Journal use studies provide meaningful data to consider in shaping a library's journal collection. The University of California at Los Angeles (UCLA) Louise M. Darling Biomedical Library undertook such a study of 2,552 print subscription titles over one year, gathering data on circulation, in-house use, and interlibrary loan (ILL) use. Objectives focused on gathering practical data to support cancellation decisions and to determine whether reliable relationships of in-house to checkout use would emerge, upon which to base future decisions. Data were analyzed for all titles, for titles grouped by publication frequency, and for titles grouped by ten major subject headings. Results, to be interpreted within the limitations of this study and of use studies in general, showed in-house use to be higher than checkouts across all subjects and all publication frequencies—but in ratios too complex to be reduced to a single regression line. All use increases with increases in titles' frequency of publication. Even titles with few or no checkouts show some in-house use. Patterns of serial use differ among general subject disciplines.

INTRODUCTION

The use made of a specific journal by library clientele has always weighed heavily in the complex equation determining retention of that title. Since rising serial costs have far outstripped the ability of libraries to fund all desired subscriptions, and subscription cancellations have become a necessity in the struggle for fiscal balance, local title usage has emerged as the most probable prime component in the cancellation equation. One method used to provide data about this component, the journal use study, which is designed to gather objective information on actual consultation of specific titles in an institution, has a long history in a variety of library settings.

The Louise M. Darling Biomedical Library is one of thirteen libraries on the University of California at Los Angeles (UCLA) campus. It serves the Schools of Medicine, Nursing, Dentistry, and Public Health; the UCLA Medical Center; and the departments of Biology, Microbiology, Molecular, Cell and Developmental Biology, Physiological Sciences, and Psychology in the College of Letters and Sciences; and numerous research institutes and units. In 1987, as rising serials costs began to outstrip the acquisitions budgets at this and many other health sciences libraries, the biomedical library received a few more than 7,000 serial titles. Successive waves of subscription cancellations, paralleled by some addition of new titles, have brought the number of currently received titles to approximately 5,800, with the number decreasing very slightly each year. Bound serial volumes and all but recently received unbound issues circulate to UCLA and all University of California-affiliated persons for one day.

Needing hard data to support cancellation suggestions to a faculty already traumatized by repeated cancellation cycles, the UCLA Biomedical Library initiated a journal use study in 1993 for two purposes: (1) to provide data on in-house use, checkout circulation, and interlibrary loan (ILL) activity for purchased circulating print journals, and (2) to determine what the relationship of in-house to checkout use is for this library, with the hope that checkout data alone could be relied on for responsible future journal title retention decisions. This was not a research study to test a hypothesis; rather, it sought data to use for practical decisions.
BACKGROUND
A rich literature exists on use studies. Within that literature, some percentage deals with journal use in academic and health sciences libraries, although a much greater part deals with monograph use. Periodical use studies are based either on indirect measures such as citation or reference studies, or on direct measures of use such as circulation or in-house consultation [1].
A look at the published literature reveals the following factors concerning direct-measurement use studies:

Definitions
The definition of “use” is not self-evident and must be determined for each study. If a patron takes a volume from the shelf to scan the table of contents and then replaces it without reading, should that be counted as a use? If all a title’s unbound issues are removed to a table but only one is read, how is that to be counted? One frequently applied measure is to count as one use any volume or issue needing to be reshelved by library staff.
“Use” is not necessarily equal to “need.” As Schad has pointed out, a university library meets the need for a small body of instructional materials that undergo intensive use; but equally vital to its mission is providing the vast body of current and retrospective materials needed only occasionally for research [2]. The divergence of need from use should be kept in mind when applying results of use studies in shaping a collection.

Gathering data
There is general agreement that for a true picture of journal use three counts are needed for each title: circulation, in-house use, and ILL statistics. The methods for gathering in-house use data vary in detail but utilize four basic approaches: (1) sweeps—library staff pick up items left lying in reading rooms, in the stacks, by photocopy machines, and in similar locations, counting as they pick up; (2) reshelving counts—library staff count items as they build reshelving trucks or as they place items back on shelves; care may or may not be taken to separate externally circulated items or those loaned to other libraries; (3) something placed in or around volumes—questionnaires to be filled out by users or slips of paper wrapped around the volumes, which users tear as they open the covers, and which can be spotted by library staff members as they periodically check the survey volumes; and (4) observation of user behavior by library staff during survey hours.

