Survey of integrated statistical computer packages

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The statistical features and general characteristics of seven integrated packages were surveyed. SPSS, DATA-TEXT, and OSIRIS emerged as the most comprehensive. OSIRIS in particular offered the most extensive multivariate analysis capabilities. The only category of statistical analysis neglected in all of the packages was nonparametric procedures related to ordinal data. Information on availability and user's manuals is provided.

Several recent surveys of statistical computer programs have been conducted (Allerbeck, 1973; Anderson & Coover, 1972; Armor, 1970; Coover, Dyer, Gross, Johnson, Lutgen, & Miner, 1974; Schucany, Minton, & Shannon, 1972; Hall, Note 1, 2; Rowe, Hall, & Scheer, Note 3; Tauchi, Note 4). Despite the number of programs reviewed, no comprehensive examination of the specific statistical procedures included in the programs has been undertaken. This paper surveys the statistical features and general characteristics of seven popular integrated packages: (1) Statistical Package for the Social Sciences (SPSS), (2) DATA-TEXT, (3) Organized Set of Integrated Routines for Investigation with Statistics (OSIRIS), (4) OMNITAB, (5) Statistical Analysis System (SAS), (6) MANOVA, (7) MULTIVARIANCE (MULT). No attempt has been made to evaluate the computational accuracy of the individual routines. The statistical effectiveness of the packages is currently being assessed by the Committee on Evaluation of Statistical Program Packages, Section on Statistical Computing, American Statistical Association (Francis, Heiberger, & Velleman, 1975).

METHOD

The first step in the survey was the compilation of the statistical techniques employed most often by researchers. A list of descriptive, parametric, and nonparametric statistics was developed.¹ It is by no means exhaustive of the numerous methods of data analysis being used.

Nine integrated computer packages were selected based on their frequency of use in descriptive and experimental research and compatibility with third-generation computers. Complete documentation was obtainable for all except P-STAT and SOUPAC. The seven remaining packages were divided into two categories: generalized and specialized. This distinction was made to differentiate between five which offer both data maintenance and statistical analysis capabilities (SPSS, DATA-TEXT, OSIRIS, OMNITAB, SAS) and two that provide only the latter (MANOVA, MULTIVARIANCE).

A thorough examination of the documentation currently available for each package was conducted. All statistics designated as mandatory or optional program output were identified. A statistic that did not satisfy this criterion was not listed for the package, for example, multivariate analysis of variance

(MANOVA) output not designated by the package although obtainable from a multiple regression program.

RESULTS AND DISCUSSION

The statistical features and general characteristics of the packages are presented in Tables 1 and 2, respectively. SPSS, DATA-TEXT, and OSIRIS appear to offer the most comprehensive analyses for the three statistical categories. OSIRIS distinguishes itself within this group by requiring the least core and providing the most extensive multivariate analysis capabilities. The MANOVA program in OSIRIS is, in fact, an earlier version of the MANOVA package reviewed in this survey (Clyde, Cramer, & Sherin, 1966). In addition to the capabilities listed in Table 1, OSIRIS includes Automatic and Theta-Aid Interaction Detector programs (AID, THAID) and multivariate nominal, multiple classification, and configuration analyses. Data simulation and lag-lead management programs are also provided. The latter is particularly useful for preparing data for time-series experiments.

Despite the outstanding features of OSIRIS, SPSS has become the most widely used package. It can be found at over 700 installations throughout the world and is the most used package for academic survey analysis in the United Kingdom (Rowe et al., Note 3). Current developmental efforts are focusing on an interactive version, capable of reading and producing batch-SPSS-format system files, and Versions 7 and 8 with test and scale item analyses, nonlinear regression tests, log linear modeling, path analysis, frequency and joint frequency distributions of multiple response variables, Automatic Interaction Detection (AID), and a variety of nonparametric tests for ordinal data (SPSS, Inc., Note 5). SPSS, along with OSIRIS and SAS, also contains a Guttman scaling program.

