STATISTICAL ANALYSIS OF THE ASSOCIATION BETWEEN

LIBRARY OF CONGRESS SUBJECT HEADINGS AND

THEIR CORRESPONDING CLASS NOTATIONS IN

MAIN CLASSES OF LCC AND DDC

BY

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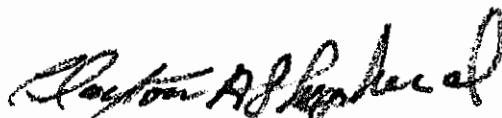LIBRARY AND INFORMATION SCIENCE

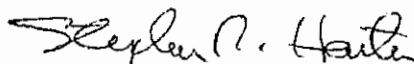INDIANA UNIVERSITY

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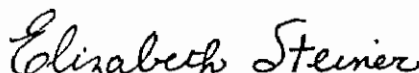Indiana University.

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DEDICATION

TO MY WIFE HOMA

AND

MY CHILDREN PEYMAN AND PAYAM

ABSTRACT

A database consisting of 101,347 of the Library of Congress MARC records was created and the Library of Congress Subject Headings (LCSH), Library of Congress Classification (LCC), and Dewey Decimal Classification (DDC) were analyzed to determine variations in the association between LCSHs and LCC/DDC notations with respect to the variations in the number of LCSHs per record, the order of headings in records, and the sorting of entries.

The analysis showed that as the number of LCSHs per record increased, the association between LCSHs and class notations decreased. The probability of having identical class notations for identical LCSHs in single-heading records was found to be significantly higher than in multiple-headings records.

Association of LCSHs and class notations with respect to the variation in the order of LCSHs revealed that LCSHs which were listed first had a significantly higher association with class notations than the succeeding headings. The main classes within each classification system were significantly different at the 0.001 level.

The difference between association measures in the subject catalog and the shelf list catalog was significant at the 0.001 level in bibliographic records with a different number of LCSHs per record and for LCSHs listed first, but

there was not a significant difference for headings listed second or more. The difference between the association of LCSH with LCC and the association of LCSH and DDC was significant in the bibliographic records with a single LCSH and for headings listed first.

The study indicated that the class notations are not consistently assigned to subject headings: LCSH, LCC, and DDC should be improved to increase the association between subject headings and class notations. In filing identical subject headings, it would more logical to subarrange entries by number/order of headings in records. In developing a pattern-recognition algorithm to compute class notations or LCSHs when either one of the two is known, going from LCSHs to compute class notations is more likely recommended than the reverse approach, and LCC would be a better choice than DDC.

_____, Chairman

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INTRODUCTION

Information Needs

In order to cope with the problems of his environment
and to enlarge his own 'self' through experience and thought,
man needs information.[1]   Although libraries may be involved
in research, the primary function of libraries is not to make
discoveries but to provide appropriate means of retrieving
knowledge already discovered. Libraries can contribute to
the improvement of knowledge by providing efficient means of
access to knowledge already existing. "The quality of know-
ledge is improved when people have access to diverse sources
of information. We should work at creating conditions that
allow diversity, access, and the tools to translate the in-
formation into knowledge."[2]   In any information based
society, the efficiency of information retrieval is very
important. This implies that accuracy and quick access to

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[1]D. J. Foskett, "The Contribution of Classification to a
Theory of Librarianship," in Toward a Theory of Librari-
anship; Papers in Honor of Jesse Hauk Shera ed. by Conrad H.
Rawski (Metuchen, N.J.: Scarecrow Press, 1973), p. 170.

[2]Carlton C. Rochell, "An Information Agenda for the
1980s: An Essay Based on the Discussions," in An Information
Agenda for the 1980s; Proceedings of a Colloquium, June
17-18, 1880, ed. by Carlton C. Rochell (Chicago: American Li-
brary Association, 1981), p. 5

information is very crucial in the process of information retrieval. Therefore, these two should be included in the objective of any information retrieval system.

Traditionally the library had been one of the major sources of printed information. However, modern libraries are no longer limited to printed materials, and from the computer technologist's point of view, a library is a data bank or memory--storehouse of information.[3] In any case, librarians had to find ways to provide quick access to the available information in the collection. Categorization is an aid to achieve such an objective.

A study of the effectiveness of back-of-the-book indexes for subject retrieval indicates that there are serious inadequacies in book indexing, and that almost half of the books in the areas of humanities and social sciences do not have any book index.[4] Greene's study also, reveals that books obtained by browsing were judged to be less useful than those obtained by other means.[5] This implies that other

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[3]William J. Kubitz, "Computer Technology: A Forecast for the Future," in The Role of the Library in an Electronic Society; Proceedings of the 1979 Clinic on Library Applications of Data Processing, F. Wilfrid Lancaster ed. (Urbana-Champaign, Ill.: University of Illinois, Graduate School of Library Science, 1980), p. 136.

[4]Bonnie Gratch, Barbara Settel, and Pauline Atherton, "Characteristics of Book Indexes for Subject Retrieval in the Humanities and Social Sciences," The Indexer 11 (April 1978): 14.

[5]Robert J. Greene, "The Effectiveness of Browsing," College & Research Libraries 38 (July 1977): 313.

methods of subject access to the collection should be studied
to develop an effective system for information and/or docu-
ment retrieval.

