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ABSTRACT

This report discusses the seven basic types of problems found in business and industry as they apply to library institutions. These seven basic types are: (1) inventory problems, (2) allocation problems, (3) queueing problems, (4) sequencing problems, (5) routing problems, (6) replacement problems and (7) search problems. (MF)

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Operations Research Applied to Libraries

by

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Paper presented at an Institute on Program Planning and Budgeting Systems for Libraries at Wayne State University, Detroit, Michigan, Department of Library Science, Spring 1968

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Introduction
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The following paper was presented at an institute on Program Planning and Budgeting Systems for Libraries, held at Wayne State University under the Higher Education Act, Title IIB, in the spring of 1968.

The intent of the institute was to introduce administrators and finance officers of large libraries, public, state, and academic to the principles and procedures of PPBS.

Each participant in the institute brought with him the most recent budget document from his own library, and with the help of the institute staff, attempted to convert it into a PPBS presentation.

Operations Research Applied To Libraries

by
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Operations research may be defined as the application of scientific methodology to the solution or problems in business, industry, and other organizations. Seven basic types of problems found in business and industry were applied to the library institutions. The seven basic types of problems are:

1. Inventory problems.-- Inventory may be considered idle resources. Resources are anything that can be used to get something of value. Men, machines, materials and money are the principle resources in the firm. Idle resources in the library can be books, periodicals, tapes, clipping files, sorting equipment, bindery and catalog equipment, librarians and specialty librarians. The major problem in inventory analysis is to select an order-quantity, or frequency of acquisition of a particular resource, so that the sum of all relevant costs involved in obtaining these resources is minimized. These costs include set-up costs, e.g., cataloging; shortage costs, i.e., the costs of being out of stock; quantity discount or purchase-price costs, e.g., savings through the purchasing of multiple subscriptions, and labor costs, which fluctuate as demand for a service fluctuates. Typical library areas suitable for operations research inventory application are:

   a. Training programs. We often turn out too many librarians, or too many specialty librarians, leading to idle personnel. If we turn out too few, which is more often the case, we have unfulfilled demand.

b. Books. The problem of keeping a single copy of rare manuscript arises, but what if two or more users arrive to use the collection at the same time?

Problems in implementing inventory solutions in libraries arise when the costs of "out of stock" are to be evaluated. Techniques to be utilized to solve inventory problems are probability models and simulation.

2. Allocation problems.--The general allocation problem comes about when there are (1) a set of jobs to be done, e.g., classifying, cataloging, purchasing and shelving of books; (2) scarce resources, i.e., people, rooms, etc., available to them; (3) jobs which can be done in different ways, or with different combinations of resources, e.g., machine printing of catalog cards versus hand typing; (4) ways of doing these jobs which are better than others, as in (3) above; (5) not enough resources to do every job in the best way. The problem is, therefore, to allocate all resources to the various jobs so as to maximize efficiency, either by minimizing costs or maximizing profits. Since in libraries it may be best to use something like best service at lowest costs, quantification of costs ~~was~~ is discussed.

Typical allocation problems in the library include:

a. Assigning staff to different jobs.

b. Allocating expenditures to different functional areas, for example, social work, social science, education, science, etc.

c. Transportation scheduling in a library bookmobile system.

d. Budget allocation to different functions in the library.

3. Queueing problems. These are the typical waiting-line problems where customers arrive, wait in line for a service such as a library book or a film, are serviced, and then depart from the facility. Costs of carrying additional librarians or books is of course an important concern. You can always increase

the numbers of these, but at a significant cost. The question arises, however, as to what to do with idle books, librarians, or films. The technique utilized in queueing models is known as queueing theory, where arrivals are "simulated" entering into a queue, i.e., arriving at various service facilities. The techniques utilize probability theory to predict "arrivals". Sometimes the basis of observation is a real system, such as studying an existing library service facility.

The major problem is to minimize waiting time and costs, while maximizing service. These techniques have been used in tunnel toll-booth analyses, bank teller waiting-line problems, and machine service problems.

4. Sequencing problems.--These occur similarly to queueing problems, but apply where multiple services are performed on the same customer or job with some priority present and a required sequence of steps, e.g., when changing over from the Dewey Decimal System to the Library of Congress Catalog. Certain services must be performed first, e.g., changing new book arrivals, more frequently used books, etc. These problems can be simulated using various computer simulation models. Frequently the technique known as CPM, or critical path method, is used. CPM is used where one-time, low-frequency projects are being carried out. It has been successfully used in the development of the Polaris missile system, and changing over to a computer.

Library problems would include establishing a tape library or performing a recataloging job. Management must initially establish date priorities, and find the critical path through the job to discover the essential steps to be conducted.

5. Routing problems. The "traveling salesman" routing problem is a

typical example. This was previously discussed under allocation problems. Linear programming solutions are applied in this case. It is difficult to isolate a specific library use, except possibly the bookmobile routing problem.

6. Replacement problems. Problems of obsolescense of resources, for example, old encyclopedias, old plants, old machinery, etc. are of concern here. Some items suffer from rapid deterioration through use, others ~~automatically~~ deteriorate, e.g., rubber bands. The operations research technique utilized in this case is computer simulation to decide alternative replacement strategies, considering their costs and effects on service.

7. Search problems. Here the problem is one of searching and inspection of various types of data, e.g., cataloging and classifying in order to detect errors. In this area, the costs of not finding an error are weighed against the cost of finding all errors. Typical methodologies include statistical sampling, such as in auditing. This may be utilized in libraries for keypunch verifying, purchase order searches, etc.

Recommendations were made as to location of the operations research function in the library organization; hiring of outside consultants for specific problems and the necessity of staff personnel to have a sound mathematics background.

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