RESEARCH LIBRARIES: CONNECTING USERS TO NUMERIC AND SPATIAL RESOURCES

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ABSTRACT:
The burgeoning use of numeric data resources across all academic disciplines raises significant questions about the library's role in providing data services and promoting quantitative literacy. This study analyzes the Web pages of a random sample of large research libraries to determine the presence and promotion of data services and sources at a sample of large research libraries (and their related institutions) in North America. The results prompt the authors to challenge libraries to more fully engage their users in efforts at richer discovery, use, and analysis of data.

Keywords: numeric data, spatial data, data library, data retrieval, data services

THE CONTEXT

In our complex world, adults are challenged to apply increasingly sophisticated quantitative knowledge and reasoning in their professional and personal lives. Newspaper headlines are replete with measures that report, for example, increases in gas prices, incidence of cancer by age group, or educational attainment in regions of the country. Universities are responding by either strengthening existing policies or crafting new policies to prepare students for this "data-drenched society" (Steen & National Council on Education and the Disciplines., 2001). Building upon the concept of a data-drenched society, Steen suggests that "quantitatively literate citizens need to [be] predisposition[ed] to look at the world through mathematical eyes, to see the benefits (and risks) of thinking quantitatively about commonplace issues" (Steen & National Council on Education and the Disciplines., 2001). Academic librarians who have not already perceived an increase in the frequency and complexity of reference inquiries involving data identification and analysis may reasonably expect to confront such an upsurge soon.

As a follow up to our preliminary examination of some of these questions in "Interactions Between the Academic Business Library and Research Data Services" (Bennett & Nicholson, 2004), we are interested in assessing the presence and promotion of data services and sources for all disciplines within academic libraries. [Data services and sources could include numeric data sets, statistics, and services related to the manipulation and analysis of these data and statistics. Hereafter, we refer to these sources and services in tandem by the generic phrase "research data resources" or "data resources".] The library's role in meeting the traditional information needs of its users is well-examined; we would like to embark on a deeper exploration of the emerging role of libraries in support of data-seeking users.

NUMERIC DATA COLLECTIONS IN LIBRARIES

Librarians and archivists have a relatively long and distinguished history of thinking about numeric data collections and services (Fishbein *et al.*, 1973; Heim, 1982, *The proceedings*, 1970). Even during the formative years – the 1960s and early 1970s saw an increased effort to create and market numeric collections – concerns about findability and usability were well voiced. Heim describes the "high cost and poor understanding" of the role of numeric

collections (Heim, 1982). Adams did not mince words when she wrote, "put most simply, the material in data libraries is a vital source of information for social research, yet because of the nontraditional format of these data, has been ignored by the information community at large" (*The proceedings*, 1970).

In his 1969 paper, "The Library of the Future," Welsch couches similar concerns in far too common terms of "centralization vs. decentralization" (Welsch, 1969). Because of proximity issues, he worried that traditional librarians were unable to fully utilize data archives. Though he was speaking then about physical library space, we can easily transfer the concept to the findability and usability issues that pervade the organization of online space at an institution's Web site.

Yet despite their collective worries, these early authors were quite prescient when commenting that "it is now clear that an archive for machine-readable data and programs will be an increasingly important part of the library of the future" (*The proceedings*, 1970). Moreover, their objectives were pragmatic for sure: stimulate communication with front-line librarians and promote the creation and development of data libraries as an integral part of the campus library system. That was more than thirty years ago. It is interesting to examine now whether these goals perdure, and if academic librarians have made significant strides towards achieving them.

PARALLELS: INFORMATION LITERACY AND QUANTITATIVE LITERACY
At roughly the same time that Adams *et al.* were exploring and promoting numeric data libraries, a host of writers were extolling the concept of information literacy. As recounted in Spitzer, in 1974, Paul Zurkowski, president of the Information Industry Association, introduced the concept of information literacy in a proposal submitted to the U.S. National Commission on Libraries and Information Science (NCLIS) (Spitzer *et al.*, 1998). The proposal recommended that a national program be established to achieve universal information literacy by the end of the 1970s. As presently formulated, information literacy is a set of abilities requiring individuals to "recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information" ("Information literacy competency standards for higher education", 2000).

Though definitions for quantitative literacy abound (Steen & National Council on Education and the Disciplines., 2001), we have settled on quantitative literacy as the ability to formulate, evaluate, and communicate conclusions and inferences from quantitative information. Though information literacy and quantitative literacy have traveled on parallel tracks, their connection cannot be overstated. Fundamentally, each literacy effort works from the same model: find, retrieve, analyze, and use. Typical patron-librarian interactions often end after the information sought has been retrieved. However, the emergent trends in quantitative literacy focus on the last two elements of the model. As a result, librarians will no longer be able to simply point to data resources; rather, a successful transaction will be defined by the librarian's understanding of how a user intends to manipulate the data (analyze and use). This shift in service responsibilities will challenge the traditional role of librarians, and may necessitate a more formal and intensive collaboration with data experts external to the library.