> Except for a few indexing studies, such as the
> Cranfield investigations, which have included library
> card catalogs, very little research is available
> about the quality of information produced by each of
> the methods. Therefore, little is known about the
> value or usefulness of information discovered in dif-
> ferent ways in libraries.[6]

Considering these facts, it is important to pay more at-
tention to the subject retrieval tools available in
libraries.

Fundamentals of Bibliographic Control

There are basically two principal elements in biblio-
graphic activities in libraries:[7]

1. Analytical, critical, or descriptive bibliography,
which describes the physical state, the format, and
identifications such as authors, title, place of publication,
publisher, size, illustration, number of pages, series, etc.
The purpose of descriptive bibliography is to provide an ac-
curate and precise identification of a work; and

2. Systematic bibliography, which is concerned with the

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[6]Ibid., p. 313.

[7]Frances Neel Cheney and Wiley J. Williams, Fundamental
Reference Sources, 2nd ed. (Chicago: American Library Associ-
ation, 1980), p. 18.

intellectual content of a work. The purpose of systematic bibliography is to provide information about subject content of an individual work and to assemble this information into a logical and useful arrangement. Systematic bibliography includes library catalogs, periodical indexes, union catalogs, national bibliographies, abstracts, concordances, etc.

Activities related to the production of library catalogs involve subject analysis of documents. Systematic bibliogrphy, as related to the subject analysis of library materials, is composed of two basic operations:

(a) Subject Cataloging: It involves identifying topics discussed in a document and assigning appropriate subject headings to represent these topics. It serves as an alphabetical index to the holdings, and is used to provide multiple access to items in the library collection.

(b) Classification: It is used to provide a logical and practical arrangement for the books so that works dealing with the same subject would be shelved together. It is used to help patrons browse through the collection, and may be used as another access point in an online catalog.

This introduction attempts to discuss issues involved in the relationship between two approaches to subject analysis with an emphasis on the Library of Congress Subject Headings, Library of Congress Classification, and Dewey Decimal Classification. The development of the subject control, the

differences between existing systems, and the limitations of this process are discussed in this section. It also reviews the official Policy of the Library of Congress subject practice in relation to the objectives of this study.

Historical Development of Subject Control

The organization of library materials has a long history, one that goes back to the early days of human civilization: Aristotle attempted to classify human knowledge into ten classes; Callimachus, the librarian of the Library of Alexandria in 'Egypt, designed a classification system for his library; and in medieval libraries books used to be arranged by several general subjects.

The geometrical growth in human knowledge has increased the number of information sources in libraries. The organization of library materials thus became more and more crucial. Subject categorization is indeed one of the major features of modern librarianship, not only a traditional feature but a pragmatic necessity of today's libraries.

The first American code related to the subject analysis of library materials can be traced back to the rules 151-153 and 161-188 of Cutter's Rules for a Dictionary Catalog, published first in 1876 by Charles Ammi Cutter, librarian of Boston Athenaeum Library.[8] As a means of providing patrons

with effective access to information sources contained in libraries, librarians have evolved the mechanism of subject control over their collection. Subject control is achieved through analyzing the subject content of documents and providing an index to these subjects while arranging documents in a logical order according to subject.

For a long time, the index to library collections was in the form of 'class catalog'. The class catalog, or the classed subject catalog, is the arrangement of entries under main divisions, where each division is subdivided by subtopics in a hierarchical form using some sort of classification.[9] The problem, however, with the class catalog is that the patron must be familiar with the classification system before he/she can efficiently use the catalog. Therefore, librarians tried to develop other ways of accessing the library collection, and as a result the classified catalog was gradually changed to the dictionary catalog--a catalog which is more practical and easy to understand by the users.

The dictionary arrangement, as the name implies, is the ordering of entries alphabetically. Subject headings in a dictionary catalog are supposed to be specific and familiar to the users: "The essential principles of the dictionary

[8]Charles A. Cutter, Rules for a Dictionary Catalog, 4th ed. (Washington: Government Printing Office, 1904), pp. 63-64, 66-80.

[9]Julia Pettee, Subject Headings: The History and Theory of the Alphabetical Subject Approach to Books (New York: H. W. Wilson, 1946), p. 25.

heading are that the entries should be direct, specific, and in the form which will be looked for by the majority of the users of the catalog."[10]

The dictionary catalog has an advantage over the classified catalog in that it provides patrons with direct access to the specific subject. Pettee points out that although in a subject catalog it is not possible to bring related materials together in a logical way, one has not only the ability to provide direct access to specific subjects but can also bring materials from different fields under a single heading:

> The superiority of the alphabetical subject catalog over the classed catalog rests not only upon its direct access to specific subject matter without the intermediary of an index to a classification scheme, but also upon its ability to collect material from different fields under a topical name, and this is its supreme claim to distinction.
> Its disadvantage is, of course, that the alphabetical dispersion of topics makes it impossible to assemble logically related material brought together in a linear classification scheme.[11]

Haykin believes that specificity of headings in the two approaches are almost the same; however, they differ in that the specific topic in a classed catalog is the last element, while in a dictionary subject catalog the specific topic is used directly. Therefore, subject headings in a dictionary catalog are both direct and specific.

