Journal deselection in a biomedical research library: a mediated mathematical approach*†

By Richard K. Hunt, M.L.S.
Research Information Group Leader

Lawrence Livermore National Laboratory
Library, L-610
University of California
P.O. Box 5500
Livermore, California 94550

A unique mathematical formula was developed to use for journal deselection decisions. The formula factors in subscription cost, shelving and storage cost, interlibrary loan cost, staffing cost, and use level to determine the institutional cost ratio; this ratio serves as an indicator of the cost-effectiveness of each subscription title. Once the institutional cost ratio was calculated for each of 537 titles, a committee of library staff and senior library customers reviewed the ranked list to decide which subscriptions should be canceled. The committee also considered possible exceptions based on subjective criteria such as availability at local libraries, unrecorded use, and relative importance of the journal. The preliminary cancellation list was then reviewed by the library's research users. They were able to justify library subscriptions to a few additional titles. This method enabled the library to cut its subscription costs by 46%, while cutting only 8% of the total use. In addition, by mediating the mathematical approach with human intervention, the library made these severe cuts without unduly distressing its patrons.

INTRODUCTION

The Biomedical Library at Lawrence Livermore National Laboratory (LLNL) supports about 200 biomedical and environmental sciences researchers. The collection, comprising 40,000 volumes, emphasizes cancer research, genetic toxicology, biotechnology, and environmental science. In response to significantly reduced funding in the 1987 fiscal year, the library was forced to consider the cancellation of a large number of its journal subscriptions. A unique mathematical formula was developed to use as the initial basis for the deselection decisions. This formula used cost data such as subscription cost, interlibrary loan cost, staffing cost, and shelving and storage cost in combination with the level of use to determine the institutional cost ratio (ICR) for each title. The cost ratio serves as an indicator of the cost-effectiveness of subscribing to each title.

Once the ICR had been determined for each of 537 titles, a committee of library staff and senior library customers reviewed the ranked list to decide which subscriptions should be canceled based on the rankings. The committee also considered exceptions to the rankings based on subjective criteria such as availability at local libraries, unrecorded use, and relative importance of the journal. The preliminary cancellation list was then reviewed by all the library customers, who were able to justify subscriptions to a few additional titles.

A committee of library staff and senior library customers reviewed the ranked list to decide which subscriptions should be canceled based on the rankings.

The library staff developed the ICR formula in response to a literature review of other numerical journal deselection methods; the literature review revealed no options that could be suitably applied to

Table 1
Annualized use of biomedical library journals (top ten titles and totals)

Title	Price	Use
Nature	$ 251.07	500
Mutation Research (all sections)	$ 1,426.15	413
National Academy of Sciences. Proceedings	$ 219.62	413
Nucleic Acids Research	$ 602.96	375
Science	$ 183.00	315
Cancer Research	$ 216.43	308
Cell	$ 242.94	298
Toxicology and Applied Pharmacology	$ 475.00	255
Environmental Science and Technology	$ 164.00	215
National Cancer Institute Journal	$ 59.00	208
Total top ten titles	$ 3,840.17	3,300
Total all titles	$173,073.73	12,003

the library. Brookes developed a formula that used most of the variables included in the ICR calculation, but his method was based on average cost, which does not account for individual variances in subscription price [1]. Broude presented a formula that included several additional variables, including impact factor, places indexed, availability elsewhere, publisher prestige, and curriculum-relatedness [2]. The committee chose not to use this formula because some of the variables (e.g., publisher prestige) and the weights assigned to each variable were too subjective for local use. Other methods were also ruled out because they depended largely on a subjective evaluation of relevance or worth [3]. Segal provided a good overview of both numerical and other journal deselection techniques [4].

The staff also considered methods based on citation frequencies or "impact factors," the ratio of the number of times a journal is cited in a given period versus the number of articles produced by that journal in the same period [5–6]. These methods were not selected because such data, which is derived from the universe of cited literature, could not be applied reasonably to a small special library that concentrated on only a few specific subject areas. As a result of the narrow research interests of the library's patrons, many high-impact factor journals may not be relevant because the high citation frequency may have come from scientists writing in other subject specialties. This conclusion was supported by a comparison of the final cancellation list with the journal impact factors for 1987, which show little useful correlation between impact factor and cancellation. For example, 177 of the retained subscriptions had an impact factor greater than one, but 112 of the canceled subscriptions also had an impact factor greater than one. Thus, using only impact factor data, the committee would have been unable to separate the 112 subscriptions that were eventually canceled from 177 subscriptions

that were retained, because all 289 titles would appear roughly equivalent when ranked by impact factor.