Within the generalized package group, OMNITAB provides an attractively compact and versatile (machine-independent) alternative to the larger packages at a fraction of the cost. It contains the basic descriptive

Table 1
Statistical Features of Seven Integrated Packages

Statistics	Integrated Packages						
	SPSS	DATA-TX	OSIRIS	OMNITAB	SAS	MANOVA	MULT
I. Descriptive Statistics							
A. Mean	X	X	X	X	X		
B. Median	X	X	X	X			
C. Mode	X		X				
D. Range	X			X			
E. Variance	X	X	X	X	X		
F. Standard deviation	X	X	X	X	X		
G. Standard error (mean)	X			X			
H. Skewness	X	X	X				
I. Kurtosis	X	X	X				
J. Frequency distribution	X	X	X	X	X		
K. Crosstabulation	X	X	X		X		
L. Scattergram/plot	X	X	X	X	X		
II. Parametric Statistics							
A. Correlation							
1. Pearson	X	X	X	X	X		
2. Biserial							
3. Tetrachoric	X*		X				
4. Partial	X		X	X	X		X
B. Univariate Analysis							
1. t test (independent samples)	X	X	X				
2. t test (correlated samples)	X	X					
3. ANOVA/ANCOVA	X	X	X	X†	X	X	X
4. Factorial ANOVA/ANCOVA	X	X**	X**	X†	X**	X**	X**
C. Multivariate Analysis							
1. MANOVA/MANCOVA			X**		X††	X**	X**
2. Multiple correlation/regression	X	X	X	X	X		X
3. Simple/multiple discriminant analysis	X	X			X		X
4. Canonical correlation	X				X		X
5. Factor analysis	X	X	X		X		
6. Cluster analysis			X				
7. Multidimensional scaling			X				
III. Nonparametric Statistics							
A. Nominal Data							
1. Chi-square	X	X	X		X		
2. McNemar's test	X*						
3. Fisher's exact test	X	X					
4. Cochran's Q	X*						
5. Contingency coefficient	X	X	X				
6. Phi coefficient	X	X	X				
7. Cramer's V	X	X	X				
8. Goodman-Kruskal's lambda	X	X	X				
B. Ordinal Data							
1. Kolmogorov-Smirnov's tests	X*		X				
2. Runs test	X*						
3. Sign test	X*						
4. Wilcoxon's matched-pairs test	X*						
5. Median test	X*						
6. Mann-Whitney's U	X*						
7. Wald-Wolfowitz's runs test	X*						
8. Moses' test of extreme reactions	X*						
9. Friedman's ANOVA	X*						
10. Kruskal-Wallis' ANOVA	X*			X			
11. Spearman's rho	X	X	X	X	X		
12. Kendall's tau	X	X	X		X		
13. Kendall's W							
14. Goodman-Kruskal's gamma	X	X	X				
15. Somer's D	X	X					

*This statistic is to be included in Versions 7 and 8.

**These analyses also include repeated measures designs.

†No ANCOVA is computed.

††No MANCOVA is computed.

Table 2
General Characteristics of Seven Integrated Packages

Characteristics	Integrated Packages						
	SPSS	DATA-TEXT	OSIRIS	OMNITAB	SAS	MANOVA	MULT
Version	6	3.2	III	5		II	V
Date of Release	1975	1975	1973	1970	1972	1974	1974
Language(s)	FORTTRAN IV	FORTTRAN IV	FORTTRAN IV PL/1	ANSI FORTRAN	FORTTRAN IV Assembly PL/1	FORTTRAN IV	FORTTRAN IV
Machine(s)	IBM 360/70 CDC 6000 UNIVAC 1100 Others*	IBM 360/70 CDC 6000	IBM 360/70	MI**	IBM 360/70	IBM 360/70	IBM 360/70 CDC 6000 UNIVAC 1100
Core Required (K bytes)	220K	250K	104K	90K words	120K+	125K	150K+
Cost							
Nonprofit	\$1,250***	\$ 750†	\$ 750	\$250	\$ 600††	N/A	\$ 840
Profit	\$5,000	\$1,000	\$1,000	\$250	\$1,000	N/A	\$1,200

*There are conversions to almost 20 different operating systems.

