A comparison of inexpensive statistical packages for Apple II microcomputers

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The purpose of this paper is to describe and compare some inexpensive software packages that calculate a variety of statistics on the Apple II microcomputer. For each package, hardware requirements, program capacity, limitations, constraints, accuracy, editing, error handling, and other features were studied.

The purpose of this paper is to compare inexpensive (less than \$100) statistical packages that run on Apple II microcomputers. Several sources were used to find packages, including previous reviews (e.g., Butler, 1986; Henry & Bauer, 1986), advertisements in numerous journals (e.g., *Amstat News*), and listings of programs (e.g., Datapro/McGraw-Hill, 1985). Packages that had too little flexibility (e.g., packages from Dynacomp and PARsoft) were not included. Two of the packages found are no longer on the market: Ustats (Wm. C. Brown Publishers) and Statistics 3.0 (Eduware). Some packages could not be obtained. For unobtained packages, the information included in the present paper is brief (because it is based upon advertisements), and those packages are not included in Table 1, the primary summary of the reviewed packages.

GENERAL CHARACTERISTICS OF PACKAGES

Table 1 summarizes a variety of information about the packages. The features included in the table are described below. For each package, characteristics that are difficult to include in the table are described following the description of tabled features.

General Features

All of the packages are menu driven, at least for procedure selection. The hardware requirements of the packages are very similar. All worked on an Apple II+, Apple IIe, and Franklin 1200, although some subtle differences in operation were found. Copy-protected programs could not be copied with the standard DOS 3.3 copy program or the Pascal Filer. Error trapping refers to the program containing checks for such conditions as divide by zero and non-numeric data and appropriate handling of such conditions.

Statistics

The statistics calculated by the programs were compared to a list of fundamental statistical routines, those found in at least 10 of 20 general statistics textbooks we examined. The fundamental routines are those listed in Table 1. For each statistical routine, the programs' limitations were studied: maximum number of scores, maximum number of cells or groups (where appropriate), and accuracy. Accuracy was examined using the basic technique described by Butler and Eamon (1985). This technique is particularly sensitive to rounding errors, especially those resulting from computing a power of a large number. A number of similar data sets were used. The table shows the maximum number of digits that could be used in any of the data sets to obtain correct statistics.

Speed was not easy to assess. Overall, Statistix was the fastest and Statistics Software for Microcomputers was the slowest. Speeds of the other three programs were approximately the same. However, speed depended upon length of the data set, statistic used, options, and number of consecutive runs of a procedure (i.e., most routines were slower the first time they were run).

Other Features

Disk files for all packages were sequential files. All had files with names, structures, or contents that were unique, or specific to the package. Usually these unique files were compatible with a variety of routines within the package. Some of the packages could also save ASCII data-only files or other types of files that could be used by other programs. Statistix's saved data structure contains "dummy" or "grouping" variables as well as data.

Data editing is best when data are numbered and editing is done onscreen, which means the data is seen during the editing. Transforming variables means to change data values using algebraic expressions.

UNIQUE PROGRAM CHARACTERISTICS

Those characteristics of the programs that are difficult to describe in Table 1 are described below, package by package. Addresses for suppliers of the programs are provided in the Appendix.

Requests for reprints should be sent to the first author at the Department of Psychological Sciences, Ball State University, Muncie, IN 47306.