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[10]Wyllis E. Wright, "Standards for Subject Headings: Problems and Opportunities," Journal of Cataloging & Classification 10 (October 1954): 175.

[11]Pettee, Subject Headings, p. 59.

In effect the headings for a given topic in an alphabetico-classed and a dictionary catalog are equally specific. The difference lies in the fact that in the former the specific topic is the last element in a complex heading, whereas in the latter it is named directly; what distinguishes the subject heading in a present-day dictionary catalog from other forms is that it is both specific and direct.[12]

No matter what method is used to gain subject control over the library collection, the process involves the analysis of subject content of the library materials and the representation of the content in a coded format, that is, a notation or a controlled vocabulary. Haykin uses the term 'subject analysis' to mean both classification and subject cataloging:

> . . . the term "subject analysis" is used in the sense of that method of "subject control" of library materials which comprehends both their organization through a system of classification and the provision of a key in the form of an alphabetical catalog or index; . . . the distiction between "subject cataloging" and "subject analysis" is that the "subject cataloging" provides a key to physical units of library materials, such as books, sets of periodicals, motion pictures, and groups of manuscripts, where "subject analysis," being the borader term of the two, includes also the analytical treatment of the contents of such physical units, that is, subject indexing whether by means of classification or subject headings.[13]

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[12]David Judson Haykin, Subject Headings: A Practical Guide (Washington: Government Printing Office, 1951), pp. 3-4.

[13]David Judson Haykin, "Subject Headings: Principles and Development," in The Subject Analysis of Library Materials ed. Maurice F. Tauber; Papers Presented at an Institute, June 24-28, 1952, Under the Sponsorship of the School of Library Service, Columbia University and the A.L.A. Division of Cataloging and Classification (New York: School of Library

Hickey considers subject analysis to consist of two
diciplines. "[T]he field of subject analysis divided itself
into two essentially separate disciplines: subject cataloging
and classification,"[14] where subject cataloging logically is
associated with descriptive cataloging, while classification
is an attempt to group materials in a meaningful way and is a
separate operation by itself. At any rate, the fundamental
purpose of subject analysis of library materials is (1) to
identify the content of the materials so that each can be
retrieved uniquely according to its particular aspects, and
(2) to identify the content of the materials in such a way
that each can be related to other materials and be retrieved
in conjunction with them.[15]

The first purpose is achieved by the use of subject
headings, and the second is met through the use of classifi-
cation systems. With the emergence of machine readable data
bases there seems to be more emphasis on cataloging, at least
in the United States. In particular, subject cataloging has
gained more importance, since electronic cataloging makes it
economically feasible to provide various access points to
each document.[16]

Service, Columbia University, 1953), p. 44.

[14]Doralyn J. Hickey, "Subject Analysis: An Interpretive
Survey," Library Trends 25 (July 1976): 273.

[15]Ibid., p. 274.

[16]F. W. Lancaster, Laura S. Drasgow, and Ellen B. Marks,
"The Changing Face of the Library: A Look at Libraries and
Librarians in the Year 2001," Collection Management 3 (Spring

Differences in the Two Subject Approaches

Classification and subject headings are two different approaches to subject retrieval in libraries. The difference between subject indexing and classification is that in the former the access to documents is through a set of ordered descriptors, while the latter consists of logical relations between concepts represented by notations expressing descriptors.

> The essential difference between them [i.e., subject index and classification] is that an index is an ordered set of descriptor-object pairs, ordered by descriptor; a classification is a set of relations between the descriptors.[17]

Shelf classification provides a logical or systematic approach to the subject matter of documents, while subject headings provide an alphabetical approach to subject content of documents.[18] Classification schemes and subject headings together provide a dual approach to library materials, clas-

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1979): 68.

[17]Martha W. West, What Where We've been Says about Where We Are: Research and Information Science; A Paper Prepared for the System Development Foundation, Palo Alto, Caifornia (Palo Alto, Calif.: System Development Foundation, 1982), p. 5

[18]Bohdan S. Wynar, Introduction to Cataloging and Classification, 5th ed. Prepared with Assistance of John Phillip Immroth (Littleton, Colo.: Libraries Unlimited, 1976), p. 329.

sified and alphabetic. Each one permits approaching informa-
tion from a different angle.

Hyman mentions that subject headings lead library users
to a particular topic, and are good for less experienced
users such as public library users, while classification
leads them to systematically related subdivisions and is good
for researchers. He believes that in practical sense, the
alphabetical subject catalog is more useful:

> The subject heading supposedly leads the reader
> to works concerned with a particular topic, whereas
> the classification scheme leads the reader through a
> systematic sequence of related subjects arrayed in
> logical divisions and subdivisions. The former is
> considered best for someone seeking specific informa-
> tion; the latter, for researchers surveying a dis-
> cipline or subject area. Thus, the alphabetical sub-
> ject catalog was considered more useful for the un-
> sophisticated but pragmatic nonscholar, the public
> librarian's target market.[19]

Manheimer states that the purpose of classification is
not only to provide a place for every work in the collection,
but to bring together all the works that deal with the same
subject. She points out the fact that each book can receive
only one class notation because it can be shelved in only one
place:

> The classification scheme is used primarily, in this
> country, to arrange books on the shelves so that
> materials that are alike according to the scheme will
> be found together. In an open stack library this ar-
> rangement provides another subject approach to books
> in addition to that provided by the subject headings
> used in the catalog. . . .

