

Trends in Statistical Methods in Indian Library Science Research (2012-2022)

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ABSTRACT

This research surveys statistical techniques used in Indian Library and Information Science (LIS) studies by investigating 624 articles published during 2012-2022 in two prominent indexed journals-DJLIT and ALIS. The study classifies statistical techniques under descriptive techniques, parametric inferential techniques, nonparametric inferential techniques, and predictive techniques to gauge prevailing practices and identify trends. Analysis indicates descriptive statistics, in the form of frequency distributions and percentages are predominant in LIS research. Of inferential techniques, F-test/ANOVA and Chi-square tests were most common under parametric and nonparametric categories respectively. Predictive statistics were found to have had limited use, and of those, Pearson correlation was the most used technique. Reliability analysis was applied only in 6.09 % of articles, suggesting a large methodological gap. Microsoft Excel was the most used statistical package followed by SPSS, indicating low use of advanced analytical tools. Binary logistic regression analysis illustrated that multi-authored papers and papers with academic affiliations were more likely to use predictive approaches, while foreign authors made greater use of advanced statistical methods compared to Indian researchers. The results call for increased statistical training, better standards of research methodology, and more use of advanced analytical techniques in Indian LIS studies to solidify the empirical underpinnings of the discipline.

Keywords: LIS research; Research methods; Statistical methods; Quantitative methods; Quantitative analysis

1. INTRODUCTION

Over the past few decades, the area of Library and Information Science (LIS) in India has experienced substantial expansion, keeping up with increased demand for information and technological advancements. Statistics are useful for the effective administration and planning of libraries and for assessing and improving library services. While statistics are used for a wide range of purposes in LIS, including the methodical organisation and retrieval of information as well as the assessment of user behaviour and library services, these techniques help information scientists and librarians allocate resources more efficiently, make data-driven decisions, and raise the service standard. While globally the LIS community faces certain barriers in reporting research findings through publications¹, the various factors and their impact on the local LIS community may differ among different countries. Lack of statistical skills is reported to be one of the factors that act as a barrier in LIS research². A lot of studies have been done on the growth of LIS in India and research trends in LIS in India³⁻⁵,

discussing in detail the most contributing institutions to highly evolving domains. None discuss the strengths and weaknesses in the LIS research in detail. This research will try to identify the strengths and weaknesses of the Indian LIS community regarding Statistical skills through their scholarly works.

In the context of Indian Library and Information Studies, The Defence Scientific Information & Documentation Centre (DESIDOC) and CSIR-National Institute of Science Communication and Information Resources (CSIR-NISCAIR) publications, DESIDOC Journal of Library & Information Technology (DJLIT) and Annals of Library and Information Studies (ALIS) respectively, are very important for the advancement of the field.

To improve the efficacy and efficiency of library services in this environment, statistical methods have become essential. We examined papers from 2012 to 2022 from two eminent Indian LIS journals indexed in Scopus and WoS⁶, the DJLIT and ALIS, to comprehend the significance and development of these approaches. The goal of this analysis is to shed light on the patterns, difficulties, and potential paths for statistical application in Indian LIS research. We aim to show how statistical

approaches have been used to diverse library science problems by looking through eleven years' worth of academic publications.

2. LITERATURE REVIEW

Research is an effort to learn new things and look for solutions to scientific problems. Research is an art of smart inquiry into the unknowable, and the desire to learn the world's untold truths is what drives researchers to conduct their studies⁷. Research methodology can be of many types, including quantitative research methodology to observe problems from a problem-solving angle with a strong emphasis on structure, quantification, measurement, and evaluation⁸. Quantitative studies emphasise measurement, experimentation, and causation based on the use of statistical methods to determine the relationships between variables, whereas qualitative research studies apply in-depth description, analysis, and interpretation to the resolution of a problem⁹. Mixed research methodology refers to a research strategy that employs both qualitative and quantitative methods.

While research involves the generation/gathering of data, these data need to be analysed and validated for better expression of findings and relations to the existing problems. Statistics, a branch of mathematics concerned with organising, summarising, and interpreting data, is extensively adopted in research¹⁰. According to the type of study variables, the number of groups being examined, and the inference's aim, the best statistical methods should be chosen. Additionally, the appropriate use of statistical methods must be made based on both the types of information collected and underlying assumptions to make valid conclusions and apply the study results accurately¹¹. As a result, a variety of software packages are available to aid in the application of statistical research methods¹².