Circulation to in-house-use ratios
Rather little literature discusses this aspect, and almost all of it focuses on monograph use. Authors unfortunately do not agree on the meaning of findings. Fussler and Simon, McGrath, and Lancaster, among others, agree that the ratio of in-library use to at-home use tends to remain relatively constant [3–5]. Hayes, however, in his analysis and critique of a study conducted at the University of Pittsburgh, states that “[t]he results of the analysis suggest that circulation in not an adequate index of all use” [6].

Library settings
Use studies have been conducted in special libraries; branch libraries in chemistry, physics, and life sciences; and humanities and social sciences libraries, small and large. Broadus, Cooper, and Tobin review methodologies and approaches for periodical use studies [7–9]. Since the mid-seventies, a number of periodical use studies have also emanated from hospital libraries [10–13] and medium and large academic health sciences libraries [14–21]. No studies concerned with the serials checkout-to-in-house use ratio in a health sciences setting have been located.

General caveats
A number of limitations and unknowns inherent in the method must be considered when interpreting use studies, since how well past use predicts future use is unclear [22]. No weighting factors are available to give relative value to each use, and data is always lost by users reshelving items on their own [23]. A number of authors have voiced the warning that only data gathered in a specific library can reliably describe and predict title use in that particular setting. For instance, Line states that “no measure of journal use other than one derived from a local-use study is of any significant practical value to libraries” [24; see also 25].

METHODOLOGY
This study was restricted to purchased, non-reference, non-history-of-medicine print serials, including annuals and irregulars. Approximately 2,600 titles for the survey were selected manually from a systems-generated list of currently purchased titles. Excluded were non-circulating (for whatever reason) serials and those for which no volumes had been received for several years. Because this was mainly a

† The numbers changed slightly during the year of the study as titles died, merged, or underwent other dynamics to which serials are prone.
pragmatic study intended to aid cancellation decisions, approximately 130 major high-use titles that would obviously never be canceled (e.g., *New England Journal of Medicine, JAMA, Science, Nature, Cell*) were also excluded from the main study.‡

Since the library’s automated circulation system is unable to account for in-house use, a manual count had to be devised. For bound material, all 1990 and later volumes of the selected titles were labeled on the spine with yellow tape; efforts were made to catch and label volumes that had been off the shelf at the time of initial labeling, but this attempt was not completely successful. The bindery assistant affixed tape to recent study title volumes as they were returned from the bindery.

The list of study titles was arranged in call-number order. After each journal truck had been loaded in call-number order for reshelving, student assistants would enter a tick mark on the prepared survey list for each yellow-tape-marked volume. At the end of the week the data were transferred to a master list, also in call-number order. Reshelving counts of bound volumes were taken during the first full week of each month for twelve months starting in September, 1993; thus any changes in use patterns arising from the academic year cycle were accounted for. If a checked-out volume was returned during a sampling week it was counted twice—once as a checkout and once as a reshelving statistic; with the number of volumes reshelved every day in this library, there was no efficient way to avoid the dilemma; but of course all titles had the same probability of being counted twice.

Reshelving counts for unbound journal issues were gathered during the second full week of each month, also for twelve months. Separate weekly lists were given to resharers of unbound journals, and their data were also transferred to the master list for each month. In addition, any ILL requests received during the bound-volume-sampling week for 1990 and later volumes of the titles in the study were gathered and entered into the master list. Circulation (that is, checkout) statistics for 1990 and later volumes were gathered from the automated system for all study titles just before and just after the year-long study period; unfortunately these counts were arbitrarily cut off at seventy-five for some titles; thus the upper limit of the circulation curve.§ was underrepresented.