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[19] Richard Joseph Hyman, Shelf Access in Libraries
(Chicago: American Library Association, 1982), p. 47.

The function of the classification scheme is to provide a place for every work in the collection, in which that work will be shelved with other works that are alike according to the scheme.[20]

As Black points out, the "function of a subject heading is to enable groups of readers to find from the whole body of literature, materials which will help satisfy their specific needs."[21]

Richmond mentions that both classification and subject heading assignment may be inadequate if a monograph is dealing with several subjects, unless a deeper subject analysis is provided by the librarian. It is not possible to find out information from a complex, multi-subject work without going through a deep subject analysis:

Classification is made a tool for achieving consistent, fixed location of like material. On the other hand, realization that a classified shelf list leaves something to be desired in the way of subject analysis has forced catalogers to add subject entries to the card catalog, each corresponding to one of the major topics covered by the book and chosen from a standardized subject heading list containing a mixture of terms gathered through literary warrant. . . .

If the book is a monograph on a homogeneous subject, the system of shelf classification, supplemented by subject headings, is usually adequate. On the other hand, if the book represents a cross-fertilization among subject fields or if it is a collection of

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[20]Martha L. Manheimer, "The Relationship of Classified Library of Congress Subject Headings to the Library of Congress Classification Scheme," in Classified Library of Congress Subject Headings, 2 vols., ed. by James G. Williams, Martha L. Manheimer, and Jay E. Daily, (New York: Marcel Dekker, 1972) 1: 13-14.

[21]Henry Black, "An Approach to a Theory of Subject Headings," College & Research Libraries 7 (July 1946): 245.

papers, possibly on one central theme, but from many points of view representing many different fields, and if the information in it is to be sought from all these subject angles, then it is impossible to. present its true subject coverage without either a multiple-classification approach or a much deeper subject analysis than can be made with standard methods.[22]

Limitations of Each Subject Approach

While the two approaches complement each other, each one has its own advantages and its own limitations. In book classification only one principle can be applied at a time for physically gathering items together.[23] In an alphabetical subject catalog, theoretically, there is no restriction in assigning subject headings; the limitation being practical considerations.

In other words, while the subject heading approach could be multidimensional, the traditional library classification system is unidimensional in nature. Ranganathan points out that "library classification is equivalent to a representation of a multi-dimensional continuum in a single dimension."[24] Cutter realized the limitations of the classifi-

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[22]Phyllis Allen Richmond, "Some Aspects of Basic Research in Classification," Library Resources & Technical Services 4 (Spring 1960): 140.

[23]A. C. Foskett, The Subject Approach to Information, 4th ed. (Hamden, Conn.: Linnet Books, 1982), p. 182.

[24]S. R. Ranganathan, Philosophy of Library Classification (Copenhagen: Munksguard, 1951), p. 94.

cation approach, but he felt strongly that a catalog is no substitute for browsing through the shelves. He claimed that "a book on the shelves is worth two in the catalog ".[25] He recognized the fact that a book could be shelved in one place, whereas it could be listed in several places in the catalog.

This difference was discussed by many others after Cutter. Dewey stated that:

> Any book in a library can be shelved in only one place. It cannot be shelved simultaneously under its author's name, under its title, and under its subject (or subjects). The catalog, however, can list a book in several places.[26]

Similar views have been expressed by others. Foskett indicates that shelf classification is one way of showing semantic relationships.[27] By juxtaposition, or grouping together related concepts in a systematic arrangement, one can form a classification scheme that can be used for two purposes: (1) to help reader-browsing, and (2) to help reader-looking for information on a particular topic. Foskett points out that for shelf classification notations

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[25]Charles Ammi Cutter, "Close Classification: With Special Reference to Messrs. Perkins, Schwartz, and Dewey," Library Journal 11 (July 1886): 180-84.

[26]Harry Dewey, An Introduction to Library Cataloging and Classification, 4th ed., rev. and enlarged (Madison, Wis.: Capital Press, 1957), p. 15.

[27]A. C. Foskett, Subject Approach to Information, p. 150.

should be as brief and straightforward as possible.[28]

Theoretically, any book can receive as many subject headings as there are subjects in the book.

> Instead of fully exploiting the classification scheme's subject-revelatory potential through the classified catalog, American librarians have used multiple subject headings to express the major specific topics dealt with in a book; thus, at least theoretically, as many subject headings as necessary can be applied to the same work.[29]

However, as Dewey mentions, in practice assignment of subject headings is limited.[30] Economic factors play a role in this regard, and any decision is affected by economic considerations.

> In recent years, the high cost of cataloging has led some librarians to the conclusion that the lists of books under subjects must be limited in various ways, especially since no cataloger can hope to to reveal in the subject catalog all the library's holdings on each subject; for example, no library card catalog today lists under subject all the magazine articles in the library.[31]

It should be noted that some libraries and institutions in the United States do use classification for purposes other than what Fairthorne called the 'inscribing' and 'ordering' or the 'marking' and 'parking' syndrome.[32] The Universal

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[28]Ibid., p. 150.

