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STATISTICAL METHODS USED BY AUTHORS OF LIBRARY
AND INFORMATION SCIENCE JOURNAL ARTICLES

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Abstract - Twenty-five core journals in the field of library and information science published in 1985 were examined to determine institutional affiliation of authors and their use of descriptive statistics and inferential statistics. Of the 915 articles studied, it was found that academic librarians published more research but relied on descriptive statistics, whereas, library school faculty published less, but made more use of inferential statistics.

INTRODUCTION

Concern for the lack of quantitative research in library and information science is echoed throughout the literature (see Butler, 1933; Shera, 1964; Goldhor, 1972; Busha, 1980). Too often, the discipline has relied on practical application and general consensus, rather than on the testing of hypotheses and the relationships between variables (Ennis, 1967). Quantitative measurement is needed to build a body of scholarship. Goldhor (1974) summarizes it best:

"If librarianship is ever to be a discipline with its own laws and principles, the derivation of those principles will have to rest in large part on the quantification of relevant observations and on the proper use of appropriate statistical methods. In general, the more nearly a field of study can deal with quantifiable data, the more likely it is to be able to express principles from which correct predictions can be made." (1)

A number of studies have examined the research processes used in library and information science literature. Wallace (1985) compared the use of statistics in four disciplines: library and information science, education, social work, and business. He argued that the use of inferential statistics indicates that a study is more scientific in its approach than the use of descriptive statistics or no statistics. Inferential statistics, in particular, test hypotheses and relationships between variables. He made no judgment regarding the appropriate use of statistical techniques, nor the logical design of the experiment. He found that only 6 percent of the articles studied used inferential statistics.

Similarly, Wyllys (1978) examined 1,157 articles in library

and information science journals for 1975 and found that while 45.1 percent made use of statistics, only 2.9 percent used inferential statistics. Kim and Kim discovered that, between 1957 and 1966, 15 percent of the articles published in College and Research Libraries were quantitative in nature, and of those, 3 percent used inferential techniques -- an amount that represented less than half of one percent of all articles examined. Between 1967 and 1976, the percentage of quantitative articles increased to 43 percent, with 24 percent of those (or 10 percent of all articles) using some inferential method. Atherton (1973) found that of the 211 research articles reviewed between 1969 and 1971, 12.8 percent employed inferential statistical analysis. Van de Water (et al., 1976) replicated this study for 1974 and discovered an increase in the use of inferential statistics to 13.4 percent. But it must be noted that the Van de Water (et al. 1976) study used only four library and information science journals: Journal of the American Society for Information Science; Journal of Library Automation; Information Storage and Retrieval; and The ASIS Proceedings. While direct comparisons among studies should not be made, general trends may be determined. From these studies, it can be observed that the use of inferential techniques in analyzing data varied widely. Upon closer examination, it appears that smaller sample size and the study of research journals (as opposed to those journals that do not publish research) showed higher inferential use. However, when the sample size was larger, and the journals represented a

broader range of library and information science literature, observed inferential use was smaller.

Much of the research in library and information science is performed by faculty and academic librarians (Childers, 1984; Krause and Sieburth, 1985; Swigger, 1985). Faculty members are required to publish in order to attain tenure, and an increasing number of academic librarians must publish to achieve tenure and faculty status (see Krause and Sieburth, 1985). Are faculty members and academic librarians, then, the major producers of research in library and information science? Swigger (1985) studied 200 Social Science Citation Index (SSCI) database entries of library and information science articles published between 1977 and 1984, and learned that 32 percent were authored by academic librarians, 23 percent by library school faculty, and 45 percent by professionals or librarians with other institutional affiliations.

Likewise, Watson (1985) analyzed the affiliation of authors of articles published from 1979 through 1983 in eleven major library and information science journals and discovered that academic librarians led in publication, followed by library school faculty.

Kim and Kim (1978), in the study mentioned earlier, also tested the professional affiliation of authors, and determined that between 1957 and 1976 academic librarians (primarily administrators) accounted for 60 percent of the publication of research articles, while faculty lagged behind at 7.2 percent. A

change occurred in the 1967-76 decade, when faculty doubled their publication efforts to 15.4 percent and academic librarians dropped slightly to 57 percent.

Krause and Sieburth (1985) surveyed twelve library journals and found that academic librarian authorship increased from 28 percent in 1973 to 42 percent in 1982. A compilation of the findings is presented in Table I.

From the studies presented, it can be seen that academic librarians have been reported as the largest single group contributing to library and information science literature. Does this group also contribute the most to research? This study examines the use of statistics by academic librarians, library school faculty, and authors with other affiliations, in order to determine who is producing research in library and information science. It also looks for the presence of statistical analysis in order to determine the scientific basis of the research being produced. This study assumes, like Wallace (1985), that the use of inferential statistics indicates research that is more quantifiable and scientifically oriented than the use of descriptive statistics. However, it is recognized that research encompasses much more than the methods used to analyze data.