In "When Quantitative Analysis lies Behind a Reference Question" (D. R. Gerhan, 1999), and the follow-up "Statistical Significance: How it Signifies in Statistics Reference" (D.

Gerhan, 2001), David Gerhan addresses this need for specialized reference services much more directly. Largely primers for academic reference librarians, these instructive articles assert that it is not enough for reference librarians to be able to identify the sources for successful data retrieval. In order to deliver accurate and complete data reference service, it is also essential that the reference librarian understand how the user intends to statistically manipulate the data retrieved. While it may not be practical for all reference librarians to become statistics experts, Gerhan nevertheless maintains that "whatever intellectual preparation permits the reference librarian to speak the user's subject language and to raise intelligent and effective alternatives when retrieval appears blocked would be worthwhile"(D. Gerhan, 2001). The emergence of instructional articles such as these indicates the growing need for data manipulation to be combined with traditional reference services.

It is within this context that we sought to explore how libraries currently fare in their efforts to connect users to numeric and spatial resources.

METHODOLOGY
This study analyzes the Web pages of a random sample of member institutions of the Association of Research Libraries (ARL), an organization of libraries at major universities and certain other institutions, whose collections are broadly based and whose services are recognized as having a national significance. The purpose of this analysis is to determine the presence of research data resources (in the library or elsewhere at the institution); the ease with which library users can find these resources; and the library's role in support of the use of numeric data in scholarly research. Using the randomizer within Microsoft Excel, the 50 percent sample (N=62) of the 123 ARL member institutions was generated. Reflecting the composition of ARL membership, the sample includes mostly large academic libraries (N=56) from the United States and Canada, along with a small number of public and governmental libraries that have a major research focus.

The analysis was conducted from July through September 2005. Using an unobtrusive survey technique, descriptions of data resources and the paths to discovery of these resources were placed into four broad code categories: data, statistics, government, and GIS. The content was further divided into subcategories, and a system for coding was developed to describe the observed results (see Appendix). Codes were entered into a spreadsheet for analysis. This method of analysis of Web content and data collection is similar to the coding technique described by Hahn and Schmidt, who proclaim that "a library's Web site can provide a powerful forum for communicating with users…" (Hahn, 2005). While Hahn and Schmidt were concerned with the use of library Web pages to communicate to faculty the library's collections policies as well as broader issues of scholarly communication, our focus is on the use of library Web pages to promote research data resources.

For our examination, analysis of each case followed the same pattern: 1) The library's Web site was browsed for relevant terms from each broad category; 2) the site was then searched for these terms (except in the few instances where no search function was available); and 3) a search was performed on the institution's entire Web site (except in the few instances where the library and the institution were one in the same). This combination of browsing and searching was intended to replicate the information-seeking behavior of a typical user, in accordance with observations made by Chen and Feng-Yang et al. (Chen *et al.*, 2005; Feng-Yang *et al.*, 2004). No matter how many results arose from searches, we chose to limit our

review of search results to the first two pages displayed, assuming that the typical user would not probe deeper than this to review the results of a search. The Appendix includes the aggregated results of our examination and coding.

ANALYSIS

Library Homepages
The most striking observation from our analysis of these ARL library web sites is that nearly four out of five (79%) of the library homepages in our sample made no mention of the availability of research data resources (Figure 1). This supports our concern that users at academic institutions may disregard the library as a starting point for access to research data resources – at least from the cues they receive on their first glance at the library's Web site.

This also supports the more troubling conclusion that while academic libraries may indeed be the *intended* access point to data resources, these resources remain difficult to find and are woefully undermarketed. It would be unfair, however, to neglect to also acknowledge that this observation reflects a growing trend toward homepage simplification (with fewer words on the homepage and detailed information placed more deeply within the Web site). Nevertheless, for those of us who would contend that data resources are an essential component of the research process, we would expect that "find data" would be as prominent a homepage feature as "find books" or "find articles." However, only 21% of the libraries from our sample offered this feature.

Browsing for Data Services and Statistics
The homepage observations discussed above are not indicative of the actual availability of research data resources at the libraries in our sample. By browsing beyond the libraries' homepages, users will find richer rewards. Those who follow likely paths in pursuit of "data" or related terms would find relevant results at 40 institutions – a 65% success rate (Table 1). Among these 40 institutions, however, at 11 of them (28%) a browse for "data" and related terms leads the user through a trajectory that ends at only government-provided data sources.

Although our methodology involved separate browses for "data" (or related terms) and "statistics," one of the revelations from our analysis is that libraries generally make no attempt to differentiate between these terms when providing pointers to numeric information sources. Thus, a browse for "statistics" from library web sites is even more fruitful than a browse for "data" – 49 of the libraries in our sample (79%) offered links to significant statistics resources for users willing to probe a page or two in from the home page. The type of information resulting from these browses was usually indistinguishable from the result of browsing for "data." And the prevalence of browses for "statistics" that ended at government-provided sources only – 27% of the total successful browses – was, not surprisingly, very similar to that found from browses for "data" terms. (See *Government Information* below for an additional discussion of government data sources.)