In addition to the formula for ICR, this study included data from the use survey that was conducted at the beginning of the deselection process and the final results of the cancellation process, including its effect on the potential use of the library collection.

USE SURVEY

Using a modification of the "spine–marking method" presented by Slote [7], the library staff conducted a six-month use survey of both the unbound and bound journals in the library. The spine of a bound journal was marked with a piece of colored tape each time that it was used. The staff used ten colors, each representing a different amount of use, from one to ten. If a volume was used more than ten times, a second piece of tape was added. Unbound issues were treated similarly except that each use was denoted with a colored mark on the library's check-in label.

In order to avoid errors created by patrons reshelving a volume before it was marked, all library customers were instructed not to reshelve the material. In spite of these instructions, several library patrons later claimed they did reshelve materials during the study period. The review committee compensated for this missing data by allowing the scientists to report this use during the review cycle.

At the end of the six-month study period, the staff walked through the stacks to tabulate the use for each title by totaling the number of uses represented by the piece of colored tape on the spine of each volume of a title. A low-use title could be readily identified by the sparsity of colored tape on its bound volumes. The results of the user survey (Table 1) show the ten titles used most often, as well as the total use and cost.

INSTITUTIONAL COST RATIO (ICR)

In a research institution such as LLNL, it is important to have a rational, numeric basis for making a decision. Judgments based on the intrinsic value of an item are less acceptable than judgments based on cost. In order to have a logical basis for the deselection decisions, the library developed a formula that would provide a measure of the cost-effectiveness of subscribing to a journal. This formula serves as a means to compare the cost of owning a journal with the cost of acquiring individual articles through interlibrary loan, at any given level of use. By comparing all cost aspects of owning a journal title with all cost aspects of procuring requested articles from that title through interlibrary loan (ILL), the library could logically choose the most cost-effective alternative for each

journal. The formula for the ICR is based on three variables and three constants:

U = annual use
P = annual subscription cost
L = size of bound collection
I = cost of performing an ILL
M = annual cost of maintaining a subscription
S = shelving and storage cost

The three constants I, M, and S were established as $17.20 per transaction for ILLs, $27.00 per title for subscription maintenance, and $6.00 per linear foot for shelving and storage costs.

By comparing all cost aspects of owning a journal title with all cost aspects of procuring requested articles from that title through interlibrary loan (ILL), the library could logically choose the most cost-effective alternative for each journal.

The department's resource manager determined I and M by analyzing the various costs that went into each activity. Costs for ILL were computed by totaling the annual cost of staffing, supplies, lending library charges, mail, supervision, and overhead for the ILL function. This total ILL cost was then divided by the number of transactions to arrive at the cost per transaction. Subscription maintenance costs (M) were determined by computing the total cost of maintaining all the library's subscriptions, including staffing, supplies, and overhead, which includes the serials module of the library's automated system. The annual subscription maintenance cost was divided by the total number of subscriptions to determine the maintenance cost per subscription. These costs vary from library to library, depending mostly on the cost of staffing.

Shelving and storage costs (S) were derived from data used by a compact shelving supplier; these data provided a national average of $19.75 per square foot [8]. This constant was converted to $6.00 per linear foot of shelving by multiplying the cost per square foot by the overall area of the library stack space; the product was then divided by the total linear feet of shelving available in the stacks area. This cost (S) will vary from library to library, since it is dependent on the density of the shelving. For example, the shelving maintenance cost would be lower if a library used compact shelving, because more linear feet of shelving would be packed onto an equal amount of floor space.