Table 1
Requirements, Features, and Limitations of Programs

	Programs				
	Keystat	Statistical Programs	Statistical Software	Statistics with Interpretations	Statistix
GENERAL FEATURES					
Hardware					
RAM	48K	48K	48K	48K	64K
Minimum Number Disk Drives	1	1	1	1	2
80-Column Card	No	No	Yes	No	Optional
Printer	Optional	Optional	Optional	Optional	Optional
Cost	\$50/\$10	Free	\$26	\$25	\$75
Menus	Yes	Yes	Yes	Yes	Yes
Copy Protected	Yes	No	No	No	No
List Protected	Yes	No	No	No	Yes
Language	Unknown	BASIC	Unknown	BASIC	Pascal
Manual	No	No	Yes	No	Yes
Overall Error Trapping Good	No	No	No	Yes	Yes
STATISTICS					
Descriptive Statistics					
Number of Cases	200	2,100	100	2,000	3,000
Mean (Accuracy)	Yes (9)	Yes (8)	Yes (7)	Yes (9)	Yes (6)
Median (Accuracy)	Yes (9)	No	Yes (7)	Yes (9)	No
Mode (Accuracy)	No	No	Yes (0)	Yes (9)	No
Variance (Accuracy)	Yes (9)	Yes (3)	Yes (3)	Yes (8)	Yes (6)
Standard Deviation (Accuracy)	Yes (9)	Yes (3)	Yes (3)	Yes (8)	Yes (6)
Min, Max (Accuracy)	No	No	Yes (7)	Yes (9)	Yes (6)
Correlation/Regression					
Pearson <i>r</i>	Yes	Yes	Yes	Yes	Yes
Number of Cases	500	2,050	239	2,000	3,000
Accuracy	9	3	4	6	5
Spearman rho	No	Yes	No	Yes	Yes
Number of Cases	—	2,050	—	1,000	3,000
Accuracy	—	3	—	9	6
Simple Linear Regression	Yes	Yes	Yes	Yes	Yes
Number of Cases	500	2,000	239	2,000	3,000
Significance Tests					
<i>t</i> Test (One Group)	Yes	No	Yes	No	Yes
Number of Cases	200	—	10 ⁷	—	3,000
Accuracy	9	—	3	—	4
<i>t</i> Test (Independent Groups)	Yes	Yes	Yes	Yes	Yes
Number of Cases	300	2,400	10 ⁷	3,000	3,000
Accuracy	5	3	3	8	4
<i>t</i> Test (Dependent Groups)	Yes	Yes	Yes	Yes	Yes
Number of Cases	100	1,200	10 ⁷	3,000	3,000
Accuracy	9	3	2	8	4
Mann-Whitney <i>U</i>	Yes	Yes	No	Yes	Yes
Number of Cases	200	1,400	—	2,000	3,000
Accuracy	9	4	—	9	9
Wilcoxon	Yes	Yes	No	Yes	Yes
Number of Cases	100	800	—	2,000	3,000
Accuracy	9	4	—	9	9
ANOVA (One-Way Between)	Yes	Yes	Yes	Yes	Yes
Number of Levels	9	Dep	Dep	100	30
Total Number of Cases	400	Dep	Dep	3,000	90,000
Maximum Cases Per Level	50	Dep	Dep	2,998	3,000
Accuracy	6	4	6	8	7
ANOVA (One-Way Within)	Yes	Yes	Yes	Yes	Yes
Number of Levels	9	Dep	Dep	100	20
Maximum Number of Cases	9	Dep	Dep	2,000	3,000
Accuracy	3	4	5	8	3
ANOVA (Two-Way Between)	Yes	Yes	Yes	No	Yes
Number of Levels	9*9	9*9	Dep	—	20*20
Total Number of Cases	729	2,025	Dep	—	3,000
Maximum Cases per Level	9	25	Dep	—	2,998
Accuracy	3	4	5	—	3

Table 1 (Continued)