Using the Search *Feature to Dig Deeper*
When we compare the results of *searching* versus *browsing* at library Web sites, we again conclude that libraries (or at least their Web designers) are their own worst enemy in promoting use of research data resources. At libraries where *browsing* a seemingly intuitive path often leads to a dead end, a subsequent site *search* uncovers a relevant result.

Specifically, in our attempt to browse the libraries' Web pages for "data" terms in the same manner as typical users might, we were unable to find any mention at all of data sources at 35% of the libraries in our sample – yet a subsequent *search* revealed that 77% of these libraries actually had viable sources of data available (Table 2). A search for "statistics" yielded a similar browse-versus-search success ratio. Of the 21% of all libraries in our sample at which it was not possible to encounter statistics sources by browsing, 69% of these actually did offer relevant resources, which were uncovered as the result of a site search.

Moreover, even in instances where a browse for data terms or statistics was successful, it was frequently observed that additional viable results could be revealed by searching. This was true for data terms at 32% of the libraries in our sample; and for statistics, at 45% of the libraries in our sample (Table 2).

Government Sources of Data and Statistics
As noted above, for some libraries the principal sources for data or statistics are compilations from the U.S. Census Bureau and other government agencies. Therefore, our analysis also considers the possibility that users may be directed to statistics – and possibly raw data – by browsing the libraries' links to government information. At an impressive 87% of the institutions from our sample, users could easily browse to relevant sources of government statistical information (Table 3). Fully 89% of these were either compilations of links to a significant range of statistics or data sets – or else to the most efficient search tools for finding them (FedStats, FirstGov, etc.).

This is a heartening observation, although it is tempered by the well-documented knowledge that the typical user is likely to be unaware that the federal government gathers and disseminates voluminous statistics in a variety of disciplines (Caswell, 1997; Hogenboom, 2002; Reeling *et al.*, 1991). So, it remains unlikely that statistics-seeking patrons would follow the path to government resources without librarianly intervention.

Notwithstanding users' unawareness of the wealth of available government statistics, the tireless efforts of librarians to promote the use of government information is evident from the results of our analysis. It is not surprising that there was only one institution within our sample at which users would be unable to browse to or search for government data. Similarly, there were only seven institutions at which users needed to *search* to find government data after a fruitless *browse*. However, much government data remains elusive, as evidenced by the high proportion of libraries – 24 out of 54 (44%) – at which a search is required to uncover additional available resources that are not revealed by a typical browse.

Interactions between the Library and the Institution
As we observed in our earlier article (Bennett & Nicholson, 2004), research data resources are not the exclusive purview of libraries, so we also wanted to identify the presence of these resources external to the library in the institutions represented by our sample. [At some ARL libraries – such as the National Library of Medicine or the New York Public Library – there is no institution that is distinct from the library. Six such libraries ended up in our random sample, so for purposes of this part of our analysis the sample size is 56.]

At 48% of the institutions sampled, the library was the only source of relevant results from searches for "data" and related terms (Table 4). Even more impressive was the number of institutions (64%) at which a search for "statistics" pointed only to the library for significant

resources. Considered in tandem, these numbers marginally support an expectation that the library will serve as the primary repository of data and statistics in support of academic research. While this observation is buttressed by the high rates of successful browses for data and statistics at library Web sites, it would be stronger if it were not contravened by the very low rate of library home pages that mention research data resources. These findings are consistent with the results from our previous study (Bennett & Nicholson, 2004), where we discovered a wide variation among institutions concerning the presence of research data resources, as well as the ease with which users could expect to find them.

 Supplementing Data Delivery with Data Analysis
As noted above, a fully successful reference transaction that involves requests for data or statistics may also include assisting the user with analysis or manipulation of these resources. With this in mind, we also tried to identify libraries and institutions that offered these additional services (that is, help with the use and manipulation of data). For example, of the 40 libraries at which a browse for data resources yielded viable results, fully 50% of these offered data services as well as data sets (Table 5). Not surprisingly, none of these libraries offered data services only; in all cases these services were coupled with links to data sets.

However, among the 29 institutions where data resources were available from locations external to the library, not only did a smaller proportion of these (38%) feature services along with links to datasets, but a small number (5%) offered data services only: data consultants were available to assist with data interpretation; or data analysis software was available; but there was no apparent link to data sources.

An institution-wide search for "statistics" found only 20 institutions where resources were available from outside the library, but more than half of these (55%) offered services in support of the use and manipulation of these statistics. Among these institutions, 11% offered services only, with no apparent link to actual data sets or statistics.