The hypothesis of the present study states that there is no significant difference between the use of statistics and the institutional affiliation of authors of library and information science literature.

METHODOLOGY

The journals used for this study were taken from the 1985 Journal Citation Reports, Information Science and Library Science category, published as part of Social Science Citation Index (SSCI) by the Institute for Scientific Information. This method was also used by Wallace (1985), Peritz (1980), and Nour (1985). The twenty-five journals for 1985 with the highest impact factor were selected and labeled "core journals" for this study. (The 1985 impact factor is the number of citations to 1983 and 1984 articles divided by the number of articles published by those library and information science journals in 1983 and 1984. Use of rank order based on 1983 and 1984 articles assumes 1985 journal rankings are similar.) Journal Citation Reports for a given year are published late in the following year, i.e., 1985 JCR became available in December 1986; thus, obtaining the list and analyzing the year's publications cannot begin promptly at the end of the year studied.

The most highly-cited journal for 1985, Information Technology: Research, Development, Applications, was published in 1983 and 1984, but was absorbed by Information Technology in 1985. The surviving publication was analyzed in this study. The second journal for 1985, Annual Review of Information Science and Technology was omitted from consideration because, as an annual review, it does not contain the original publication of research. Journals in languages other than English were not considered. Social Science Information was not included because its articles

represented the social sciences, and were not related to library and information science. The twenty-five core journals chosen are listed in Appendix A.

A journal article was defined as any article appearing in one of the core journals, with exception of editorials, letters to the editor, news items, columns, book lists, bibliographies, book reviews, and obituaries.

The affiliation categories developed for this study were based on those established in the Wallace (1985) and Swigger (1985) studies. The statistical methodologies used were no statistics, descriptive statistics, and inferential statistics. The category no statistics indicates no mathematical manipulation of data. Descriptive statistics indicates a description of a measureable characteristic of a given situation. The tests used include frequencies, percentages, means, standard deviations, and correlation coefficients. The category inferential statistics is used when conclusions are drawn about the truth of a hypothesis or the relationship between variables, and inferences are made about a characteristic of a population from which a sample has been drawn. The tests used include chi-square, T-tests, F-tests, and analysis of variance. Throughout this work, only one tally was made for each article in the categories listed.

In the data collection process, a number of articles were recognized as developing sophisticated models and containing scientific notation. In order to replicate Wallace (1985), if these articles contained neither descriptive nor inferential

statistics, a no statistics tally was counted. Likewise, articles that reported on reprinted statistics established in other studies, but did not introduce new quantitative data, were reported as no statistics.

Institutional affiliation was generally based on Swigger's (1985) categories. It was anticipated that the 18 categories initially created for this study would be collapsed in order to create fewer categories at the time of analysis. A pre-test was done using the first 1984 issue of each core journal and an authority list was drawn to assure uniformity among the three data collectors. Once the categories for author affiliation were created, the differences between 'printed' and 'actual' affiliation may best be illustrated by example. In the Sliney (1985) study, "One-Woman Show: The Case of the Electronics Library," the affiliation given with the author's name was Dublin Public Library. However, the article itself was based on the author's experience as a consultant in determining the feasibility and establishment of an industrial library. In addition, a footnote explains that the author was presently working as a school librarian in a program administered by the Dublin Public Library. Not all articles examined described the author's affiliation as thoroughly as Ms. Sliney's, but neither did any others reflect such a complex relationship between the author's 'printed' affiliation and the 'actual' affiliation. In fact, some articles contained no information other than the author's name.

To determine author affiliation, the first and last pages of the article were searched. If no affiliation was found, the ALA Membership Directory and the ALA Library Directory were consulted. Affiliation was determined according to the time the article was published, and in cases of multiple authorships only the first author listed was considered. The categories used were as follows:

Library School Faculty -- library school faculty and graduate students.

Academic Libraries -- academic libraries.

Other Libraries -- special, public, and school libraries.

Faculty, Other Disciplines -- faculty of non-LIS disciplines and other university affiliations.

Government Agencies -- government agencies.

Industry/Commerce -- information industry, publishing industry, library networks.

Consultants -- Consultants, editors, professional organizations, freelance writers, no affiliation given.

The institutional affiliation and the statistics used were recorded for each core journal article for 1985, which totalled 915 articles (n=915). All data was coded, tabulated and submitted to the chi-square comparison.