[29]Hyman, Shelf Access in Libraries, p. 46.

[30]Harry Dewey, Cataloging and Classification, p. 16.

[31]Ibid., p. 16.

[32]R. A. Fairthorne, Towards Information Retrieval, Index Compiled by Calvin N. Mooers. (London: Butterworths, 1961),

Decimal Classification is used, for example, at the Center

for Atmospheric Research in Boulder, Colorado, and the

professionals in that institution manage to shelve their

books while assigning more than one classification.[33]

In some cases, the variation may be due to the fact that

while several subject headings can be expressed in one single

class notation, it may not be possible to represent all sub-

jects of a book, or all aspects of a subject matter discussed

in a document, in a single subject heading:

> The subject approach nearly always requires at
> least one card. If a book deals with several sub-
> jects, several cards must be provided, unless a
> general subject heading can be found that embraces
> all or most of the specific ones.[34]

Gorman suggested using different levels of complexity

for classifying library materials to solve the dichotomy

between the class notation as a shelving device, and class

notation as a retrieval device:

> The solution to the classification problem is to
> use two different schemes (or two levels of the same
> scheme): One to arrange the materials, and the other
> to provide subject-searching capability on machine
> systems.[35]

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p. 95.

[33]John S. Davis and Mary F. Haymes, "The Organization of
Geophysical Data Collection," Special Libraries 69 (May-June,
1978): 216.

[34]Harry Dewey, Cataloging and Classification, p. 17.

[35]Michael Gorman, "The Longer the Number, the Smaller
the Spine: Or, Up and Down with Melvil and Elsie," American
Libraries 12 (September 1981): 498.

He added that if the classifcation scheme changed, the
detailed number--which is used for subject search--can be
changed without changing the shorter number in the record or
the book. The first scheme is to be used for shelf arrange-
ment and would have a reasonable length. The second scheme
would be a longer number for detailed subject access.

There are cases in which a subject may be presented by
different terms. In such cases, the principle of uniform
heading requires one to choose a heading which represents the
material best. In other words, "when a subject has more than
one name, one must be chosen as the heading to represent all
materials on that subject, regardless of the author's
usage."[36] The principle of uniform heading requires using a
single subject heading to represent a topic.

Classification notations, on the other hand, should be
used ideally for the purposes of shelf arrangement as well as
symbolizing subject matter. Daily mentions different
purposes of these two systems of organizing knowledge: "Head-
ings are meant to bring together what the classification
separates." [37] He points out that the ideal scheme of the ar-
rangement of knowledge is the object of subject heading while
utilitarian arrangement of books on the shelf is the purpose

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[36]Lois Mai Chan, Library of Congress Subject Headings:
Principles and Application (Littleton, Colo.: Libraries Un-
limited, 1978), p. 25.

[37]Jay E. Daily, "Subject Headings and the Theory of
Classification," American Documentation 8 (October 1957):
272.

of classification.

For any given classification system, class notation does not vary with respect to the language of subject headings. As long as classification does not change, the classification notation for a given concept will remain the same. For instance, class notation '501' in the Dewey Decimal Classification (DDC),[38] or class notation 'Q 175' in the Library of Congress Classification (LCC)[39] is equivalent to the Library of Congress Subject Heading (LCSH): 'Science--Philosophy' or its equivalent in other languages.

Therefore, with regard to this limitation, while in a particular shelf classification system there may be more than one subject heading in a bibliographic record, there is usually only one class notation corresponding to all subject headings in that record.

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[38]Melvil Dewey, Dewey Decimal Classification and Relative Index, 3 vols., 19th ed, Edited Under the Direction of Benjamin A. Custer. (Albany: Forest Press, 1979), 2:1179.

[39]Library of Congress. Subject Cataloging Division, Classification; Class Q: Science, 6th. ed. (Washington, D. C.: The Library of Congress, 1973), p. 3.

Processes of Subject Analysis

The intellectual process of assigning class notation to
a title involves several mental activities. Part of these
mental activities is taken care of by the creator of a class-
ification system, and the rest is done by the classifier.
Williams identifies three processes in classification:
(1) defining a structure of categories, influenced by the
need of the organization, (2) determining a basis for class-
ification decision, and classifying documents into
categories. The first process is performed by the classifi-
cationists, while the last process is done by the clas-
sifier.[40]

Traditionally, subject headings and class notations have
been assigned to library materials by human classifiers.
Black points out that in a system of human classifiers and
indexers, retrieval is a direct function of input quality,
which is determined by four elements: (1) the availability of
qualified individuals, (2) their knowledge of the system, (3)
the quality of their training, and (4) continuing coordina-
tion and auditing of the work.[41]

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[40] J. H. Williams, Jr., "Computer Classification of Docu-
ments," in Mechanized Information Storage, Retrieval and Dis-
semination; Proceedings of the F. I. D./I. F. I. P. Joint
Conference, Rome, June, 14-17, 1967, ed. by Kjell Samuelson
(Amsterdam: North-Holland Pub. Co, 1968), p. 236.