DISCUSSION

Imprecise Terminology
As noted in the description of our methodology, we were careful to separate the terms "data" (raw numbers or other observations) and "statistics" (the result of data that has been analyzed or pre-compiled) when performing our browses and searches. However, there seemed to be almost no attempt to give effect to the distinction between these two terms at the institutions in our sample. Thus, it was not unusual to find that our observations became blurred by sections of library Web pages with headings such as "find data" or "data and statistics," which might include data sets only, statistics sources only, or a combination of both. These resources were categorized in some instances by academic discipline; in other instances by the source of the data or statistics. This lack of clarity is certainly consistent with common parlance – as well as with the authors' own anecdotal observations about reference-desk transactions involving data or statistics sources – but ultimately it may indicate that patrons are being underserved as we try to help them move towards increased numeric literacy.

Institutional Inertia
It is also important to acknowledge that while our findings indicate no clear model for offering research data resources, this may be nothing more than a very accurate reflection of the natural evolution of historical practices. At some institutions, data resources may fall

under the purview of an academic department such as Sociology or Political Science or Economics; at other institutions they may be aligned with Information Technology or another administrative area that can offer the technology and technical expertise to support data storage and manipulation or statistical analysis software. In tandem with historical precedent and entrenched institutional custom, there may also be budgetary considerations that would make it impractical for the library to be the primary repository of research data resources. If the purchase and maintenance of expensive data sets or statistical software is tied to an academic department or administrative office external to the library, it may be difficult to effect the institutional sea change that would move this expense to the library's budget.

GIS – a Model of New Best Practices?
In view of the above-cited observations of nonuniform practices in providing access to research data resources, we determined that it would be useful to observe how a very specific, and relatively new, subset of data resources is being made available at the academic institutions in our sample. Researchers – and the librarians who assist them – are only beginning to realize the unique possibilities for data analysis and representation offered through geographic information systems (GIS). As this valuable data-laden research tool rapidly emerges in support of scholarly inquiry in a variety of academic disciplines, we set out to discover whether the availability of GIS-related data resources mirrors the patterns that we found for other non-GIS data resources. Put simply, we wanted to know whether GIS resources are as haphazardly placed and difficult to uncover as other data resources, or if a new paradigm – untethered to historical precedent and institutional intransigence – has emerged. If so, would that model reflect the strong recommendation of other librarians – and ARL's own guidelines (French, 2001; Shuler, 2001) – that GIS would be most efficiently accessible via a prominent presence at the library?

Library Web site users at more than half of the institutions in our sample (55%) can easily browse to GIS resources (Table 6). Of the 28 libraries where typical users would be unable to *browse* to GIS resources, 11 of these were actually found to have GIS resources available, after the library Web site was *searched* for GIS information. The proportion of library Web sites at which a typical user would be unable to find GIS resources by browsing or searching (27%) is much higher than those that result in unsuccessful browses and searches for "data" (8%) or "statistics" (6%) (Table 2).

Given that the use of GIS resources is still an emerging phenomenon, it is not surprising to discover that such resources are not as prevalent at libraries as are other types of data and statistics. What is impressive, though, is the low proportion of libraries at which a *search* of the Web site was needed to yield additional viable results after results had already been found by *browsing*. To find "data" or "statistics," 32% and 45% of libraries, respectively, require a search to uncover additional viable results after a browse has already yielded results (Table 2). In contrast, only 10% of libraries that have GIS resources that a user could *browse* to have *additional* GIS resources that could only be discovered through a *search* of the library Web site (Table 6). So, while fewer libraries have GIS resources, these resources are more prominently featured at these libraries than are other data resources. Stated differently, at 74% of the libraries that had GIS data, all of this data could be found by *browsing*; a *search* of these libraries' Web sites turned up no additional GIS information.

A search for GIS resources external to the library revealed that at 48% of the institutions in our sample, it was necessary to look beyond the library in order to find relevant GIS

resources (Table 6). This is slightly less pervasive than the *data* resources at our sample institutions that are external to the library (52%), but much greater than the proportion of institutions that have *statistics* sources external to the library (36%) (Table 4). Stated differently, data resources and GIS resources are almost equally likely to be accessed via the library as via an institutional source external to the library. As with data resources, the adequate delivery of GIS resources includes a strong service component (that is, it is not sufficient for users to merely find and retrieve data and GIS resources, but also to analyze and use them). It is therefore not surprising to find that a similar proportion of libraries that lack the staff or expertise to handle complex data requests also are unable to handle GIS requests. These resources, by necessity, then fall under the purview of institutional centers external to the library.

We would expect that users may be largely unfamiliar with the concepts and techniques needed to make meaningful use of GIS resources, so it is also not surprising to find that, where GIS resources are available, a majority of libraries and institutions (68% and 67%, respectively) offer specialized services (dedicated GIS workstations, consultation, instruction, etc.) along with access to GIS data. This is much higher than the proportion of libraries – or institutional locations external to the library – at which services are offered in support of the use and manipulation of data and statistics (Tables 4 and 5).