**Machine independent.

***Cost is \$750 for degree-granting institution.

†Cost is \$500 for degree-granting institution.

††Cost is for degree-granting institution.

Table 3
Availability and User's Manuals of Seven Integrated Packages

Package	Availability	User's Manual
SPSS	National Opinion Research Center University of Chicago 6030 South Ellis Avenue Chicago, Illinois 60637 (312) 753-1546	Nie, N. H., Hull, C. H., Jenkins, J. G., Steinbrenner, K., & Bent, D. H. <i>SPSS: Statistical package for the social sciences</i> (2nd ed.). New York: McGraw-Hill, 1975.
DATA-TEXT	Dr. David J. Armor 3625 Serra Road Malibu, California 90265 (213) 456-3015	Armor, D. J., & Couch, A. S. <i>DATA-TEXT primer</i> . New York: Free Press, 1972.
OSIRIS	Institute for Social Research P.O. Box 1248 Ann Arbor, Michigan 48106 (313) 764-4417	Institute for Social Research. <i>OSIRIS III, Volume 1: System and program description</i> . Ann Arbor: University of Michigan, 1973.
OMNITAB	Computer Products Group U. S. Department of Commerce National Technical Information Service 5285 Port Royal Road Springfield, Virginia 22151 (703) 321-7281	Hogben, D., Peavy, S. T., & Varner, R. N. <i>OMNITAB II user's reference manual</i> . (National Bureau of Standards Technical Note 552). Washington, D. C.: U. S. Government Printing Office, 1970. (SD No. C13.46:552)
SAS	SAS Project Institute of Statistics North Carolina State University P.O. Box 5457 Raleigh, North Carolina 27607 (919) 737-2585	Service, J. <i>A user's guide to the statistical analysis system (SAS)</i> . Raleigh: North Carolina State University, 1972.
MANOVA	Dr. Elliot M. Cramer L. L. Thurstone Psychometric Laboratory University of North Carolina Chapel Hill, North Carolina 27514 (919) 933-5085	Cramer, E. M. <i>Revised MANOVA program</i> . Chapel Hill: University of North Carolina, 1974.
MULTIVARIANCE	International Educational Services P.O. Box A3650 Chicago, Illinois 60690 (312) 684-4920	Finn, J. D. <i>MULTIVARIANCE: Univariate and multivariate analysis of variance, covariance, and regression</i> . Chicago: National Educational Resources, 1972.

and parametric statistics with the exceptions of ANCOVA and multivariate analysis. ANCOVA and certain applications of MANOVA could even be computed by the multiple regression program.

The SAS package possesses powerful parametric statistical features comparable to OSIRIS and the two specialized integrated packages. Its flexible least squares and randomized plans for experiment programs are not available in any of the other packages. SAS also incorporates most of the options offered by the largest multivariate package (MULTIVARIANCE) at a lower cost.

Nonparametric statistical analysis of ordinal data seems to be the single category conspicuously neglected in all of the packages. To compensate for this deficiency, researchers have written their own specific, machine-dependent programs, as evidenced by the numerous program abstracts that have appeared over the past decade in journals such as *Educational and Psychological Measurement*, *Behavioral Science*, and *Behavior Research Methods & Instrumentation*. There are very few nonparametric "packages" that are capable of handling a variety of research problems, for example, NPSTAT (Computer Institute for Social Science Research, 1970) and SIEGEL (Vegelius, 1975).

Additional information on the foregoing packages can be obtained by writing the distributors. The addresses and user's manuals for the seven packages are listed in Table 3.

REFERENCE NOTES

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4. Tauchi, H. J. *Abstracts of statistical computer programs*. IBM Statistical Program Evaluation Committee, 1965.

5. SPSS, Inc. SPSS Newsletter, No. 8, July 1975. Pp. 5-6.

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NOTE

1. University professors, practitioners, graduate students, and about 60 textbooks served as the sources for the list of statistical procedures.

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