Researchers believe that studying research methodology provides students and future researchers with the necessary training in selecting methods, materials, and scientific tools¹³. Although they have different objectives, these methodologies have similar elements in common, including research design, sampling strategies, data collection methods, and data analysis techniques.

A critical review of the Literature in LIS can shed some light on the examination of research methodology adopted by LIS professionals. Studies on research strategies adopted in the group of top LIS journals¹⁴ as well as Statistical applications in LIS literature over fifteen years have been reported¹⁵. Studies analysing the quantity of published research and the research methodologies used, as well as other characteristics, have provided numerous descriptions of the LIS literature overall¹⁶. The statistical techniques used in LIS literature have been focused on examining a comparatively small number of studies. It has also been debated for several decades how statistical techniques are currently used in LIS research¹⁷⁻²¹. To sum up, some previous studies have examined the topics and themes of LIS journals, while others have looked

at the research methodologies and strategies used by researchers. Furthermore, prior research has shown that the use of quantitative methodology, particularly statistical methods, plays an important role in LIS research²²⁻²³. However, few studies have looked into how different statistical methods are used in different research areas. In the field of LIS, researchers must investigate the connections between methodological elements and research topics. The current study, tries to analyse the specific statistical methods adopted in papers published in DJLIT and ALIS journals for 11-year period (2012 to 2022).

3. METHODOLOGY

Prominent LIS journals from India, viz., DJLIT and ALIS, indexed in Scopus and ESCI of Thomson Reuters, were only considered. Websites of DJLIT and ALIS were visited, and data were gathered for the period 2012 to 2022. We manually accessed the journal websites and meticulously recorded all published materials, including paper names, authors, publication dates, and abstracts. We screened 1,023 publications published within this period in total. Of them, 399 articles, which include review articles, guest editorials, brief communications and bibliographies, were not considered and removed; this thorough screening process ensured that only pertinent and unique research publications were analysed, enhancing the study's dependability and comprehensiveness.

In the end, 624 eligible research publications were chosen for study. These publications were systematically examined to provide insight into the research trends and subject focus of these defined journals. We evaluated the year and the volume of papers to ensure an in-depth review of the research output during the decade. We created a data frame to enter the variables, developed from existing frameworks for the current study, accordingly, the research approach and research method²⁴, subject domain²⁵ and statistical tests²⁶ are adopted for the current study. This thorough screening and selection procedure identified major trends and contributions to the area of LIS, providing a clear picture of the changing research landscape.

We used Microsoft Excel to document the data for each article and subjected it to further analysis using Python. Initially, we used Excel for descriptive statistics to explore relationships between variables such as journal of publication, number of authors, and types of statistics used. Subsequently, the data was imported into Python for more comprehensive statistical analyses, including Binary Logistic Regression and Cross-tabulation.

4. FINDINGS

4.1 Profile of the Authors of Articles Under Study

The profiling of authors of the selected articles was tabulated in Table 1, which reveals that male researchers (72.12 %) contributed more than their female counterparts, and a majority (88.62 %) of the authors were from

academic institutions. This profiling provides a better knowledge of the contributors' demographics and institutional backgrounds, revealing trends in author participation and affiliations within the LIS research community. Profiling authors by their country of affiliation revealed that the 624 articles were from 34 different nations. The majority of the submissions, 511 (81.90 %), came from India, followed by 28 (4.49 %) from Nigeria and 18 (2.8 %) from Iran. The remaining countries each contributed fewer than ten articles, with approximately eighteen countries contributing only one each. This analysis of contributions by country underscores the geographic diversity and concentration of LIS research, with a significant predominance of submissions from India.

Table 1. Profile of authors

Variable	Description	ALIS	DJLIT	Total	%
Gender	Male	157	293	450	72.12
	Female	63	111	174	27.88
Organisation type	Academic	184	369	553	88.62
	Non-Academic	36	35	71	11.38
Countries	India	171	340	511	81.89
	Nigeria	17	11	28	4.49
	Iran	5	13	18	2.88
	Indonesia	3	6	9	1.44
	Sri Lanka	8	1	9	1.44
	South Africa	2	5	7	1.12
	Bangladesh	1	4	5	0.8
	Oceania	0	5	5	0.8

4.2 Research Approaches, Methods Adopted by Authors

The most popular research strategy among library professionals, according to the research approaches, as seen through Table 2, is a quantitative measure, which was utilised in 84.46 % of the publications, followed by a mixed method approach by a meagre 15.54 %.