SUMMARY AND CONCLUSIONS
Analysis of primary and secondary numeric data is an integral component of the research and scholarship taking place at research institutions, yet the role of libraries in this enterprise has been little studied. This study sought to investigate the presence of research data resources (in the library or elsewhere at the institution); the extent to which library users are made aware of such resources; and the library's role in support of the use of numeric data in scholarly research.

Not surprisingly, in our investigation of the presence of research data resources, we found very few libraries that are willing to promote these resources on their homepage. However, many libraries point to these resources elsewhere on their Web sites. A significant portion of libraries have made it easy for users to follow intuitive paths (browse) to extensive numeric and statistical sources, especially government-provided resources. However, about half of all data sources available from the library are sufficiently hidden that they can only be uncovered by more persistent means (searching). Moreover, we found that the library is not the exclusive gateway to all research data resources; users must look at institutional offerings external to the library for additional significant resources.

We also discovered that libraries and institutions that provided access to data sets and other data sources did not provide concomitant access to – or explanations of – services needed for the manipulation and analysis of these sources. As numeric data and statistical sources demand a higher level of interaction following their discovery than do typical bibliographic resources, users often require additional services (such as downloading and converting to a usable format) immediately following discovery. The findings from this study portend a general recognition at research institutions of the user's need for additional services, such as analysis and interpretation, in order to make full use of data and statistics. We believe that libraries are a natural place for this type of service. If the library does not yet have the resources or expertise to offer such services, then the user may have to seek out these services at campus units external to the library. If these units are also the source of data sets

and statistics, then the library risks becoming marginalized in serving the needs of the data-seeking user.

Our analysis of GIS resources at academic libraries and institutions was inconclusive as a harbinger of future trends, but we hold out hope that more libraries will soon serve as the primary access point for all research data resources. We acknowledge that institutional precedent may make this transformation a slow one. At minimum, libraries that do not already serve as repositories of data resources should make connections with the campus centers that provide these resources, even if these connections are merely links on Web pages. We would also caution libraries not to further stall this transformation because of the possible inability or unwillingness of librarians to deal with the potential complexities of data-related queries. If libraries are currently unprepared to position themselves as data resource centers, then they might include this goal in their long-term strategic planning. For the short term, they should serve their users by providing clearer connections from the library to the institutional data resource center.

FURTHER RESEARCH
Libraries recognize that, in order to remain relevant, they must be learning and teaching centers and not mere depositories of information. One manifestation of this model is achieved by offering effective centralized delivery of integrated research data resources. While we found several wonderful examples of this type of library-centered inclusive service, further investigation is required to determine if these models are successful. Our unobtrusive study did not ask, nor could it ask, this qualitative question. Future research efforts should focus on a comparative qualitative analysis of divergent modes of delivering research data services at academic institutions.

We realize that an integral component of any library's Web site is the online public access catalog (OPAC). This online version of the traditional card catalog remains the primary tool for identifying and finding a library's resources, yet our analysis does not consider the effectiveness of the OPAC as a means of connecting users to data resources. We specifically endeavored to assess the library's Web pages for pointing to and promoting research data resources, on the assumption that users with an ill-defined data need would be frustrated by an OPAC search – or not even conceive of a connection between the OPAC and the information needed. While the OPAC is very effective in providing access to physical items in the library's collection – especially when a user can search by title, author, or other specific descriptor – it is less efficient in helping a user with more nebulous needs (i.e., "population data" or "health statistics"). This is especially true when the types of potentially suitable resources – such as institutional resources external to the library, Web resources external to the institution, online datasets shared by subscriber institutions, or data labs with dedicated analytical software and data technicians – cannot be adequately identified within the constraints of an OPAC. As OPACs continue to evolve to accommodate the expanding prevalence of nontraditional library resources, it would be very interesting if future research efforts were to assess the effectiveness of integrating data resources into the OPAC.

We also realize that our sample for this study was drawn only from North America's largest research libraries. Our observations, therefore, do not give effect to patterns and practices at smaller academic libraries, or at libraries outside of the United States and Canada. For example, we are already aware of a compelling case study, at a non-ARL institution, of a significant transformation that resulted in library oversight of research data services that had

previously been scattered among various locations (Duke *et al.*, 2005). It would be interesting to perform a comprehensive study of current and emerging practices across various strata of non-ARL libraries, as well as an examination of libraries outside of North America.

