(16);S AEDF=F4(17);S SAS=F4(18);S ASMS=F4(19)
01.30 S BEDF=F4(20);S SBS=F4(21);S BSMS=F4(22);S ABEDF=F4(23)
01.40 S SNAB=F4(24);S NABMS=F4(25);0 T
01.45 T !!,"    SV          DF          SS          MS          F"
01.50 T !!," TOTAL   ",TDF,"   ",TS,!
01.55 T "    A     ",ADF,"   ",AQ,"   ",AMS,"   ",AF,!
01.60 T "    B     ",BDF,"   ",BQ,"   ",BMS,"   ",BF,!
01.65 T "    S     ",SDF,"   ",SQ,!
01.70 T "    AB    ",DFAB,"   ",XQ,"   ",XMS,"   ",XF,!
01.75 T "    AS    ",AEDF,"   ",SAS,"   ",ASMS,!
01.80 T "    BS    ",BEDF,"   ",SBS,"   ",BSMS,!
01.85 T "    ABS   ",ABEDF,"   ",SNAB,"   ",NABMS,!!;L C,F4;Q
*
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```
 L L,%CR,0
*W
C FOCAL-12

01.05 L 0,F4,F,D4,1
01.10 S DS=F4(8);S DQ=F4(9);S B=F4(6);S M=F4(2);S NS=F4(5)
01.15 F T=10,(B+9);S QA=QA+F4(T)↑2
01.20 F T=B+M*NS+B*NS+10,B+M*NS+B*NS+M+9;S QB=QB+F4(T)↑2
01.25 F U=T,(T+B*M-1);S QX=QX+F4(U)↑2
01.30 S F4(1)=B*M*NS-1;S C=DS↑2/B*M*NS;S F4(2)=DQ-C;S F4(3)=B-1
01.35 S F4(4)=QA/M*NS-C;S F4(5)=F4(4)/F4(3);S F4(7)=M-1
01.40 S F4(8)=QB/B*NS-C;S F4(9)=F4(8)/F4(7);S F4(11)=(B-1)*(M-1)
01.50 S F4(12)=QX/NS-C-F4(8)-F4(4);S F4(13)=F4(12)/F4(11)
01.55 S F4(15)=B*M*(NS-1);S F4(16)=F4(2)-F4(4)-F4(8)-F4(12)
01.60 S F4(17)=F4(16)/F4(15);S F4(14)=F4(13)/F4(17)
01.65 S F4(10)=F4(9)/F4(17);S F4(6)=F4(5)/F4(17)
01.70 L C,F4;L G,%6CR,0
*
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```
 L L,%6CR,0
*W
C FOCAL-12

01.05 L 0,F4,F,D4,1
01.10 S TDF=F4(1);S TS=F4(2);S ADF=F4(3);S AQ=F4(4);S AMS=F4(5)
01.15 S AF=F4(6);S BDF=F4(7);S BQ=F4(8);S BMS=F4(9);S BF=F4(10)
01.20 S DFAB=F4(11);S XQ=F4(12);S XMS=F4(13);S XF=F4(14);S EDF=F4(15)
01.25 S EQ=F4(16);S EMS=F4(17);0 T
01.30 T !!,"    SV          DF          SS          MS          F"
01.35 T !!," TOTAL   ",TDF,"   ",TS,!
01.40 T "    A     ",ADF,"   ",AQ,"   ",AMS,"   ",AF,!
01.45 T "    B     ",BDF,"   ",BQ,"   ",BMS,"   ",BF,!
01.50 T "    AB    ",DFAB,"   ",XQ,"   ",XMS,"   ",XF,!
01.55 T "    S/AB  ",EDF,"   ",EQ,"   ",EMS,!!;L C,F4;Q
*
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