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PROGRAM ABSTRACTS/ALGORITHMS

ANOVR: Minitab macro routines for calculating *A*Nalysis *O*f *V*ariance with *R*epeated measures

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Currently, one major objective in the teaching of statistics is to minimize the level of confusion and anxiety in students, in order to maximize learning. Some confusion and anxiety may be reduced by requiring students to learn only one statistical computer package for computational assignments.

Whereas most courses in statistics use one or more of the typical software packages (SPSSx or SAS), some instructors have found Minitab (Ryan, Joiner, & Ryan, 1982) to be the most appropriate for novice users, due to its interactive capabilities and simple command syntax. Although Minitab is a good package, it is deficient in many areas. One statistical deficiency involves the calculation of analysis of variance using repeated measures. When a repeated measures design is needed, students are usually required to access a different package or an individual program outside the Minitab environment. This often causes a loss of computing continuity (i.e., the loss of possible benefits from existing knowledge of Minitab commands for use in preanalysis data management) and requires the learning of unnecessary, extra command language.

The following is a brief description of a collection of Minitab macros linked to a VAX/VMS control file that allow users to calculate repeated measures analysis of variance while remaining within the Minitab environment.

Description. The ANOVR Minitab macros allow the user to directly access all Minitab commands and facilities. The macros are linked to a VAX/VMS control file, operating on a VAX 11/780 system. Although the macros were designed to operate in Minitab on the VAX 11/780, they may be easily adapted to run in Minitab on other operating systems.

ANOVR.MTB. This macro is a simple initializing routine written in Minitab to establish a workspace data matrix. This routine creates the workspace for the analysis of variance repeated measures calculations.

1FACTOR.MTB/1FBATCH.MTB. These macros allow calculation of a single-factor design using repeated measures on the same elements. The macros utilize the accepted sums-of-squares algorithm for a single-factor within-subjects design (Kirk, 1968; Winer, 1962).

2FACTOR.MTB/2FBATCH.MTB. These macros calculate a multifactorial (two-factor) design, with one factor between and one factor within. The algorithm for the calculation of the sums of squares was also obtained from Kirk (1968) and Winer (1962).

All macros are linked via a VAX/VMS control file entitled REPEAT.COM. This file, written in DIGITAL Command Language (Digital Equipment Corporation, 1982), acts as a front-end controller for the operation of ANOVR calculations using Minitab. REPEAT.COM provides the user with operating instructions, control of ANOVR macros in Minitab, and an easy routine for submitting Minitab batch runs, all in a friendly (menu-driven) environment.

Input and Output. The macros may be used in two modes: (1) interactive, in Minitab, or (2) batch. In the interactive mode, design parameters and data are entered and output of the ANOVA table is obtained while the user is in Minitab. Execution of macros ANOVR.MTB, 1FACTOR.MTB, and 2FACTOR.MTB are controlled directly through Minitab.

The user may decide to submit the macros via batch processing in order to free the terminal for other operations. Input of design parameters and data are initiated in REPEAT.COM and then saved in a file outside the Minitab environment. This file is then submitted to the batch queue for Minitab processing. Due to required changes in output files, the macros 1FACTOR.MTB and 2FACTOR.MTB have been changed for batch operation to 1FBATCH.MTB and 2FBATCH.MTB, respectively. Output of the ANOVA table is flagged at the user's terminal and is dumped to a predefined file location for future access.

If the user is operating under the VAX/VMS control file (REPEAT.COM), instructions and passage of access to and from Minitab are controlled by a user-friendly menu-driven command file.

Limitations and Requirements. In its present form, 1FACTOR.MTB/1FBATCH.MTB will calculate up to 8 within-factor levels. Execution time for this macro is approximately 29 sec on an 8-MB VAX 11/780, using a data set of five observations over four within factors (Winer, 1962, p. 112). These macros may be easily modified by the user to handle more levels. Macros 2FACTOR.MTB and 2FBATCH.MTB will currently handle up to 8 within-factor levels and up

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to 100 between-factor levels (using a minimum cell size of two). Execution time for these macros is approximately 2 min 21 sec on an 8-MB VAX 11/780, using a data set with three observations with 2 between-factor levels and 4 within-factor levels (Winer, 1962, p. 306). Expansion of these macros is difficult for the novice Minitab user, and is impractical, given the expected increase in execution time. The macros may be used only at installations that support Minitab. The VAX/VMS control file may be used only at installations supporting DIGITAL VAX/VMS operating systems.

Availability. A source listing of the Minitab macros, the VAX/VMS control file, and a brief user's guide are available without charge. Alternatively, the macros are available on nine-track tape. Please send your tape and requirements along with a check for $5.00 to cover duplication costs and postage to Roger L. Brown, Center for Research on Pre-Traumatic Behavior, Winther Hall 6055, University of Wisconsin, Whitewater, Wisconsin 53190. Please make check payable to the research center.

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