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PROGRAM ABSTRACTS/ALGORITHMS

Round robin analysis of variance: A BASIC program for microprocessors

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Round robin analysis of variance is a new statistical technique for analysis of social interaction data that are collected on all possible pairs of subjects formed from a small subject pool. Typical examples are attraction ratings made by each member of a small group toward every other member and the proportion of time spent speaking by each individual during dyadic conversations for all possible pairs of subjects in a study (Warner, Kenny, & Stoto, 1979). To analyze these data, a modified form of ANOVA is required that takes into account the empty cells in the data matrix (since each subject lacks him/herself as a partner) and the correlations among observations due to social reciprocity. This paper reports an interactive BASIC program to carry out this type of data analysis.

Input. The data layout for a round robin study consists of a square matrix with the subjects as row headings and the same subjects as column headings (see Table 1). The X_{ijk} entry refers to the behavior of Person i toward Person j on Day or at Time k. Since a person cannot ordinarily be paired with him/herself, the diagonal cells are empty. The program allows for terminal input; the first prompt supplied by the program asks whether the user wishes to read an existing disk file (sequential access type) or input new data. If new data are to be entered, the program asks for the number of subjects (which determines the number of rows and columns in the data matrix); it also asks for the number of observations in each cell. The program can handle the case in which the within-cell n = 1, although this will mean that certain of the interaction effects cannot be tested. The user should modify the dimension statements at the beginning of the program so that the maximum size of the data array does not exceed the specified dimensions. The data matrix should be asymmetric; that is, the behavior of Person i toward Person j should not be identically equal to the behavior of Person j toward Person i. The program then prints out the subscripts for each element in the matrix (row, column, and cell) and reads in values for each entry from the terminal. The resulting data matrix is printed out on the CRT, and the user is given the opportunity to alter any incorrect values.

Table 1
Typical Round Robin Data Layout

	1	2	3	4
1		X121 X122	X131 X132	X141 X142
2	X211 X212		X231 X232	X241 X242
3	X311 X312	X321 X322		X341 X342
4	X411 X412	X421 X422	X431 X432	

Note–Xijk = the behavior of Person i toward Person j on Day or Replication k.

Output. The program carries out the round robin ANOVA computations (described in Warner et al., 1979) and prints out summary results, including: row, column, cell, and grand means; row, column, and cell effect estimates; and mean squares for all the factors in the model. Ordinary F ratios cannot be set up because of violations of the independence assumptions of ordinary ANOVA, so the program tests the significance of each source of variance by estimating the omega-squared true variance component (Hays, 1963, pp. 406-407). These true variance component estimates are jackknifed to test whether they are significantly different from zero (Mosteller & Tukey, 1977, Chapter 8). The result is a t test for each factor in the model; each t test has n − 1 degrees of freedom, where n is the number of subjects in the study. An extensive discussion of an empirical example and output from this program is given in Warner et al. (1979).

Limitations. The round robin model requires an absolute minimum of four subjects, and the jackknifing procedure raises this minimum requirement to five. Ideally, since the number of degrees of freedom for all the significance tests is based on the number of subjects (rather than the number of dyads or observations), the number of subjects should be eight or more. A data matrix with many zero entries or with row totals that are fixed (e.g., rank-order preference ratings) is not appropriate input for this program.

Program Language and Requirements. This program is written in Alpha BASIC, a form of BASIC that is used on Alpha Micro Systems AM-100 microprocessors. Approximately 12K of memory is needed to accommodate the full-length program and an 8 by 8 by 3 data matrix. This memory requirement can be trimmed by deleting the sections of the program that calculate effect estimates and print out intermediate calculation results, if these pieces of information are not needed. At present, all input comes from a terminal or disk file, and all

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output is directed to a CRT. This can easily be altered for use on other systems.

Availability. A program listing (program title: OBIRD) is available free of charge from the author, Psychology Department, P.O. Box 248185, University of Miami, Coral Gables, Florida 33124. OBIRD in FORTRAN is also available, from David Kenny, Psychology Department, University of Connecticut, Storrs, Connecticut 06268.

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