In Table 3, the research methodologies adopted by the authors were analysed, DJLIT and ALIS employed four of the top five research methodologies. The aggregate proportions for these methodologies were as follows: 252 (40.38 %) studies adopted questionnaires, 236 (37.82 %) adopted bibliometric analysis, 145 (23.24 %) were content analysis and 17 (2.72 %) adopted interviews. These data indicate a strong preference for quantitative and analytical approaches among LIS researchers.

4.3 Articles by Subject Domain Distribution

In Table 4, the subject areas that are frequently explored in DJLIT and ALIS were categorised. Informetrics emerged as the leading subject domain, with a total of 246 (39.42 %). This was followed by Library Services with 90 (14.42 %) articles, Digital Library and Metadata

with 89 (14.27 %), Scholarly Communication with 67 (10.74 %), and Library Collection with 57 (9.13 %) articles. These subject areas reflect the evolving priorities and interests within the LIS community, with a significant emphasis on the measurement and analysis of information and library services.

4.4 Sampling Techniques Adopted by Authors

Upon analysis, through Table 5, it was found that 104 (16.66 %) of the studies utilised probability sampling, while 31 (4.96 %) employed a non-probability sampling method. Within quantitative research, 82 (13.14 %) utilised

Table 2. Articles by research approach

Research approach	ALIS	DJLIT	Total	%
Quantitative	174	353	527	84.46
Mixed	46	51	97	15.54
Total	220	404	624	100

Table 3. Articles by methodology

Research methodology	ALIS	DJLIT	Total	%
Questionnaire	70	182	252	40.38
Bibliometric	78	158	236	37.82
Content analysis	73	72	145	23.24
Interview	4	13	17	2.72

Table 4. Articles by subject domain

Subject domain	ALIS	DJLIT	Total	%
Informetrics	93	153	246	39.42
Library services	15	75	90	14.42
Digital libraries and metadata	21	68	89	14.26
Scholarly communication	19	48	67	10.74
Library collection	1	56	57	9.13
Information/knowledge management	12	29	41	6.57
Research in LIS	14	24	38	6.09
Library inf. systems	1	34	35	5.61
Social media	13	20	33	5.29
Information behavior	12	13	25	4.01
Library personnel	10	13	23	3.69
Information literacy	5	15	20	3.21
Spaces and facilities	2	18	20	3.21
Knowledge organisation	3	12	15	2.4
Information retrieval	1	7	8	1.28
Other	1	5	6	0.96
Organisation & management	3	0	3	0.48
LIS theory	0	2	2	0.32

simple random sampling, and 18 (2.88 %) used stratified random sampling. Furthermore, 494 (79.17 %) articles incorporated probability and non-probability sampling approaches. This highlights the need for clearer sampling procedures in many papers, pointing to a potential gap in research transparency.

4.5 Statistical Tools and Techniques Adopted by Authors

Data in Table 6 revealed that the analysed articles employed statistical techniques categorised into four distinct groups. Our findings highlighted that in research articles, parametric and nonparametric inferential methods were prominently used across the studies. Specifically, we found that 80 articles utilised nonparametric inferential techniques, while 53 articles employed parametric methods. This underscores the variety of statistical approaches adopted in Library and Information Science (LIS) research, showcasing a robust application of inferential statistics to analyse data and derive conclusions.

Moreover, our analysis shed light on the statistical methods used throughout the past decade. Through a content analysis of 624 research publications, we observed a steady increase in the employment of statistical techniques. The three most frequently used statistical methods were F/ANOVA, accounting for 62.26 % of the cases, followed by the Chi-square test at 56.25 %, and the t-test at 35.58%. Our review also noted that several tests, such as the McNemar, ANCOVA, Comparison Test, and MANOVA, were underutilised in parametric and nonparametric methodologies. Interestingly, statistical techniques were applied more prevalently in Informetrics than in other domains. Furthermore, our findings suggest that inferential statistical methods were more commonly used than predictive or other statistical approaches.

As seen in the data presented in Table 7, predictive statistical correlation is more frequently applied in LIS research, with 64 instances, as opposed to predictive statistical regression, which saw usage 24 times. Specifically, regression techniques were the most employed among these, totaling 11 instances (45.8 %), followed by Pearson correlation, used in 27 articles (42.2 %), general correlation methods in 20 instances (31.3 %), and Spearman correlation in 17 cases (26.6 %). No studies incorporated Cox regression, ordered correlation, logistic regression, or hierarchical regression methods. This distribution of statistical methods suggests a preference for the LIS research field and highlights potential gaps where specific advanced techniques are not being utilised.