All study titles were manually checked in Ulrich’s for frequency of publication [26]. If Ulrich’s frequency differed from that supplied by the UCLA serials record, the frequency of publication indicated in the January 1994 issue of the title was used. Titles with irregular or unknown publication patterns were coded as zero.

Thus, the data available at the end of the study for all titles included were

- the total number of times 1990 or later volumes or unbound issues had been checked out during the period from September 1993 to September 1994 (except circulation data for unbound issues that were bound during the study period; this information was automatically wiped out by the circulation system);
- data sampled during twelve of fifty-two weeks on the number of volumes, and the number of unbound issues, for 1990 or later that were reshelved by library staff; and
- data sampled for twelve of fifty-two weeks of the number of ILL requests received for the 1990 and later volumes of the study titles.

In addition, the frequency of publication and a general category subject heading were added to each title record. These ten general category headings (see Table 2) have been found in previous journal cancellation projects to be a meaningful way of grouping titles.

**RESULTS**

Usable data were recorded and analyzed for 2,552 titles. Table 1 summarizes the database and total usage, giving checkouts, in-house use, ILL use, and range, average, and median values. In order to compare numbers for circulation, which were counted all year, to in-house and ILL data, which were sampled during twelve of fifty-two weeks, the latter two values were multiplied by 4.3 (52/12 = 4.33) to achieve an approximate annual value.

To see whether titles with low publication frequency differ in use pattern from those of higher frequency, the database was also divided into two groups of issues-per-year segments: those published three or fewer times a year and those published four or more. ILL usage was so low (2% of in-house use) that it was disregarded in all further analysis. Mean and median in-house use values were clearly higher than checkout values, and for higher-frequency publication titles these values were higher than those for the entire database and much higher than for the titles published three or fewer times annually.

Table 2 summarizes data with titles classified under general subject headings. Almost half of the journals (42%) fell into the medicine category (diagnosis, therapy, pathology, medical specialties), with basic sciences next at 18%, behavioral sciences (psychiatry, psychology) at 14% and biology (botany, zoology, natural history, ecology) at 12%; the other six categories

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‡ Checkout figures were used to confirm the high-use status of titles.

§ Staff members helped to gather circulation numbers. Some individuals unfortunately simply stopped counting at seventy-five, and this was not discovered until some months later.
Table 1
Summary of database and use of 1990 and later volumes

<table>
<thead>
<tr>
<th>No.</th>
<th>Range</th>
<th>Mean</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>All titles</td>
<td>2,552</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Titles with publication frequency ≥ 4/yr</td>
<td>2,097</td>
<td>0-96†</td>
<td>13.7</td>
</tr>
<tr>
<td>Checkouts all titles</td>
<td>34,887</td>
<td>0-96†</td>
<td>15.3</td>
</tr>
<tr>
<td>Checkouts titles with publication frequency ≥ 4/yr</td>
<td>32,117</td>
<td>0-96†</td>
<td>15.3</td>
</tr>
<tr>
<td>Checkouts titles with publication frequency ≤ 3/yr</td>
<td>2,770</td>
<td>0-78</td>
<td>6.1</td>
</tr>
<tr>
<td>In-house use all titles</td>
<td>197,953*</td>
<td>0-421</td>
<td>77.6*</td>
</tr>
<tr>
<td>In-house use titles with publication frequency &gt; 4/yr</td>
<td>191,402*</td>
<td>0-421</td>
<td>91.2*</td>
</tr>
<tr>
<td>In-house use titles with publication frequency ≤ 3/yr</td>
<td>6,551*</td>
<td>0-120</td>
<td>14.2*</td>
</tr>
<tr>
<td>ILL requests</td>
<td>4,734*</td>
<td>0-32*</td>
<td>1.7*</td>
</tr>
</tbody>
</table>

* Adjusted annual value: data was collected in twelve of fifty-two weeks (52/12 = 4.33); counts were therefore multiplied by 4.3 to achieve an approximate annual value.
† Upper limit underestimated (see text).