[41] Donald V. Black, "Automatic Classification and In-
dexing, for Libraries?," Library Resources & Technical

When human beings tire of doing repetitious work, they become less alert. Assigning classification notations and subject headings to library materials by human labor is a very tedious job and may result in some inconsistency in performing these tasks.[42] In additon, a human being's attitudes may change under different conditions, and one's judgment in classifying a document may vary accordingly. These factors may affect one's performance, and the result may be inconsistency in assigning class notations or subject headings to a document being cataloged.

Library of Congress Subject Headings (LCSH)

The Library of Congress first published its subject catalog in the form of an alphabetico-classed catalog in 1869, and adopted the dictionary form for its catalog in 1898.[43] The Library of Congress Subject Heading list was first published for general use in American libraries from 1909-1914. Now it has gone to its ninth edition, being

Services 9 (Winter 1965): 49-50.

[42]Harold Borko, "Measuring the Reliability of Subject Classification by Men and Machines," American Documentation 15 (October 1964): 268. See also: Harold Borko, "Research in Computer Based Classification Systems," in Classification Research; Proceedings of the Second International Study Conference Held at Hotel Prins Hamlet, Elsinore, Denmark, 14th to 18th September 1964 ed. by Pauline Atherton (Copenhagen, Munksguard, 1965), pp. 220-267.

[43]L. M. Chan, Library of Congress Subject Headings, p. 13.

published in 1979 in two volumes. Each edition is an accumulation of experiences in developing new subject headings and keeping the headings up to date.

Although it was never explicitly mentioned in the Library of Congress Policy, Cutter's <u>Rules for a Dictionary Catalog</u> was the foundation for developing this index. As Angell points out, the Library of Congress list of subject headings is a controlled, pre-coordinated indexing vocabulary which is basically derived from the statements of 'objects' and 'means' formulated by Charles Ammi Cutter and his rules of dictionary catalog.[44]

In fact, Cutter himself states that there are no basic differences in his rules and the practice of the Library of Congress:

> The differences between these rules [Cutter's] and those adopted by the Library of Congress are of two classes. The first class of differences is in trifles of punctuation, capitalization, the place of certain items on the cards, and the like. . . . [and]
> In the second class of differences, those relating to place of entry of the card in the catalog, or of choice of heading.[45]

The Library of Congress cataloged about half a million

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[44] Richard S. Angell, "Library of Congress Subject Headings--Review and Forecast," in <u>Subject Retrieval in the Seventies: New Directions</u>, Proceedings of an International Symposium Held at the Center of Adult Education, University of Maryland, College Park, May 14 to 15, 1971; ed. by Hans (Hannan) Wellisch, and Thomas D. Wilson, (Westport, Conn.: Greenwood Pub., 1972), p. 143.

[45] Cutter, <u>Rules for a Dictionary Catalog</u>, pp. 5-6.

items annually during the early 1970's.[46] Most of the

bibliographic records of the Library of Congress contain full

cataloging information, subject headings, DDC and LCC

notations.

As Gorman points out, the Library of Congress Subject

Headings List "is far and away the most comprehensive and

widely used list of its kind."[47] The understanding and com-

prehension of the Library of Congress Subject Headings list

is recommended by various experts in the field. Gorman

states that: "In theory, an understanding of this huge list

is essential to the proper use of the Library."[48] The main

purpose of this research is not to examine the policy of the

Library of Congress; however, the policy of the Library of

Congress on assigning subject headings and/or class notations

is discussed in the course of this study as bibliographic

records used in this study are retrieved from LC MARC Tapes.

This list contains class notations and can be used to

some extent for classification purposes. As Metcalfe has

mentioned, there is no relative index for the Library of Con-

gress Classification:

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[46]Bruce J. Reid and Betty Green, "An Analysis of LC
Retrospective Cataloguing Data to Determine its Relevance for
the British University Library," Journal of Librarianship 6
(January 1974): 29.

[47]Michael Gorman, "Fate, Time, Occasion, Chance, and
Change; or How the Machine May Yet Save LCSH," American
Libraries 11 (October 1980): 557.

[48]Ibid., p. 557.

> . . . it is important not to confuse the classifica-
> tion of [the] Library of Congress with the subject
> headings for its dictionary catalogue; these have
> been published by Congress in one volume, and in an
> abrideged form in Sears' list. In the [Library of]
> Congress list LC numbers are given for subjects, so
> that the list can be used as an index to the clas-
> sification, and as a list of decisions on class-
> ifyings, but it is not published as one and it is not
> "relative".[49]

The list of revised subject headings is published

quarterly with an annual cumulation as a supplement to the

Library of Congress Subject Headings.[50] Because of attempts

to save labor, and due to practical necessity, American and

other libraries have increasingly relied upon the Library of

Congress Subject Heading list.[51]

Although subject headings used by the Library of Con-

gress said to be revised as needed,[52] it has been accused of

all sorts of deficiencies including use of awkward headings,

delay in replacing new terms, maintenance of both new and

superceded terms, having a low level of subject exhaustivity,

exhibiting a variable quality of subject analysis throughout

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[49]John Metcalfe, Subject Classifying and Indexing of
Libraries and Literature (New York: Scarecrow, 1959): p. 114.