Kruskal-Wallis	Yes	No	No	Yes	Yes
Number of Levels	9	—	—	100	30
Total Number of Cases	450	—	—	2,000	??
Maximum Cases per Level	50	—	—	1,998	3,000
Accuracy	9	—	—	9	9
Friedman	Yes	No	No	Yes	Yes
Number of Levels	9*9	—	—	500	30*30
Total Number of Cases	729	—	—	2,000	3,000
Maximum Cases per Level	9	—	—	1,998	2,998
Accuracy	9	—	—	9	9
Chi-Square Goodness of Fit	Yes	No	No	Yes	No
Number of Levels	100	—	—	2,000	—
Maximum Frequency	10 ⁹	—	—	10 ⁹	—
Accuracy	9	—	—	8	—
Chi-Square Contingency	Yes	No	Yes	Yes	Yes
Number of Levels	9*9	—	~ 100	45*45	30*30
Maximum Frequency	10 ⁹	—	??	10 ⁹	?
Accuracy	8	—	1	8	9
OTHER FEATURES					
Graphics					
Scattergram	Yes	No	No	No	Yes
Histogram	No	No	No	No	Yes
Data Input Disk Files	Yes	Yes	Yes	Yes	Yes
Specific to Package	Yes	No	Yes	Yes	Yes
Compatible Across Routines	No	Yes	Yes	Yes	Yes
Other (e.g., ASCII)	No	Yes	No	No	Yes
Grouping Variables Needed	No	No	No	No	Yes
Good Error Trapping	No	No	No	Yes	Yes
Data Editing	Yes	Yes	Yes	Yes	Yes
Onscreen	No	No	No	Yes	No
Cases Numbered	Yes	No	Yes	Yes	Yes
Good Error Trapping	No	No	No	Yes	Yes
Transforming Variables	Log	No	No	Log	Extensive

Note—Dep = dependent (e.g., in ANOVA, the number of cases may depend on the number of levels of the independent variable; see text for descriptions of dependencies). ?? = testing was not extensive enough to determine the precise nature of the maximum. — = not applicable.

Key-Stat

The correlation/regression program is a strength of this package. Output of the regression routine includes descriptive statistics and many intermediate values used in calculating the correlation coefficient. A scatter plot and regression equation are generated. The best-fitting line can be added to the scatter plot. (Note, the scatter plot is accurate only when the data have four digits or less.)

In addition to the statistics listed in Table 1, Key-Stat has a rather elaborate calculator that simulates a Hewlett-Packard RPN calculator.

Some of the menus (especially the opening menu) are long and use confusing terminology. As a result, it is difficult to find some statistical routines. To aid the user, a separate program is included that helps the user to choose the correct statistical technique. Another inconvenience not apparent in Table 1 is that the user must return to the main disk menu before rerunning some of the procedures.

For another review of Key-Stat, see Henry and Bauer (1986).

Statistical Programs for the Apple II

In the ANOVA routines, the number of levels of independent variables and the number of scores per level are

interdependent. For example, a one-way between design with two levels accepts 500 scores per level, a one-way with four levels accepts 150 scores per level, and a one-way with 20 levels accepts only 7 scores per level.

In addition to the statistics listed in Table 1, this package calculates three-way ANOVAS, simple Latin square ANOVAS, and ANCOVAS with a maximum of 100 cells and 25 scores per cell. The ANOVA routine is accurate to three digits.

The program was originally described in Steinmetz, Romano, and Patterson (1981). Several procedures have been added since the original publication.

Statistics Software for Microcomputers

In the ANOVA routines, the total number of scores allowed is dependent upon the number of cells in the design. For example, a one-way between design with two levels accepts 3,450 total scores, a one-way with five levels accepts 1,700 total scores, and a one-way with 15 levels accepts 625 total scores.

In addition to the statistics listed in Table 1, this package can compute multilinear regression and factor analysis.

The program's greatest weakness is in the data input routines. The input routines vary with procedure and all

are very slow. The user is forced to start a routine over if any error is made. With the exception of the excellent editor for the descriptive routines, editing is difficult and the chi-square routine does not allow editing. Calculations are very sluggish. For example, the descriptive statistics program requires approximately 10 min to calculate statistics on 200 data. Note that Table 1 indicates that the descriptive statistics can only handle 100 values. That is the number of values the program can process in 3 min. A more patient user may find that the program has great capacity.