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Appendix	
Research data resources at ARL libraries	
Coding scheme with aggregated results	

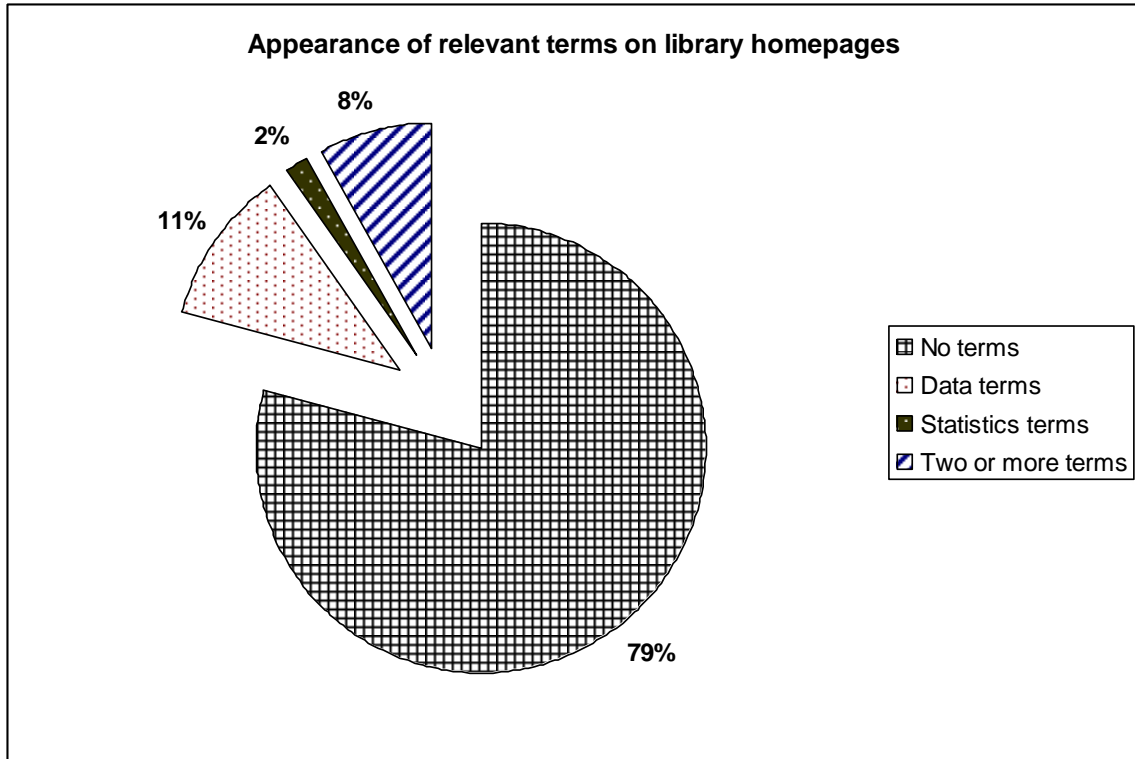| Code	Description	Totals
1.0	No mention of datasets, statistics, government data, etc. on library homepage	41
1.1	Library homepage mentions data, numeric data, or dataset	7
1.2	Library homepage mentions statistics	1
1.3	Library homepage mentions government statistics, or government data	0
1.31	Library homepage mentions government *documents*, but not specifically government *data* or *statistics*	8
1.4	Library homepage mentions GIS	0
1.5	Library homepage mentions two or more relevant terms	5
2.0	Unable to readily browse to data terms on library website *	22
2.1	Data terms found by browsing library website, includes data services only (data lab, consultation, reference assistance)	0
2.2	Data terms found by browsing library website, includes data sets only (ICPSR, etc.)	9
2.3	Data terms found by browsing library website, includes data services *and* data sets	20
2.4	Data terms point primarily to government resources	11
3.0	Unable to readily browse to statistics on library website	13
3.1	Statistics terms found by browsing library website, with links to statistics resources	28
3.2	Statistics terms found by browsing library website, with no links to significant statistics resources	7
3.3	Statistics terms point to proprietary databases (Statistical Universe, TableBase, etc.) with significant statistical content	1
3.4	Statistics terms point primarily to government resources	13

4.0	Unable to readily browse to government terms on library website **	8
4.1	Government terms found by browsing library website, with extensive links to a broad range of statistics or data sets	34
4.2	Government terms found by browsing library website, primarily with links to government search tools (FirstGov, Fedstats, etc.)	14
4.3	Government terms found by browsing library website, primarily with a links to the US Census website	6
5.0	Unable to readily browse to GIS on library website	28
5.1	GIS terms found by browsing library website, includes services only (GIS software and workstations, consultation, instruction)	0
5.2	GIS terms found by browsing library website, includes data sets only	11
5.3	GIS terms found by browsing library website, includes GIS services *and* data sets	23
6.0	Could not readily *browse* to data terms, and a *search* of the library website also turned up nothing	4
6.1	Could not readily *browse* to data terms, but a *search* of the library website turned up viable results	17
6.2	Data terms were found by browsing the library website, and a search turned up *additional* viable results	20
6.3	Data terms were found by browsing the library website, but a search turned up nothing new	15
6.4	No library website search is available	6
7.0	Could not readily *browse* to statistics, and a *search* of the library website also turned up nothing	3
7.1	Could not readily *browse* to statistics, but a *search* of the library website turned up viable results	9
7.2	Statistics were found by browsing the library website, and a search turned up *additional* viable results	28
7.3	Statistics were found by browsing the library website, but a search turned up nothing new	16
7.4	No library website search is available	6
8.0	Could not readily *browse* to government terms, and a *search* of the library website also turned up nothing	1
8.1	Could not readily *browse* to government terms, but a *search* of the library website turned up viable results	7
8.2	Government terms were found by browsing the library website, and a search turned up *additional* viable results	24
8.3	Government terms were found by browsing the library website, but a search turned up nothing new	24
8.4	No library website search is available	6
9.0	Could not readily *browse* to GIS terms, and a *search* of the library website also turned up nothing	14

