SESSION V STATISTICAL ANALYSIS ON MICROCOMPUTERS

Richard S. Lehman, *Presider*

BASIC meta-analysis: Description of a statistical package

BRIAN MULLEN

Syracuse University, Syracuse, New York

Meta-analysis refers to the statistical integration of results of independent studies. Mullen and Rosenthal's (1985) recent book provides a package of 14 BASIC language computer programs which perform a wide variety of meta-analytic procedures. This paper describes the system requirements, strengths, and limitations of this package.

Meta-analysis generally refers to the statistical integration of the results of independent studies. In a sense, meta-analysis is a method of statistical analysis wherein the units of analysis are the results of independent studies, rather than the responses of individual subjects. This quantitative approach to the assessment of research domains represents a growing trend toward more rigorous and more precise summarization and integration of research literature.

BASIC Meta-analysis: Procedures and Programs, a recent book by Mullen and Rosenthal (1985), provides the listings for a package of 14 BASIC language computer programs which allow the user to perform a variety of meta-analytic computations. These programs, and the Mullen and Rosenthal book, represent an attempt to make the techniques of meta-analysis more accessible and the conduct of meta-analyses more "time-efficient."

The subset of BASIC in which these programs are written is an extremely generic dialect which is compatible with most micro-, mini-, and mainframe computer systems. Spacings and commands which are optional in some BASIC dialects and required in other dialects are included in these programs. Experienced users operating with a more amenable BASIC dialect may reduce the memory requirements of these programs by deleting spaces, THENs and GOTOs not required by their particular system.

Table 1 presents a summary of each of the 14 programs. Generally, these programs prompt the user to enter the test statistic, sample size or *df*, and a weight

for each study included in the meta-analysis. The meta-analytic technique, the output generated, program line length, memory space, and capacities are presented in Table 1.

LIMITATIONS

Generally, these programs require the user to enter for each study the type of test statistic (*t*, *F*, χ^2 , *r*, or *p*), the numerical value of the statistic, and the direction of effect (+ if in the expected direction, - if in the unexpected direction). The user may also be prompted to enter the associated *df* or sample size and a weight for each study. However, there are some limitations imposed on the use of these programs by the logic of meta-analytic techniques. For example, only *F* tests with one degree of freedom in the numerator and only χ^2 s based on one degree of freedom can be legitimately included in a meta-analysis (since these are the only *F* tests and χ^2 s which can be considered as true, specific tests of a well-defined hypothesis). There are also some limitations imposed upon these programs by the number of significant digits which most popular computer systems can carry for internal computations. For example, the most extreme *p* value which these programs will retrieve for a computed *Z* for comparison or combination is *p* = .000000001 (*Z* = 6.03788). More extreme *Z*s may be computed, but in such cases, the associated *p* will be correctly, but imprecisely, reported as "*p* < .000000001."

STRENGTHS

The obvious strengths of this package are the breadth of techniques covered, the reliability, the ease of use, and

The author's address is: Department of Psychology, Syracuse University, Syracuse, NY 13210.

Table 1
Summary of 14 BASIC Language Computer Programs

(Program) Technique	Output	Line Length	Memory (K)	Capacities
Two Studies				
(a) Comparison of Significance Levels	Z one-tailed <i>p</i>	73	2.84	2 studies
(b) Comparison of Effect Sizes	Z one-tailed <i>p</i>	103	4.00	2 studies
(c) Combination of Significance Levels	Z one-tailed <i>p</i>	78	2.84	2 studies
(d) Combination of Effect Sizes	$\bar{Z}$ Fisher $\bar{R}$ $\bar{R}^2$ BESD $\bar{d}$	108	4.00	2 studies
Three or More Studies				
(e) Diffuse Comparison of Significance Levels	χ^2 one-tailed <i>p</i>	106	3.40	500 studies
(f) Diffuse Comparison of Effect Sizes	χ^2 one-tailed <i>p</i>	140	4.32	500 studies
(g) Orthogonal Contrast Weights	linear and quadratic coef.	44	2.00	450 levels of an attribute
(h) Focused Comparison of Significance Levels	Z one-tailed <i>p</i>	86	2.84	500 studies
(i) Focused Comparison of Effect Sizes	Z one-tailed <i>p</i>	117	4.00	500 studies
(j) Combination of Significance Levels	Z one-tailed <i>p</i> $N (p = .05)$	84	2.84	500 studies
(k) Combination of Effect Sizes	$\bar{Z}$ Fisher $\bar{R}$ $\bar{R}^2$ BESD $\bar{d}$	110	4.00	500 studies
(l) Correlation	<i>r</i> partial <i>r</i> multiple <i>r</i>	177	4.86	100 studies, 8 variables
(m) Disjoint Cluster Analysis	identification of disjoint clusters of studies	74	2.28	300 studies
(n) Model Estimation	least squares prediction of effect size	104	3.40	500 studies

Note—data is derived from *BASIC meta-analysis: Procedures and programs*, by B. Mullen and R. Rosenthal, 1985, Hillsdale, NJ: Erlbaum. Copyright 1985 by Erlbaum.

the documentation. Using the 14 programs in this package, the meta-analytic reviewer is able to describe a research domain with a tremendous degree of precision and focus (cf. Table 1). These programs were designed to be as user-friendly as possible. The user is prompted for each input, and the meta-analytic outputs are clearly labeled.

Through the use of these programs, the meta-analytic reviewer is relieved of the burden of tedious computations which have so often in the past been conducted by hand. As an anecdotal illustration, the Mullen and Rosenthal text demonstrates the application of each of the 14

meta-analytic techniques with a hypothetical research domain comprised of five studies. Each technique was applied to this hypothetical research domain by hand, as well as by the use of the corresponding computer programs. Attesting to the reliability of the programs, the computer-generated results presented in the book are equal to the hand-calculated results presented in the book (up to six decimal places). However, the 14 analyses took several hours when conducted by hand, but only 20 min when conducted by the computer programs. This time-efficiency becomes even more salient to the serious meta-analyst when a real, publication-oriented meta-analysis may in-

clude well over 100 hypothesis tests (e.g., Mullen et al., 1985, recently reported a meta-analysis of 115 tests of the false consensus hypothesis).

Finally, the Mullen and Rosenthal book was written around these 14 programs, with the intent of avoiding the all-too-common inconsistency between programs and documentation. The book, as a whole, was designed to provide both a thorough conceptual introduction to meta-analytic techniques for the novice, and a useful practical guideline for the experienced meta-analytic reviewer. This

package provides a broad, accessible, and reliable tool for researchers interested in meta-analysis.

REFERENCE

- MULLEN, B., ATKINS, J. L., CHAMPION, D. S., EDWARDS, C., HARDY, D., STORY, J. S., & VANDERKLOK, M. (1985). The false consensus effect: A meta-analysis of 115 hypothesis tests. *Journal of Experimental Social Psychology*, **21**, 262-283.
- MULLEN, B., & ROSENTHAL, R. (1985). *BASIC meta-analysis: Procedures and programs*. Hillsdale, NJ: Erlbaum.