Statistics with Interpretations

One strength of this package is the output. It includes the statistics and, where appropriate, a verbal statement indicating whether the statistic is significant, the degrees of freedom, the probability of the statistic, and a list of the assumptions of the test.

In addition to the statistics listed in Table 1, Statistics with Interpretations calculates skewness, kurtosis, Cramér's V for contingency tables, and multiple regression. However, Cramér's V is only accurate to two digits, and the multiple regression routine is limited to two predictors.

At the beginning of each statistical procedure is a list of the procedure's capacity and limitations; then the user has the option to escape, input data from the keyboard, or read data from a disk file.

Statistix

This package is the most comprehensive reviewed here. The output of several of the routines (e.g., ANOVA) is far more complete than any other package reviewed here, and many more options are available (e.g., contrasts). In addition to the statistics described in Table 1, this package also computes the following statistical procedures: ANOVA (up to five independent variables), ANCOVA (up to five covariates), principal components (up to 30 variables), multiple regression (up to 30 predictors), sign test, median test, Kolmogorov Smirnov test, log linear models, McNemar's symmetry test, 11 different statistics on 2x2 tables, the runs test, Wilk-Shapiro/Rankit Plots, and several types of cross tabulations. There is also an extensive procedure for calculating probabilities.

This package is relatively easy to use, but is a bit more difficult to use than the other packages reviewed here. For example, the ANOVA routines require the user to specify the model and indicate the error term(s). A split-plot factorial design may be specified as follows:

$$DV = AB A*B(ERROR) C C*B(ERROR) A*C A*B*C(ERROR),$$

where A, B, and C are dummy variables specifying group membership and DV is the data to be analyzed.

For another review of the package, see Russek-Cohen (1986).

Psychostat-3 (and newer version called Apstat)

Several telephone calls and a written communication to this company were made requesting a review copy. In

addition, I offered to purchase a copy if they would refund my money after the review. The company did not cooperate. As a result, the following comments are based upon advertisements of this package.

This package runs on a one-drive Apple II or compatible. It costs \$99. Calculations include descriptive statistics, *t* tests, ANOVAs (up to five factors and unlimited cases), multiple regressions (up to 25 predictors), and non-parametric statistics. Data editing, transformations, file compatibility with other packages, and graphics (bar-graphs and scattergrams) are included in this menu-driven program.

Statcalc

This package costs \$100. We did not test it, because no copy was received. However, it is a command language program that accommodates 2,000 data on a 48K, one-drive Apple. There are seven types of commands: (1) input, editing, and display of data; (2) means, variances, *t* tests, chi-squares, ranks; (3) plots: scatter plot, triplots, stem and leaf, boxplots, normal plots, histograms; (4) transform and sorting; (5) random number generation; (6) one- and two-way ANOVA, regression, multiple regression; and (7) DOS commands.

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APPENDIX

Program Suppliers' Addresses

Key-Stat
Oakleaf Systems
P.O. Box 472
Decorah, IA 52107

Statistical Programs for the Apple II
Michael M. Patterson
College of Osteopathic Medicine
Ohio University
Athens, OH 45701
(614) 593-2337

Statistics Software for Microcomputers
Kern International, Inc.
433 Washington St.
P.O. Box 1029CA
Duxbury, MA 02331
(617) 934-0445

APPENDIX (Continued)

Statistics with Interpretations**Darrell L. Butler****Department of Psychological Science****Ball State University****Muncie, IN 47303****(317) 285-1690****Statistix****NH Analytical Software****801 W. Iowa Ave.****St. Paul, MN 55117****(612) 488-4436****Psychostat-3 (and Apstat)****Statsoft****2832 E. 10th St., Suite 4****Tulsa, OK 74104****(918) 583-4149****Statcalc****Alan J. Lee and Peter McIneruey****Department of Mathematics and Statistics****Peter R. Mullins****Department of Community Health****University of Auckland****Private Bag****Auckland, New Zealand**