Table 2
Database by major subject heading

<table>
<thead>
<tr>
<th>Major subject headings</th>
<th>No. titles</th>
<th>Mean checkout</th>
<th>Mean in-house</th>
<th>Median checkout</th>
<th>Median in-house</th>
<th>Median in-house/checkout</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic sciences</td>
<td>447</td>
<td>17.4</td>
<td>77.8</td>
<td>10</td>
<td>55.9</td>
<td>5.59</td>
</tr>
<tr>
<td>Behavioral sciences</td>
<td>358</td>
<td>10.5</td>
<td>74.8</td>
<td>7</td>
<td>51.6</td>
<td>7.37</td>
</tr>
<tr>
<td>Biology</td>
<td>319</td>
<td>5.8</td>
<td>28.0</td>
<td>1</td>
<td>12.9</td>
<td>12.90</td>
</tr>
<tr>
<td>Dentistry</td>
<td>63</td>
<td>15.0</td>
<td>66.8</td>
<td>10</td>
<td>55.9</td>
<td>5.59</td>
</tr>
<tr>
<td>Medicine</td>
<td>1,073</td>
<td>15.8</td>
<td>86.2</td>
<td>9</td>
<td>64.5</td>
<td>7.21</td>
</tr>
<tr>
<td>Nursing</td>
<td>81</td>
<td>14.5</td>
<td>114.8</td>
<td>11</td>
<td>98.9</td>
<td>8.99</td>
</tr>
<tr>
<td>Pharmacology</td>
<td>79</td>
<td>16.2</td>
<td>127.7</td>
<td>10</td>
<td>107.5</td>
<td>10.75</td>
</tr>
<tr>
<td>Public Health</td>
<td>84</td>
<td>9.2</td>
<td>85.1</td>
<td>4</td>
<td>64.5</td>
<td>16.13</td>
</tr>
<tr>
<td>Veterinary sciences</td>
<td>13</td>
<td>7.4</td>
<td>35.3</td>
<td>3</td>
<td>30.1</td>
<td>10.03</td>
</tr>
<tr>
<td>Other</td>
<td>35</td>
<td>7.9</td>
<td>41.7</td>
<td>2</td>
<td>30.1</td>
<td>15.05</td>
</tr>
</tbody>
</table>

* Adjusted annual values.

combined for the remaining 14% of titles.** The "other" category includes broadly multidisciplinary titles.

Interesting differences among the categories emerge. The median†† checkout ranges from one to eleven, the median in-house use from 12.9 to 107.5.

Biology shows the lowest rate of journal use, nursing and pharmacology the highest. All disciplines use more materials within the library than they check out, but again the rate differs; sixteen in-house uses were recorded for each checkout in public health, almost thirteen in biology, and almost eleven in pharmacology; basic science and dentistry journals showed a ratio of only six in-house uses to each checkout.

Table 3 describes findings grouped by frequency of publication of titles. Eighteen percent of all titles have an indeterminate publication schedule (coded as zero), or come out one to three times each year; many of these are review volumes. This frequency range shows the lowest values for both checkouts and in-house use. Half of the database clusters in the four-to-six-issue-per-year group; with the titles published seven to twelve times each year, these constitute 79% of all titles. Use values climb with frequency of publication to a high in the nineteen-to-twenty-four-issue-per-year range for checkouts, while in-house use peaks in the twenty-five-to-thirty-six-issue-per-year range. Again, in-house use is always higher than checkouts, with ratios ranging from four in-house uses for each checkout to more than nine.

Part of Table 3 focuses on titles of high interest to collection development librarians because they seem like perfect targets for cancellation: these are titles with low checkout values. It is clear from Table 3 that more than half of the zero-to-three-issue-per-year titles fall into this category: 41% showed no checkouts for the year, an additional 11% showed one; 33% tallied no in-house use, an additional 17% tallied only one use. In the four-to-six-issue-per-year publication range, a surprising 20% of titles still fall into the zero-or-one checkout range, but only 7% show this extremely low in-house use, making cancellation decisions trickier.

