Program Abstracts/Algorithms

A regression program for Tukey's test

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Tukey's (Note 1) *honestly significantly different* test is a multiple comparison method that allows an a posteriori comparison of all pairs $\binom{n}{2}$ of means following an overall F test. The present program generates the comparisons by using k 1 linear models of the form

$$Y = b_0 + b_i X_i + \cdots + b_{k-1} X_{k-1} + e, \qquad (1)$$

where $X_i = 1$ is a member of Group 1, 0 otherwise; the b_i are regression coefficients; and e is the error in prediction. Each of the k 1 models leaves a different X_i out of the equation, which allows the group left out to be compared to all other groups. The test of significance for each regression weight (a t test) is transformed to a value that can be compared to the Studentized range statistic by multiplication by $\sqrt{2}$. Alternatively, the values in the tables of the Studentized range statistic could be divided by $\sqrt{2}$, and the t values could be assessed directly. The method used in this program is fully described in Williams (1974).

The assumption is made when using Tukey's test that each group has the same number of scores. Moderate departures from this assumption do not render the test invalid, but rather cause the procedure to become approximate.

Description. This program performs a one-way analysis of variance and Tukey's test for multiple comparisons. The data cards for each observation must contain the criterion score and k (where

k is the number of groups) group membership variables. The group membership variables must be coded 1 to indicate membership in a group and 0 otherwise.

Input. Three cards precede the data cards. Card 1 contains problem identification and allows Columns 1-80 for whatever description the user prefers. Card 2, a control card, requires the number of observations, the number of groups, and an option for printout of the data. Card 3 is a format card in F format. The criterion variable must be first, followed by the group membership variables. If variables are not punched in this order, use a T format to reorder.

Output. The output from this program includes the analysis of variance tables, group means, group standard deviations, a table of computer t values for Tukey's test, and a table of modified t values for comparison to the Studentized range statistic.

Computer and language. The program is written in FORTRAN IV for the IBM 3135/370. Conversion to other computer systems should be relatively simple.

Restrictions. The number of groups must not exceed 20.

Availability. For a free copy of the program with sample output, write either author at the Computer Center, The University of North Dakota, Grand Forks, North Dakota 58201.

REFERENCE NOTE

1. Tukey, J. W. The problem of multiple comparisons. Mimeo, Princeton University, 1953.

REFERENCE

WILLIAMS, J. D. A simplified regression formulation of Tukey's test. *Journal of Experimental Education*, 1974, **42**, 80-82.