Our research revealed intriguing patterns in statistical methods within Library and Information Science (LIS) research. We discovered that researchers commonly utilise a wide range of descriptive statistics to summarise the essence of data distributions. In particular, there is a notable reliance on measures of central tendency, such

Table 5. Sampling techniques adopted in articles

Category	Type	ALIS	DJLIT	Total	%
Probability sampling	Simple random	11	71	82	13.1
	Stratified random	6	12	18	2.88
	Systematic	1	2	3	0.48
	Cluster	1	0	1	0.16
Non-probability sampling	Judgmental or purposive	3	13	16	2.56
	Convenience	2	3	5	0.8
	Snowball	2	1	3	0.48
	Quota	1	1	2	0.32
Undisclosed	Probability + Non-Probability	193	301	494	79.2
Total		220	404	624	100

Table 6. Parametric and non-parametric tests distribution

Tests applied to explore differences or relationships	ALIS	DJLIT	Total	%
Parametric (53)				
F Test/ ANOVA	11	22	33	62.3
t-test	6	13	19	35.9
Z-test	0	1	1	1.89
Non-parametric (80)				
Chi-square	10	35	45	56.3
Kolmogorov-Smirnov	6	6	12	15
Kruskal-Wallis	1	6	7	8.75
Mann-Whitney U	0	6	6	7.5
Fisher's	2	1	3	3.75
Friedman	0	2	2	2.5
Binomial	1	1	2	2.5
Wilcoxon's	0	1	1	1.25
Kendall's W	0	1	1	1.25
Sign	0	1	1	1.25

as the mean, median, and mode, as crucial indicators of the central value within data distributions. Dispersion statistics, particularly the range, were also emphasised for their role in elucidating the variability of data surrounding these central measures. Table 8 data reveals that a significant majority, 554 articles (88.78 %), incorporated simple percentages in their research, followed by the use of measures of central tendency in 183 articles (29.33 %) and dispersion measures in 102 articles (16.35 %), demonstrating a strong engagement with both basic and more complex statistical analyses in the field.

The study also revealed a deficiency in the thoroughness of reliability assessments in LIS research. From Table 9 data, it can be observed that only 40 articles (6.41 %) explicitly discussed reliability measures, with Cronbach's alpha being the primary method in 38 articles

(6.09 %). This tool is essential for confirming the internal consistency of scales and instruments, ensuring the reliability of collected data, and the credibility of the results. The limited use of reliability measures highlights an area for potential improvement in LIS research methodologies, emphasising the need for more rigorous validation of research tools and data collection techniques to strengthen the credibility and robustness of the findings.

The tabulation of software used for analysis by the authors is listed in Table 10. Our investigation found that statistical analysis tools were used in 309 articles (49.51 %), with a clear preference for specific software packages. Excel was the most frequently used tool, appearing in 198 articles (31.73 %), demonstrating its popularity and user-friendly nature among researchers. Following closely was SPSS, utilised in 95 articles (15.22 %), and R, employed in 16 articles (2.56 %). The prevalence of these tools highlights the diverse approaches to statistical analysis in the field, ranging from the use of accessible software like Excel to the adoption of more specialised programs such as SPSS and R, which cater to advanced statistical methods.

Table 7. Correlation and regression distribution

Tests applied to explore the relationship between variables	ALIS	DJLIT	Total	%
Predictive statistical correlations (64)				
Pearson's	7	20	27	42.2
Correlation	6	14	20	31.3
Spearman's	6	11	17	26.6
Predictive statistical regression (24)				
Regression	4	7	11	45.8
Multiple regression	5	5	10	41.7
Linear regression	1	2	3	12.5

Table 8. Analysis of descriptive statistical measures

Descriptive statistics	ALIS	DJLIT	Total	%
Percentage	191	363	554	88.78
Mean	52	131	183	29.33
Std. Dev	34	68	102	16.35
Skewness	1	6	7	1.12
Kurtosis	2	6	8	1.28
Undefined	26	37	63	10.10

Table 9. Distribution of reliability measures

Reliability	ALIS	DJLIT	Total	%
Cronbach's	21	17	38	6.09
Cohen's kappa	0	1	1	0.16
Split-Half technique	0	1	1	0.16
Undefined	383	201	584	93.59
Total	404	220	624	100

Table 10. Distribution of software usage

Software used	ALIS	DJLIT	Total	%
Excel	141	57	198	31.73
SPSS	69	26	95	15.22
Any other	28	28	56	8.97
R	12	4	16	2.56
Unspecified	199	129	328	52.56

Binary Logistic Regression was employed to predict the likelihood of an article utilising predictive statistics based on demographic characteristics and summarised in Table 11. In cross-tabulation analysis, we found that the number of authors and affiliation with academic organisations significantly impact the use of predictive statistics in research publications. For example, predictive stats were used only 10 times among 144 articles with one author, whereas articles with two authors had 35 occurrences out of 322. The frequency of usage increased with more authors, reaching a peak when there were five authors, with nearly half (5 out of 11) utilising predictive stats. An apparent disparity was observed between academic and non-academic affiliations. Authors with academic affiliations were much more likely to use predictive statistics (71 out of 552) than non-academic ones (only 1 out of 71). A higher number of authors and academic affiliations increased the likelihood of employing predictive methods.