9.1	Could not readily *browse* to GIS terms, but a *search* of the library website turned up viable results	11
9.2	GIS terms were found by browsing the library website, and a search turned up *additional* viable results	6
9.3	GIS terms were found by browsing the library website, but a search turned up nothing new	25
9.4	No library website search is available	6
10.0	Institution search for data terms yielded no additional relevant results	12
10.1	Institution search for data terms primarily points to the library	12
10.2	Institution search for data terms yielded data sets not found in library search	18
10.3	Institution search found significant mention of the use and manipulation of numeric data, including codebooks, but no links to datasets (except from the library)	0
10.4	Institution search found significant mention of the use and manipulation of numeric data, but no links to datasets	3
10.5	Institution search found significant mention of the use and manipulation of numeric data, *and* links to datasets not found in the library	8
10.6	Search results are dominated by institutional datasets (admissions, enrollment, etc.) -- not applicable	3
11.0	Institution search for statistics terms yielded no additional relevant results	5
11.1	Institution search for statistics terms primarily points to the library	16
11.2	Institution search for statistics terms yielded statistics or data sets not found in library search	9
11.3	Institution search found significant mention of the use and manipulation of statistics (workstations, software, consultations), but no links to datasets (except from the library)	3
11.4	Institution search found significant mention of the use and manipulation of statistics (workstations, software, consultations), but no links to datasets	6
11.5	Institution search found significant mention of the use and manipulation of statistics (workstations, software, consultations), *and* links to datasets not found in library	2
11.6	Search results are dominated by institutional statistics (admissions, enrollment, lab usage, etc.) -- not applicable	15
12.0	Institution search for GIS terms yielded no additional relevant results	17
12.1	Institution search for GIS terms primarily points to the library	12
12.2	Institution search for GIS terms yielded GIS data not found in the library search	9
12.3	Institution search found significant mention of GIS instruction or services (workstations, software, consultations), but no links to datasets (except from the library)	4
12.4	Institution search found significant mention of GIS instruction or services (workstations, software, consultations), but no links to datasets	7
12.5	Institution search found significant mention of GIS instruction or services	7

	(workstations, software, consultations), *and* links to datasets not found in library

* Data terms include "data," "numeric data," "data set," and "dataset."
** Government terms include "government data" and "government statistics."

Appearance of relevant terms on library homepages

- 8%
- 2%
- 11%
- 79%

Legend:
- No terms
- Data terms
- Statistics terms
- Two or more terms

Figure 1: Appearance of data, statistics, government, or GIS on library homepages. Note that Government and GIS terms are included in some sites where two or more terms were found.

Table 1
Browsing **for "data" and "statistics"**

Data	Code(s) *	Number/ Subtotal	Percent of Total (n=62)	Percent of Subtotal
Unable to browse to data terms on library website	2.0	22	35%	
Browse points to data sets only	2.2	9	15%	
Browse points to data sets and data services	2.3	20	32%	
Browse points to government-provided resources only	2.4	11	18%	
Subtotal: all successful data browses	2.2, 2.3, 2.4	**40**	65%	
Government-provided resources included above	2.4	11		28%
Statistics				
Unable to browse to statistics on library website	3.0	13	21%	
Browse points to statistics resources at the library	3.1	28	45%	
Results of browse are not significant statistical resources	3.2	7	11%	
Browse points to databases with statistical content	3.3	1	2%	
Browse points to government-provided resources only	3.4	13	21%	
Subtotal: all successful statistics browses	3.1, 3.2, 3.3, 3.4	**49**	79%	
Government-provided resources included above	3.4	13		27%

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 * See Appendix for fuller description of codes

Table 2
Comparison of *browsing* and *searching* for "data" and "statistics"