[50]Library of Congress, Subject Cataloging Division,
Library of Congress Subject Headings, 9th ed. (Washington, D.
C.: The Library of Congress, 1980).

[51]Sanford Berman, Prejudices and Antipathies: A Tract on
the LC Subject Heads Concerning People (Metuchen, N.J.:
Scarecrow, 1971), p. ix.

[52]Library of Congress, Subject Cataloging Division,
"Changing Subject Headings and Closing the Catalogs,"
Cataloging Service Bulletin 4 (Spring 1979): 11-12.

the list, and not being comprehensive in certain areas.[53]   It

has also been accused of being racist and sexist:

> For years Public Service Librarians have been
> frustrated with LC Subject Headings. Not only were
> the headings accused of being subtly racist and
> sexist, they also took forever to change.[54]

In spite of all these problems, and although the Library

of Congress Subject Heading was never meant to be a national

standard tool for subject analysis, it is used not only by a

majority of American libraries but by many other libraries

around the world as well. In Daily's words:

> . . . the Library of Congress list is a structure
> that is at once necessary, inflexible, largely insuf-
> ficient for users, and a puzzle for catalogers; but
> it has provided the only subject access to informa-
> tion that is expanding in volume, broadening in
> coverage, and reaching into new profundities of ex-
> planation and fact.[55]

The principles of "specific and direct entry" and "uni-

form heading" have been generally recognized by the Library

of Congress. The former requires that "each subject appears

in the catalog under one name and in one form only" while the

latter indicates that " a subject catalog must bring together

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[53]William Mischo, "Library of Congress Subject Headings:
A Review of the Problems, and Prospects for Improved Subject
Access," Cataloging & Classification Quarterly 1 (1982): 105.

[54]David F. Kohl, "Public Service and the Disappearing
Card Catalog," RQ 17 (Summer 1978): 309.

[55]Jay E. Daily, "From Alphabetic Puzzle to Classified
Order," in Classified Library of Congess Subject Headings, 2
vol., ed. by James G. Williams, Martha L. Manheimer, and Jay
E. Daily (New York: Marcel Dekker, 1972) 1:1.

under one heading all the books which deal principally or exclusively with the subject."[56]

Library of Congress Subject Heading Practice

With respect to the assigning of class notation to a monograph, the policy statement of the Library of Congress indicates that regardless of the number of subject headings assigned to a given document, the first subject should be the determinant for the choice of class notation:

> The first subject heading assigned should normally represent the actual class number assigned to the work (the monographic class number for analytics of collected sets). In some cases a combination of two headings is needed to represent the class number, and these two should normally be listed as the first and the second subject headings assigned. Important headings which narrowly miss designating the class number (such as a special approach to the major topic, or the second of two major topics of the work) should be listed next. Finally, headings added to elaborate certain aspects, such as bibliographical headings, extra local history headings, etc., are listed last. If a work is being reclassed at the time the card is being reprinted, it is customary to renumber the tracings to correspond to the new class number assigned.[57]

In addition to this general policy, there are certain

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[56] Lois Mai Chan, "The Principle of Uniform Heading in Library of Congress Subject Headings," Library Resources & Technical Services 22 (Spring 1978): 126.

[57] Library of Congress. Subject Cataloging Division, "Order of Subject Tracings," Cataloging Service Bulletin 1 (Summer, 1978): 15.

cases in which the Library of Congress has provided guidelines for assigning extra headings. Generally, the Library of Congress uses two headings for parts of a heading which have equal significance:

> Strict observance of the principle of uniform entry for headings with subdivisions is not always desirable. When two components of the heading are equally significant and a reasonable choice between the two cannot be made, each component is listed as an entry element in LCSH.[58]

For a search to be exhaustive, the Subject Cataloging Division of the Library of Congress assigns additional subject headings to special categories of bibliography. For instance, in the case of reference books in any given subject, say chemistry, the following subject headings are assigned to reference sources dealing with chemistry bibliography:[59]

> Reference books--Chemistry
> Chemistry--Bibliography

Also, an alternative class notation is assigned to most of the bibliographies.[60] In some cases, for instance, in the case of Indians of North America, the Library of Congress assigns two subject headings to a document:[61]

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[58]Chan, "Principles of Uniform Headings," p. 134.

[59]Library of Congress, Subject Cataloging Division, "Additional Subject Assignments for Special Categories of Bibliography," Cataloging Service Bulletin 118 (Summer 1976): 11.

[60]Library of Congress. Subject Cataloging Division, "Alternative Class Numbers for Bibliography," Cataloging Service Bulletin 113 (Spring 1975): 5.

> Hopi Indians--Pottery.
> Indians of North America--Pottery.

In the case of fiction, the Library of Congress assigns two headings, one for the form and one for the topic. For instance, for title <u>Golf Story Omnibus</u>, the Library of Congress assigns the following subject headings:[62]

> Short stories, American.
> Golf--Fiction.

With respect to edition changes, as long as the content of the document does not vary siginificantly, the Library of Congress requires that the catalogers assign the headings and class notation of the original edition to the consecutive editions.[63] The exception to this policy is when the subject/or class notations of the original edition is deficient. If this is the case, the subject heading and/or class notation of the original edition are updated.