The variables were measured by the library staff. The use survey provided U; P was taken from the

Table 2
Journals ranked by institutional cost ratio (ICR) (top ten titles)

Title	Use	Price	ICR
Journal of Environmental Quality	95	$ 12.61	33.6
Nature	500	$251.07	24.0
National Academy of Sciences. Proceedings	413	$219.62	20.6
Science	315	$183.00	20.1
Environmental Health Perspectives	80	$ 40.00	19.1
Environmental Science and Technology	215	$164.00	17.2
National Cancer Institute Journal	208	$ 59.00	16.6
Cell	298	$242.94	16.1
American Water Works Association. Journal	80	$ 56.43	15.4
Cancer	190	$ 90.43	14.9

library's accounting data; L was calculated at the end of the use survey. The various elements combine into the following formula:

$$\text{Institutional cost ratio (ICR)} = (U \times I)/[P + M + (L \times S)]$$

The formula computes a ratio for the cost of providing requested articles through ILL at a given level of use versus the cost of subscribing to and maintaining a journal title in the library. The numerator of the ICR formula computes the cost of ILL for requested articles at a specific level of use. The denominator corresponds to the cost of subscribing to and maintaining a collection of a specific title. Since the formula compares all costs for each alternative and accounts for the specific level of use in the library, the resultant ICRs form a valid basis for decision making regarding the cancellation of each respective journal.

Once the formula had been derived, the ICR of each title was determined and a ranked list of titles was prepared for the committee's review. The larger the cost ratio, the more cost-effective it was to subscribe to the journal rather than use ILL for specific articles. Table 2 shows the ten titles with the highest ICR.

A committee composed of three senior scientists from the department served by this library and the collection development librarian reviewed the ranked list to determine which titles should be canceled. Ideally, anything with a cost ratio of less than one should be canceled because it would be more cost-effective to obtain it through ILL than through purchase. Fortunately, the committee realized that cost should not be the only consideration; they chose to consider other factors such as the time delay in acquiring ILLs, the prestige of the journal, whether the department published in the journal or had members on the editorial board, the possibility of unrecorded use, and availability at other local libraries. Using the cost ratio as a guide and weighing the other listed factors, the

committee compiled a preliminary list of 330 titles to be canceled.

The list was then circulated to all the researchers in the department for comment. The comments were forwarded to a committee member for compilation; the committee reviewed the resulting list of titles that

---

The committee decided that if more than five people stated that they used a certain title, then it should not be canceled. Consequently, fifty titles were removed from the cancellation list as a result of the researchers' input.

---

the researchers believed were important. The committee decided that if more than five people stated that they used a certain title, then it should not be canceled. Consequently, fifty titles were removed from the cancellation list as a result of the researchers' input. These fifty titles, with ICRs between 0.4 and 0.9, were borderline titles; borderline titles were kept because several scientists presented evidence of unrecorded use that lowered their ICR. The unrecorded use occurred because many after-hours users had personally reshelved titles. Journals with an ICR of 0.0 were automatically canceled, unless it was a new title for which sufficient use data had not been collected.

RESULTS AND CONCLUSIONS

This deselection method has served the biomedical library well. The library was able to cut subscription costs by 46% by canceling 280 titles. Even though 52% of the titles were canceled, the cancellations comprised only 8% of the total use as determined by the survey. After eighteen months, the library has not experienced an increase in its ILL volume, and the staff believes that the savings in subscription costs and staff time for maintaining subscriptions and shelving journals will more than compensate for any ILL increase that may occur in the future. In addition, by mediating the mathematical approach of the ICR with human intervention, the library was able to make severe cuts without unduly distressing its patrons. The biomedical and environmental researchers continue to use the library with great frequency, as evidenced by an increase in most other library statistical indicators. Number of items circulated, pages photocopied, and literature searches performed have all risen over the past eighteen months, and the library staff has received few complaints concerning the cancellations.

REFERENCES

1. BROOKES BC. Photocopies v. periodicals: cost-effectiveness in the special library. J Docum 1970;26(1):22-9.
2. BROUDE J. Journal deselection in an academic environment: a comparison of faculty and librarian choices. Ser Libr 1978 Winter;3(2):147-66.
3. KRAFT DH, POLACSEK RA. A journal-worth measure for a journal-selection decision model. Collection Manage 1978 Summer;2(2):129-39.
4. SEGAL JA. Journal deselection: a literature review and an application. Sci Tech Libr 1986 Spring;6(3):25-42.
5. BROADUS RN. A proposed method for eliminating titles from periodical subscription lists. Coll Res Libr 1985 Jan; 46(1):30-5.
6. SMITH TE. The *Journal Citation Reports* as a deselection tool. Bull Med Libr Assoc 1985 Oct;73(4):387-9.
7. SLOTE SJ. Weeding library collections—II. 2d rev. ed. Littleton, CO: Libraries Unlimited, 1982:122-41.
8. FERNBERG PM. Economics that drive mobile storage. Mod Off Tech 1987 Aug;32(8):50-6.