Data	Code(s) *	Number/ Subtotal	Percent of Total (n=62)	Percent of Subtotal
Unable to *browse* to data terms on library website	2.0	**22**	35%	
Browse is unsuccessful; *search* is also unsuccessful	6.0, (6.4 and 2.0)	5	8%	23%
Browse is unsuccessful; *search* points to viable results	6.1	17	27%	77%
Browse to data terms is successful	2.2, 2.3, 2.4	**40**	65%	
Browse is successful; *search* turns up nothing new	6.3, (6.4 and not 2.0)	20	32%	50%
Browse is successful; *search* points to *additional* viable results	6.2	20	32%	50%
	Statistics			
Unable to *browse* to statistics terms on library website	3.0	**13**	21%	
Browse is unsuccessful; *search* is also unsuccessful	7.0, (7.4 and 3.0)	4	6%	31%
Browse is unsuccessful; *search* points to viable results	7.1	9	15%	69%
Browse to statistics terms is successful	3.1, 3.2, 3.3, 3.4	**49**	79%	
Browse is successful; *search* turns up nothing new	7.3, (7.4 and not 3.0)	21	34%	43%
Browse is successful; *search* points to *additional* viable results	7.2	28	45%	57%

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 * See Appendix for fuller description of codes

Table 3
Comparison of *browsing* and *searching* for government terms

Description	Code(s) *	Number/ Subtotal	Percent of Total (n=62)	Percent of Subtotal
Unable to *browse* to government terms on library website	4.0	8	13%	
Browse is unsuccessful; *search* is also unsuccessful	8.0	1	2%	
Browse is unsuccessful; *search* points to viable results	8.1	7	11%	
Browse to government terms is successful	4.1, 4.2, 4.3	**54**	87%	
Links to extensive data sets or search tools included in results above	4.1, 4.2	48		89%
Browse is successful; *search* turns up nothing new	8.3	24		44%
Browse is successful; *search* points to *additional* viable results	8.2	24		44%

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 * *See Appendix for fuller description of codes*

Table 4
Comparison of *library* and *institutional* resources for data and statistics

Data	*Code(s) **	*Number/ Subtotal*	*Percent of Total (n=56)*	*Percent of Subtotal*
Institution search for data terms yields no results outside of library	10.0, 10.1, 10.6	27	48%	
Institution search for data terms yields results not found in library	10.2, 10.4, 10.5	**29**	52%	
Data services included in results above	10.4, 10.5	11		38%
Statistics				
Institution search for statistics yields no results outside of library	11.0, 11.1, 11.6	36	64%	
Institution search for statistics yields results not found in library	11.2, 11.3, 11.4, 11.5	**20**	36%	
Services related to use of statistics included in results above	11.3, 11.4, 11.5	11		55%

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 * See Appendix for fuller description of codes

Table 5

Services offered by libraries and institutions to support the use of data and statistics

Libraries	Code(s) *	Number/ Subtotal	Percent of Total (n=62)	Percent of Subtotal
Library browse for data terms yields viable results	2.1, 2.2, 2.3, 2.4	**40**	65%	
Library browse points to data services only	2.1	0	0%	0%
Library browse points to data sets and data services	2.3	20	32%	50%

Institutions	Code(s) *	Number/ Subtotal	Percent of Total (n=56)	Percent of Subtotal
Institution search for data terms yields results not found in library	10.2, 10.3, 10.4, 10.5	**29**	52%	
Institution search found data services; with links to library data sets	10.3	0	0%	0%
Institution search found data services only	10.4	3	5%	10%
Institution search found data sets and data services	10.5	8	14%	28%
Institution search for statistics yields results not found in library	11.2, 11.3, 11.4, 11.5	**20**	36%	
Institution search for statistics found services; with links to library data sets	11.3	3	5%	15%
Institution search for statistics found services only	11.4	6	11%	30%
Institution search for statistics found services and data sets	11.5	2	4%	10%

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* See Appendix for fuller description of codes

Table 6
Library and institutional GIS resources

GIS at the Library	*Code(s)* *	*Number / Subtotal*	*Percent of Total (n=62)*	*Percent of Subtotal*
Unable to *browse* to GIS on library website	5.0	**28**	45%	
Browse is unsuccessful; *search* is also unsuccessful	9.0, (9.4 and 5.0)	17	27%	61%
Browse is unsuccessful; *search* points to viable results	9.1	11	18%	39%
Browse to GIS terms is successful	5.2, 5.3	**34**	55%	
GIS services included in results above	5.3	23		68%
Browse is successful; *search* turns up nothing new	9.3	25		74%
Browse is successful; *search* points to *additional* viable results	9.2	6	10%	

GIS external to the Library	*Code(s)* *	*Number / Subtotal*	*Percent of Total (n=56)*	*Percent of Subtotal*
No GIS at library; institution search also yields no results	12.0 and 9.0	5	9%	
Institution search for GIS yields no results outside of library	12.1, (12.0 and not 9.0)	24	43%	
Institution search for GIS yields results not found in library	12.2, 12.3, 12.4, 12.5	**27**	48%	
Services related to use of GIS included in results above	12.3, 12.4, 12.5	18		67%
GIS data not found at the library included in results above	12.2, 12.5	16		59%

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* See Appendix for fuller description of codes