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DECUS NO.	FOCAL8-65
TITLE	KRUSKAL-WALLIS ONE-WAY ANALYSIS OF VARIANCE BY RANKS
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SOURCE LANGUAGE	FOCAL

Kruskal-Wallis One Way Analysis of Variance by Ranks

N.B.   THE EXTENDED FUNCTIONS MUST BE DELETED FROM FOCAL TO
       GIVE THIS PROGRAM ENOUGH SPACE TO RUN.

The program computes the Kruskal-Wallis statistic (H), the correction factor (C), the corrected H (H'), and the degrees of freedom (DF). Once the program is loaded the computer will request the information (Number of groups; number of subjects per group, and the data).

The program: The Kruskal-Wallis test is generally for small samples when the data are not in a normal distribution. The data are replaced by ranks and the analysis is computed on the ranked data. The program will take ties into account. The test decides if the ranks of the groups could have come from the same population.

INPUT: After the program is loaded, the computer will ask

NO GROUPS: This is a request for the number of groups. Type in the number of groups and then a space. The computer will then ask:

SS / GROUP: This is a request for the number of subjects per group. Type in the number of subjects for the first group and then a space, the number of subjects for the second group and a space, and so on for all groups. The computer will then type DATA and

G = 1:
Place in the data for the first group. After each datum there must be a space. The data can either be ranks or raw data. Prior ranking does not save time. After the data for the first group have been entered the computer will request data for group 2 and so forth until all data have been entered.

OUTPUT: The computer will give the Kruskal-Wallis statistic (H); the correction factor (C), when there are ties this will be less than 1.0, the corrected Kruskal-Wallis statistic (H'), and the degrees of freedom (DF) associated with the statistic.

When the number of groups is small ($<$3) and the number of subjects per sample is small ($<$5) the significance level for the statistic may be found in Table 0 of Siegel (1956). When number of groups is larger than 3 or there is a group with more than 5 subjects the significance level of the statistic may be found in a chi-square table with the appropriate DF.

Mathematical Technique. (From Siegel, 1956).

The Kruskal-Wallis statistic (H) is derived from the formula:

$$H = \frac{12}{N(N+1)} \sum_{j=1}^{K} \frac{R_j^2}{n_j} - 3(N+1)$$

where   K = number of samples
n_j = number of cases in the j sample
$N = \Sigma n_j$, the number of cases in all samples
R_j = sum of ranks in jth sample.

The correction for tied ranks requires that the formula be computed and then divided by

$$1 - \frac{T}{N^3 - N}$$

where $T = t^3 - t$ (where t is the number of tied observations in a tied group of scores).

The degrees of freedom is equal to K-1.

References:

Siegel, S. Nonparametric statistics for the Behavioral Sciences. New York: McGraw-Hill: 1956 (pp. 184-194).

Hays, W.L. Statistics for Psychologists. New York: Holt, Rinehart, & Winston: 1963 (pp. 637-639).

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Ø1.1Ø      ERASE
Ø1.15      S N=Ø;S TS=Ø
Ø1.2Ø      A "NO GROUPS",KI,!;T " SS / GROUP"
Ø1.3Ø      FOR I=1,1,KI; A N9(I);S N=N+N9(I)
Ø1.4Ø      T !!!, "DATA";S CH=1
Ø1.5Ø      FOR J=1,1,KI;S TS=TS+N9(J);T !!, "G ";T %1,J,!;DO 1.6
Ø1.55      GOTO 2.1
Ø1.6Ø      FOR I=CH,1,TS;ASK A (I);S G(I)=J;DO 1.7
Ø1.7Ø      S CH=TS+1

Ø2.1Ø      S I=N-1;T !
Ø2.15      T "WAIT PATIENTLY",!!
Ø2.2Ø      DO 2.3
Ø2.3Ø      S CH=Ø;DO 3; IF (CH) 5.1,5.1,2.2

Ø3.1Ø      FOR J=1,1,I;DO 4

Ø4.1Ø      S TS=A(J); S K2=G(J)
Ø4.2Ø      IF (TS-A(J+1) )4.9,4.9,4.3
Ø4.3Ø      S CH=CH+1;S A(J)=A(J+1);S  G(J)=G(J+1)
Ø4.4Ø      S A(J+1)=TS; S G(J+1)=K2
Ø4.9Ø      RETURN

Ø5.1Ø      S IT=Ø;S IC=Ø;S SM=Ø
Ø5.2Ø      S A(N+1)=999;FOR J=1,1,N;DO 6
Ø5.3Ø      GOTO 7.1

Ø6.1Ø      IF (A(J)-A(J+1)) 6.3,6.2,6.3
Ø6.2Ø      S IT=IT+1;S IC=IC+J;GOTO 6.9
Ø6.3Ø      IF (IT) 6.7,6.7,6.4
Ø6.4Ø      S IC=IC+J;S IT=IT+1;S SM=SM+(IT↑3-IT);S CH=IC/IT
Ø6.5Ø      S K2=(J-IT)+1;FOR I=K2,1,J;S A(I)=CH
Ø6.6Ø      S IC=Ø;S IT=Ø;GOTO 6.9
Ø6.7Ø      S A(J)=J
Ø6.9Ø      RETURN

Ø7.1Ø      S K2=Ø;S IC=Ø;S IT=Ø
Ø7.2Ø      FOR J=1,1,KI;DO 8
Ø7.3Ø      GOTO 9.1

Ø8.1Ø      S CH=N9(J);S I=Ø
Ø8.12      S I=I+1;IF (I-N)8.13,8.13,8.15
Ø8.13      IF (G(I)-J)8.12,8.14,8.12
Ø8.14      S IC =IC+A(I);S IT=IT+1;IF (IT-CH)8.12,8.12
08.15      S K2=K2+((IC↑2)/IT);S IC=Ø;S IT=Ø
Ø8.4Ø      RETURN
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Ø9.1Ø      S J=((12/(N*(N+1)))*K2)-3*(N+1)
Ø9.2Ø      S CH=1 -(SM/((N↑3)-N));S IT=J/CH;S KI=KI-1
Ø9.4Ø      T "H  ";T %1Ø.4,J,!
Ø9.5Ø      T "C  ";T %1Ø.6,CH,!
Ø9.6Ø      T "H' ";T %1Ø.4,IT,!
Ø9.7Ø      T "DF  ";T %3,KI,!!!
Ø9.8Ø      QUIT
*
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SAMPLE PROGRAM *

NO GROUP:3

SS / GROUP:5 :5 :4

DATA

G= 1
:96 :128 :83 :61 :1Ø1

G= 2
:82 :124 :132 :135 :1Ø9

G= 3
:115 :149 :166 :147
WAIT PATIENTLY

H   = 6.4Ø572ØØØØ
C   = 1.ØØØØØØØØØ
H'   = 6.4Ø572ØØØØ
DF   =   2

*Example from Siegel, 1956, p. 187 (Table 8.5).