DATA ANALYSIS

In 1985, articles containing no statistical analysis outnumbered those which did by a ratio of more than two to one. More specifically, the category with the greatest number of articles was no statistics, with 624 (68.2 percent) of the 915

articles. The number of articles which used some kind of statistical presentation (either descriptive or inferential) was 291 (31.8 percent). Breaking that figure into its components, descriptive statistics were used in 189, or 20.7 percent, of the published articles and the number of articles which employed inferential statistics was 102 (11.1 percent).

Of institutional affiliations, academic librarians published 239 (26.1 percent) of the 1985 journal articles examined. Library school faculty had the second highest number, with 161 of the 915 articles, or 17.6 percent.

Although academic librarians published the most articles, they did not publish the most articles using some form of statistical analysis. While either descriptive or inferential statistics were used in 74 of the 239 (30.9 percent) of the articles published by academic librarians, faculty from other disciplines published articles containing some form of statistical analysis in 75 of 125 articles (60 percent). The third largest number of articles using statistics was produced by library school faculty members, who had 58 of 161 (36.0 percent) articles in this category. No other author affiliation category had more than 27 percent of articles which reported any statistical techniques. Authors in all remaining categories used descriptive, rather than inferential, statistics.

An examination of the articles using only inferential statistics yields a different picture. The highest use of inferential statistics was found in articles published by faculty

of other (non-library science) disciplines. Forty-three of the 125 articles (34.4 percent) contributed by these authors made use of inferential statistics. The figures for library science faculty were 25 of 161 articles (15.5 percent); for academic librarians, 14 of 239 (5.8 percent) used inferential techniques.

With regard to the 628 articles which reported no use of statistical analysis, academic librarians had the largest number, 165 (26.4 percent). LIS faculty (103, or 16.5 percent) and other librarians (105, or 16.8 percent) were next, and faculty from other disciplines had the least number of these articles (50, or 8 percent).

The chi-square test for goodness of fit was employed to analyze the data collected for the 915 articles. As anticipated, nearly half (23 of the 54) of the cells in the original eighteen categories contained expected frequencies of less than five. A reliable chi-square analysis depends on expected frequencies of greater than five in each cell of the contingency table. (Some statisticians argue for expected frequencies of greater than ten.) The original categories were collapsed into seven affiliation categories with no cell having an expected frequency of less than five, and only two cells with expected values of less than ten.

The value for chi-square for 12 degrees of freedom is 121.165. The .001 level of significance gives a critical value of 32.91. Since 121.165 is greater than 32.91, the null hypothesis was rejected: the relationship between the use of

statistics and institutional affiliation is statistically significant. The contingency table and results of the chi-square analysis are shown in Table II.

DISCUSSION

Like Swigger (1985), Watson (1985), and Kim and Kim (1978), this study found that academic librarians led faculty in the publication of articles and research. What the findings of this study reveal, however, is that library faculty are producing the research that uses a more quantifiable measurement than the research of academic librarians. Could it be that the dissertation required for a Ph.D. motivates research and may introduce inferential statistics, while the M.L.S. often may not require a thesis or research? Childers (1984) lamented the fact that many library schools do not require a master's thesis (which may necessitate research) and Wyllys (1978) and Estabrook (1984) both stated that the skills needed to perform adequate research are not provided at the master's level. While the requirement to publish may be the impetus behind the proliferation of articles produced by academic librarians (see Krause & Sieburth, 1985), they may not be prepared to publish research that quantifies the results of their work.

Of all the 915 articles reviewed, a total of 11.1 percent reported inferential statistics. This compares to Wyllys (1978) at 2.9 percent; Wallace (1985) at 6 percent; Atherton (1973) at 12.8 percent and Van de Water (1976) at 13.4 percent. Has the

use of inferential statistics increased or remained about the same? The Wallace study was most closely replicated in developing the statistics categories and core journal usage. It appears, overall, the use of inferential statistics increased from 1981 to 1985. If this study is replicated at some future point, the true growth of library and information as a discipline may be more apparent.

A total of 88.9 percent of the articles reviewed in this study used either no statistics, or descriptive statistics. One factor that contributes to this lack of quantifiable research might well be the emphasis in the profession on practical application. Ennis (1967) concluded that library research is "relentlessly oriented to immediate practice." (2) It may be that librarians tend to be more interested in explaining their immediate environment than in contributing to the longitudinal development of theory. Also, it may be that the lack of support for research is partly responsible for this dearth. Pao and Goffman (1986) found that the funding level for research is directly associated with publication output. In an editorial of Library Research in 1981, Melvin Voigt pointed out that "there has been little support of research that would help establish a solid foundation for librarianship." (3) It has also been recognized that the amount of release time given to librarians for research-related activities has not increased in the last two decades, Emmick (1984).

