

Applications of Operations Research Models to Libraries: A Case Study of the Use of Monographs in the Francis A. Countway Library of Medicine, Harvard University. By CHING-CHIH CHEN. Cambridge, Mass.: M.I.T. Press, 1976. Pp. xx+212. \$17.50. ISBN 0-262-03056-X.

In 1968 Philip M. Morse published *Library Effectiveness: A Systems Approach* (M.I.T. Press). This monograph was awarded the Lanchester Prize by the Operations Research Society of America as an outstanding application of the techniques of operations research to libraries. Chen's book is an outgrowth of Morse's mathematical modeling and extends those models in several directions. The book is a revision of Chen's dissertation, which was completed under Morse's direction.

The mathematical models of circulation developed by Morse fall into two categories: queuing and Markov models. The queuing models characterize circulation in terms of the waiting time to obtain material, the interference caused by others using the material, and the effect of duplicate copies on circulation interference. Markov models portray usage in terms of transition probabilities: the likelihood that a class of books will circulate in a subsequent time period is a function of its circulation in a previous time period. Two parameters characterize these models. The first describes what the eventual (steady state) mean circulation of a class of books will be, and the second measures how rapidly the usage of a class of books will decline each year. Chen's book emphasizes this latter category of models.

Implementation of the original Morse models required information about both the circulation and noncirculation of books in the collection. Chen has extended these models by developing a correction factor which requires data only on books that have circulated and

does not require data on noncirculated books. She also proposes several other additions to Morse's models including formulae for computing the fraction of a class of books circulating more than a specified number of times, the fraction of items not available on the shelf, the number of duplicate copies of a book that are needed, and some discussion of the use of the models for weeding.

The models that Morse developed were successfully tested by him at the M.I.T. Science Library. Chen chose to validate the models and her extensions of them at the Countway Library of Medicine, Harvard Medical School. A major sampling effort involving 12,000 circulation transactions was performed during four separate months for eight different Library of Congress subject classifications. Close agreement was found between the observed values and mathematically predicted values of the mean circulation.

The book is quite successful in its stated objective of testing and verifying the models and their extensions in another environment. But the changes that Chen proposes are not major modifications—the underlying structure is mainly that of Morse's work. Since a considerable part of the model development had been done before, Chen could have paid some attention to statistical goodness-of-fit tests to see how well the observed and theoretical values agreed. Also some emphasis could have been placed on the statistical accuracy of the sample, given the size of each LC subject stratum and each time period sampled.

The book is mainly mathematical in nature, although in the later part an attempt is made to interpret the results nonmathematically. There are also good summaries of the relevant library operations research literature. But in some cases (for example, models of book duplication and budgeting) better discussions can be found elsewhere in the literature. The book should have a definite audience among library operations researchers but beyond that it is not clear that the book will be accepted.

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