Interpretation of Key Variables:

- **No of Authors:** A positive coefficient ($B=0.391$) suggests that with an increase in the number of authors, the likelihood of using predictive methods increases and is statistically significant ($p=0.002$). The odds ratio ($\text{Exp}(B)=1.478$) indicates that for each additional author, the odds of using predictive methods increase by about 47.8%.
- **Country:** The negative coefficient ($B=-0.777$) suggests that being in Country 1 (India) reduces the odds of using predictive methods compared to Country 0 (Other than India), and this is statistically significant ($p=0.007$). The odds ratio ($\text{Exp}(B)=0.460$) indicates that the odds of using predictive methods are about 54 % lower in Indian articles.

Table 11. Results of binary logistic regression analysis

Independent variables	B	S.E.	Wald	df	Sig.	Exp(B)
No. of authors	0.391	0.126	9.57	1	0.002	1.478
Cited by	0.014	0.022	0.42	1	0.517	1.015
Country	-0.777	0.289	7.23	1	0.007	0.46
Gender	-0.226	0.277	0.67	1	0.414	0.797
Organisation	2.303	1.025	5.04	1	0.025	10.006
Constant	-4.434	1.145	15.02	1	0	-

B Regression Coefficient, **S.E.** Standard Error, **Wald** Chi-Square Statistic, **df** Degrees of Freedom, **Sig.** Significance Level (p-value), **Exp(B)** Exponentiation of B (Odds Ratio)

- **Organisation:** A large positive coefficient ($B=2.303$) indicates that authors with academic affiliations (1) are much more likely to use predictive methods compared to non-academic affiliations (0). The result is statistically significant ($p=0.025$), and the odds ratio ($\text{Exp}(B)=10.006$) shows that authors with academic affiliations are ten times more likely to use predictive methods.

5. DISCUSSION

Literature has given enough signals that the library science domain has evolved in conducting research, but lacks rigour as it is meant to use statistical methodology. Previous studies stated lack of statistical skills as a major barrier in LIS research² and our study too has proved that the adoption of statistics in interpretation of data is less among LIS professionals in India. We could statistically show that the usage of descriptive statistics is predominant, and Excel usage is higher compared to other software, which shows that researchers prefer minimalistic effort and that statistics are used just to run descriptions.

6. THE IMPLICATIONS OF THE STUDY

Our research suggests important implications for the Library and Information Science (LIS) field and its education programs. Firstly, we highlight the need for methodological updates in LIS research, including a stronger emphasis on statistical reliability and detailed documentation of sampling methods. To address this, guidelines emphasising these critical elements should be established. Furthermore, the dominance of quantitative methods indicates a gap in qualitative and mixed-methods research. Expanding methodological education to include these approaches will diversify LIS research and allow the exploration of a broader range of topics.

Additionally, the prevalent use of basic statistical tools like Excel and SPSS, contrasted with the limited use of advanced software such as R, points to a skill gap among LIS researchers. We recommend training programs to enhance proficiency in advanced statistical software, potentially leading to more sophisticated analyses and better research outcomes. As our study highlights the least use of statistics in the domain, we encourage future researchers to survey LIS professionals to analyse the reasons for the non-adoption of more statistics in their research.

7. CONCLUSION

Statistical analysis has been part of research work across all the major domains. As the research domain continuously evolves across the domains, the usage of statistical methodology has evolved. Library science plays a vital role in supporting the data needs across the domains, so future researchers in the domain might need to deal with big data to build a better model to support library research work. Our study highlights the use of the descriptive statistical method as the commonly used methodology in most research. This implies that

authors tend to use statistical methods to describe the data and fail to focus on predictive or prescriptive statistics. Researchers should get hands-on training in using software to run statistical methods, as the most commonly used statistical tool remains Microsoft Excel. Addressing the gaps mentioned above will improve the quality of research in the library science domain; thus, the domain will become ready for the future.

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