Despite these factors, has the publication of research

increased? While a longitudinal comparison among this study and others cannot be made, general conclusions can be drawn. Coughlin & Snelson (1983) found that 33.3 percent of ACRL conference papers could be considered research. Atherton (1973) and Van de Water (1976) found that 49 percent of the publications studied could be considered research. For 1975, Peritz (1980) recorded that 31 percent of the papers studied were research and Neun (1985) reported a decrease for 1980 to 24.4 percent. For 1981, Wallace (1985) found the observed frequency of descriptive and inferential statistic usage combined was 26 percent. For 1985, the total percentage of articles using a statistical method (inferential and descriptive) in this study was 31.8 percent. It appears, therefore, that there has been little increase in the publication and reporting of research in library and information science during the last ten years.

These observations are not intended to denigrate the articles published in library and information science journals, but rather to encourage the use of statistics and an awareness of the opportunity to use data to support and develop ideas. Future replication of this study and the Wallace (1985) and Swigger (1985) studies would be of value in determining the direction of library and information science and provide a base for future theoretical development.

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NOTES

1. Goldhor, Herbert (1972). An Introduction to Scientific Research in Librarianship, 142.
2. Ennis, P.B. (1967). Commitment to Research. Wilson Library Bulletin 41, 899.
3. Voigt, Melvin (1980-81). Editorial. Library Research 2, 193.

APPENDIX A

LIST OF JOURNALS INCLUDED IN THE STUDY
(THE CORE JOURNALS OF 1985)

Journal	Impact Factor
Information Technology	3.000
Online	1.172
Journal of the American Society for Information Science	1.165
College and Research Libraries	0.780
Online Review	0.775
Library Resources & Technical Services	0.758
Reference Quarterly	0.757
Scientometrics	0.732
Journal of Documentation	0.727
Library Journal	0.669
Library and Information Science	0.652
Database	0.631
Serials Librarian	0.630
Medical Library Association Bulletin	0.531
Interlending & Document Supply	0.528
Journal of Information Science	0.478
Journal of Academic Librarianship	0.463
American Archivist	0.418
Special Libraries	0.377
Library Acquisitions: Practice & Theory	0.349
ASLIB Proceedings	0.343
International Forum on Information and Documentation	0.339
IFLA Journal: International Federation of Library Associations	0.325
Canadian Library Journal	0.316
Library Quarterly	0.293

TABLE I
PROFESSIONAL AFFILIATION OF AUTHORS OF LIBRARY
AND INFORMATION SCIENCE LITERATURE

Affiliation of Authors	Percentage in Studies During Given Years								
	Kim & Kim (1978)		Krauss & Sieburth (1985)				Swigger (1985)		Watson (1985)
	1957-66	1967-76	1973	1976	1979	1982	1977-84	1979-83	
Academic Librarians	60.9	57	28.2	34.2	36.6	42.3	31.78	44.2	
Library School Faculty	7.2	15.4					23.26	20.9	
Other Faculty	5.1	9.2					8.91	5.2	
Public Librarians							8.91	8.2	
Special Librarians							8.53	5.6	
Industry/Commerce							6.98		
Publishers/Editors							3.10		
Library Networks							3.10		
Information Brokers							2.32		
Association Executives							2.32		
Free Lance Writers							0.78		
Library Science Graduate Students	1.2	2.0							
Total	100	100					99.99	99.7	

NOTE: Totals do not add to 100 because of rounding.

TABLE II
CHI-SQUARE TEST OF AUTHOR AFFILIATION AND STATISTICS
Comparison of Observed and Expected frequencies

Affiliation		No Statistics	Descriptive Statistics	Inferential Statistics	Row Total
Library School Faculty	Observed	103	33	25	161
	Expected	109.8	33.3	17.9	
	Total %	11.3%	3.6%	2.7%	17.6%
Academic Libraries	Observed	165	60	14	239
	Expected	163.0	49.4	26.6	
	Total %	18.0%	6.6%	1.5%	26.1%
Other Libraries	Observed	105	10	5	120
	Expected	81.8	24.8	13.4	
	Total %	11.5%	1.1%	.5%	13.1%
Faculty, Other Disciplines	Observed	50	32	43	125
	Expected	85.2	25.8	13.9	
	Total %	5.5%	3.5%	4.7%	13.7%
Government Agencies	Observed	80	26	3	109
	Expected	74.3	22.5	12.3	
	Total %	8.7%	2.8%	.3%	11.9%
Industry/ Commerce	Observed	63	13	5	81
	Expected	55.2	16.7	9.0	
	Total %	6.9%	1.4%	.5%	8.9%
Consultants	Observed	58	15	7	80
	Expected	54.6	17.1	8.9	
	Total %	6.3%	1.6%	.8%	8.7%
	Column Total	624 68.2%	189 20.7%	102 11.1%	915 100%

Chi-Square for 12 degrees of freedom is 121.16524, α (.001)