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SNAPSHOT: ANALYSIS OF VARIANCE WITH UNEQUAL NUMBERS OF SCORES PER SUBJECT

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SNAPSHOT analysis of variance was proposed by Weiss (1985) to deal with a situation that arises in ongoing research. As subjects are recruited, they are randomly assigned to treatment conditions and then each is measured periodically. At any given time prior to the end of the study, some participants in each group are further along in the course of treatment than others. The researcher may wish to ask whether the treatments have been differentially effective up to that moment. It might be sound tactics to abandon a scheduled two-year study if no significant differences have emerged after one year.

The key design feature that allows for snapshot analysis is balance. Although the number of scores per participant within a group will differ, there must be in each group the same number of participants who have generated a given number of scores. The simplest way to achieve this balance is to use random permutations, rather than simple randomization, for the assignment of participants to groups. Balance yields a design which has the desirable property of orthogonality (Kempthorne, 1952).

Weiss (1985) presented an example in which there was one treatment factor for which an F-ratio is estimated, along with time periods, a factor which is not estimable in the snapshot situation. The SNAPSHOT program generalizes the algorithm; cases in which there are one, two, or three treatment factors may be analyzed. An F-ratio is computed for each factor as well as for the interaction among them.

The data layout for a two treatment factor example is given in Table 1. There were three participants per treatment combination; one participant in each group produced six scores, another produced

TABLE 1
Illustrative Layout for 2 × 3 Design

		$A_1 B_1$	$A_1 B_2$	$A_1 B_3$	$A_2 B_1$	$A_2 B_2$	$A_2 B_3$
		P_1 P_9 P_5	P_4 P_8 P_{13}	P_2 P_{11} P_{18}	P_6 P_7 P_{16}	P_3 P_{12} P_{17}	P_5 P_{10} P_{14}
Time	1	4 7 6	5 6 5	7 9 4	3 2 4	6 3 4	6 5 3
Periods	2	9 8 8	7 4 9	6 6 7	5 4 3	4 6 5	5 4 2
	3	6 4	9 8	4 5	2 4	3 5	3 3
	4	8 9	4 5	8 4	4 4	2 4	4 3
	5	5	6	8	3	3	4
	6	8	6	7	6	4	5

four scores, and the third produced three scores. The balance feature is that the distribution of scores across treatment combinations is the same (i.e., 6, 4, 2). The participant's subcript refers to the order of induction into the study. Participants inducted early have produced more scores.

The results produced by SNAPSHOT are shown in Table 2. The data in Table 1 were constructed to show an obvious main effect of factor A (but not of factor B), and the expected outcomes may be seen in the table. The term labeled "Residual" includes variation over time periods and all interactions involving time periods. The degrees of freedom attached to this source are wasted; this inefficiency is attributable to the inequality in the number of scores per participant, and may be thought of as the price for developing the snapshot prior to the completion of the study. The error MS against which all of the substantive sources are tested is a common term because of the nesting, in that participants are nested under all treatments and their joint interaction.

Limitations. As programmed in BASIC for an Apple IIe, the program occupies 56 sectors on a diskette. The maximum number of scores allowed is 4032. The program accepts data from keyboard or

TABLE 2
Sample Data

2-WAY SNAPSHOT ANOVA DATA FROM TABLE 1		LEVELS OF FACTORS A 2 B 3		
SOURCE	DFS	SUM OF SQUARES	MEAN SQUARES	F
A	1	115.014	115.014	102.87
B	2	.361	.181	.161
AXB	2	3.861	1.931	1.727
RES	54	134.667		
ERR	12	13.417	1.118	
TOTAL	71	267.319		

file, and allows for editing. Systems-dependent features have been avoided, except for those concerned with file manipulation and with displaying the ANOVA table via an 80-column card.

Availability. A listing of the program may be obtained without charge from David J. Weiss, Department of Psychology, California State University, Los Angeles, California 90032. If a diskette formatted for Apple IIe is submitted, the program will be added at no charge.

REFERENCES

Kempthorne, O. (1952). *Design and analysis of experiments*. New York: Wiley.

Weiss, D. J. (1985). Snapshot analysis of variance: comparing groups with unequal numbers of scores per subject. *Perceptual and Motor Skills,* 61, 420–422.