Analysis from a slightly different perspective
counted titles with zero checkout, tallied the in-house use of those titles, and counted titles with both zero checkout and zero in-house use. For the entire database \((n = 2,552)\), 385 zero checkout titles showed 4,184 in-house uses; only 147 titles had zero checkout and zero in-house use. Journals published quarterly or more often \((n = 2,097)\) had 199 titles with zero checkout, which showed 3,244 in-house uses; only 46 titles in this group had no activity during the year. These results highlight the difficulty of predicting overall demand for a title from checkout figures.

Figure 1 graphs the relationship between the medians of checkouts and in-house use. The upper trace represents publications of four or more issues per year, the lower trace those of one-to-three or occasional publication frequency; the symbols below and above each line indicate the fifth and the ninety-fifth percentiles of the predicted medians. Values were not calculated for each checkout frequency, but in ranges of five up to forty, and in tens thereafter.

For the items published four or more times a year, in-house use rises with checkout counts, although not in a simple, proportional way; even for items with the lowest range of checkouts (zero to four), the median in-house usage is twenty-eight. The variation of medians ranges from four to twenty up to the checkout frequency of thirty-five; above that, the variation within bins increases, starting at sixty for higher checkouts. For the titles of less than quarterly publication frequency, in-house usage is uniformly much lower across all checkout frequencies.

Linear regression is the common statistical method that could derive a formula for predicting in-house use from checkout figures. For the data in this study, however, a linear function could give a meaningful prediction of in-house use only for journals with a checkout frequency up to thirty-five. Above that fre-

### Table 3
Database by frequency of publication

<table>
<thead>
<tr>
<th>Publ. freq./yr.</th>
<th>No. titles</th>
<th>Checkouts</th>
<th>In-house use</th>
<th>Median in-house/checkout</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>Median</td>
<td>Zeros†</td>
</tr>
<tr>
<td>0-3</td>
<td>454</td>
<td>6.1</td>
<td>1</td>
<td>186</td>
</tr>
<tr>
<td>4-6</td>
<td>1,290</td>
<td>9.6</td>
<td>6</td>
<td>170</td>
</tr>
<tr>
<td>7-12</td>
<td>719</td>
<td>23.5</td>
<td>16</td>
<td>28</td>
</tr>
<tr>
<td>13-18</td>
<td>34</td>
<td>33.4</td>
<td>24</td>
<td>0</td>
</tr>
<tr>
<td>19-24</td>
<td>41</td>
<td>35.3</td>
<td>32</td>
<td>1</td>
</tr>
<tr>
<td>25-36</td>
<td>2</td>
<td>27.0</td>
<td>27</td>
<td>0</td>
</tr>
<tr>
<td>37+</td>
<td>11</td>
<td>21.8</td>
<td>22</td>
<td>0</td>
</tr>
</tbody>
</table>

* Adjusted annual values.
† Number and percent of titles within each frequency range showing 0 or 1 activity/yr.

### Table 4
Low checkouts vs. in-house use

<table>
<thead>
<tr>
<th>Titles</th>
<th>Titles with 0 checkouts</th>
<th>In-house use of 0 checkout titles</th>
<th>Titles with 0 checkout and 0 in-house use</th>
</tr>
</thead>
<tbody>
<tr>
<td>all: (n = 2,552)</td>
<td>385</td>
<td>4,184</td>
<td>147</td>
</tr>
<tr>
<td>publ. freq. (\geq 4): (n = 2,097)</td>
<td>199</td>
<td>3,244</td>
<td>46</td>
</tr>
</tbody>
</table>

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quency confidence limits are too wide for any trustworthy predictor function.

DISCUSSION

This study provided specific information to guide journal cancellations at the Louise Darling Biomedical Library for 1995 and 1996: titles used little or not at all became obvious candidates for discontinuation. It also furnished insight into the relationship between checkouts and in-house use, although a simple, usable formula of the type "each checkout equals x in-house uses" did not emerge. The relationship proved to be more complex and variable than this, being influenced by both a title's subject area and its frequency of publication. However, the evidence that in-house use existed for titles with little checkout activity did provoke a more thorough review of all factors pertaining to a title, and caused some to be spared from cancellation.

Comments on methodology

As this study was a practical endeavor rather than a research project, data had to be gathered amidst ongoing library operations. For example, reshelving counts of survey volumes were gathered while 1,201,035 volumes were reshelved during 1994/95. As a consequence, methodological shortcuts occurred, lessening the robustness of the findings; thus their significance lies in indicated trends and relationships more than in actual numbers. Repeating the study, and incorporating the wisdom gained from the first attempt, is presently not feasible.

Data collection depended on counting tape-marked volumes on reshelving trucks, yet some volumes lost their marking tape during the year and a few were never taped in the beginning; a lack of staff time prevented more careful attention to this mundane yet vital detail. Student assistants, who gathered the data, are believed to have been conscientious, but no attempt was made to monitor their performance.

The database constitutes only a portion of the library's serials holdings. The main selection criterion, that the title be purchased, has no direct relationship to a title's quality, user needs, or the subject distribution of included journals. Potentially biasing the results even more is the elimination of 130 "high-use" titles from the study, again with no regard to subject coverage. The high scores of pharmacology titles may very well be due to the fact that fewer high-use titles were recognized and eliminated in this field than, for example, in medicine.

Finally, figures for checkouts are the numbers recorded by the computer circulation system for the study year, except for a few titles whose counting was arbitrarily cut off near seventy-five. In-house use was counted during only twelve weeks of fifty-two, so the weekly numbers were multiplied by 4.3 to gain an annual total. These latter figures are therefore only good estimates of the year's actual usage.

Comments on results

The major finding was certainly the consistency of greater in-house use over checkouts, across all publication frequencies and all major subject categories. That even the small percentage of titles with minuscule circulation were being used within the library was enormously reassuring to the library staff. It validated the feeling that the serials collection had been well selected and maintained through all the years of cutbacks. It unfortunately also underscored the fact that very little unused material (46 of 2,097 titles published quarterly or more often, or 2%) remained to be trimmed.

The high in-house-to-checkout ratio for biology confirmed something biology faculty had told us for years: that they counseled their students to photocopy materials in the library, therefore their checkout counts were artificially low. It now seems that all use of biology materials is low in comparison to that of materials in other disciplines.

That infrequently published materials tend to receive less use than more often published items may stem from lower quality, or from the fact that having fewer volumes on the shelf allows fewer items to be checked out. Thus the data merely confirm that each title in this category must be scrutinized for retention separately, with care.

It was disappointing, but not surprising, to find that no simple formula emerged for predicting overall use of a title from its checkout data. The figure of seven or more in-house uses to one checkout, which emerges from the summarized data in Table 1, proves too low for the lower end of the checkout scale and too high for the upper end. The data reveal that the relationships differ for items published fewer than four times per year and those published more than four times, and that even most zero-checkout titles have some in-house use.

Other potentially illuminating uses for the data in hand include a comparison of frequency-of-publication curves among disciplines, since differences in use levels might arise from an unusual number of low- or high-frequency journals published for a discipline. Related to frequency of publication is the confounding factor of how many articles per year each journal publishes for potential use—a detail taken into account by the Institute for Scientific Information (ISI) in computing its impact factors. Many of the study database titles are unfortunately not included in the ISI database.
CONCLUSIONS

1. Studies that provide indications of the actual use of specific journal titles are time- and labor-consuming, but can provide valuable data for managing a serials collection.
2. In a library setting that allows short circulation of bound and unbound serial volumes and issues, in-house use of all serials is heavier than checkout use, by ratios ranging from 4:1 to 16:1.
3. In a serials collection that has already been weeded by repeated cancellation cycles, even those titles with zero or one checkout per year are likely to show considerable in-house use.
4. Usage patterns differ among titles assigned to broad subject categories.
5. Usage increases with the frequency of publication. The titles published irregularly or up to three times per year show distinctly lower checkout and in-house use than do the titles published quarterly or more frequently.
6. The scattergram of checkout versus in-house use of the study’s 2,552 titles was too skewed to be described by one or two linear regression lines. Thus no single number can describe this relationship for all titles.

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