From time to time, however, there are departures from the general policy. Boll describes one such departure:

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[61]Library of Congress, Subject Cataloging Division, "Subdivisions Under Names of Indian Tribes," <u>Cataloging Service Bulletin</u> 110 (Summer 1974): 5.

[62]Library of Congress, Subject Cataloging Division, "Fiction in Subject Heading Practice," <u>Cataloging Service Bulletin</u> 122 (Summer 1977): 11.

[63]Library of Congress, Subject Cataloging Division, "Subject Cataloging of Editions," <u>Cataloging Service Bulletin</u> 112 (Winter 1975): 14-15.

One of the few, although apparently unrecognized, departures from subject headings policy began in 1972, when LC started to assign headings that did not describe the subject matter of the work cataloged, but were useful because of what might be called the reader's "associational interest". This is one type of heading that the special libraries and academic departmental libraries tend to add to LC copy to help the special needs of their clientele.[64]

Another point to be considered about the Library of Congress Subject Heading practice is the selection of terms. Generally, the Library of Congress prefers popular terms to the technical terms.

Library of Congress Classification (LCC)

The Library of Congress Classification is one of the largest enumerated classification schemes which was based on Jefferson's Classification. The first American classification was developed by Thomas Jefferson, the third president of the United States, for his own collection. He modified the Baconian Classification for the arrangement of his personal library. When the Library of Congress moved to the new building in 1897, after the old building burned, Jefferson sold his collection to the Library of Congress; thus his schedule became a basis for the development of the present Library of Congress Classification. It has been developed

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[64]John J. Boll, "From Subject Headings to Descriptors: The Hidden Trend in Library of Congress Subject Headings," Cataloging & Classification Quarterly 1 (1982): 22.

through teamwork, and the first edition of it appeared
between 1899-1939.[65]

The library of Congress Classification has twenty-six
possible main classes, of which at present only twenty-one
are being used. Actually, the scheme is constituted of
twenty-one special classifications consisting of thirty-four
volumes, each class having its own structure, notations, and
indexes.

The Library of Congress Classification uses a mixed
notation, using one or two letters and up to four Arabic
numerals. There are gaps between numbers for future
expansion. However, the Library of Congress uses decimal
numbers to expand an area whenever these gaps are filled. In
addition, Cutter numbers are used for subdivisions.

There is no use of mnemonic devices in the Library of
Congress Classification. Geographic and form subdivisions in
each class are developed without consideration of other
classes. For this reason, it is often criticized as being
"loosely coordinated".[66]

The changes in LCC schedules are published in three
ways:[67] (1) In LC Classification-Additions and Changes, a

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[65] Bohdan S. Wynar, Introduction to Cataloging and Clas-
sification, 6th ed. With the Assistance of Arlene Taylor
Dowell and Jeanne Osborn (Littleton, Colo.: Libraries Un-
limited, 1980), p. 430.

[66] Ibid., p. 456.

[67] John Phillip Immroth, Immroth's Guide to the Library
of Congress Classification, 3rd ed. by Lois Mai Chan (Litt-

quarterly publication by the Library of Congress, (2) The

supplement to <u>Additions and Changes</u> section at the back of

each individual section, and (3) Periodic new editions of the

individual schedules.

In spite of numerous changes adopted by the Library of

Congress in the above mentioned policy, it has been

criticized that the scheme is not adequately updated.

However, one must realize that the system is a product of an

evolution based on literary warrant, and today the system is

being widely used by most of the large academic and public

libraries, even though it was not originally developed to be

used by any other library besides the Library of Congress.

Notations in the Library of Congress Classification are

being used in the most economical way. That is, to classify

a document one should first class closely, then uniquely

identify particular works or issues of works until the most

economical notation is found. Of course, this process is not

always easy, and it is particularly problematic in certain

cases.

Harris and Clack mentioned the need for updating this

classification.

> Less attention has been paid to the updating of
> the library of Congress Classification (LCC). One
> can only speculate about the reasons, but they might
> be that the meaning of a classification notation is
> not immediately obvious to the user, and that LCC is
> used almost exclusively in the United States and more

heavily in academic than in public libraries.[68]

Dewey Decimal Classification (DDC)

The Dewey Decimal Classification scheme, a classifica-
tion system intended to provide a practical approach for
classifying books, was developed by Melvill Dewey
(1851-1931), librarian of Amherst College. The first edition
of this classification was published in 1876, with less than
1,000 subdivisions, in twelve pages, and an index of eighteen
pages.[69] Currently, it is in its nineteenth edition and
there are eleven abridged editions. It is one of the most
widely accepted classifications approaches which is used in
smaller libraries and has been translated into many other
languages. Using Arabic numerals for its notations, all
human knowledge is divided into ten main classes; each main
class in turn is subdivided into ten subclasses, each sub-
class into ten sub-subclasses, and so on.

It has seven auxiliary tables and a comprehensive rela-
tive index. The principle of number building allows using

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[68]Jessica L. Milstead Harris and Doris H. Clack, "Treat-
ment of People and Peoples in Subject Analysis," Library
Resources & Technical Services 23 (Fall 1979): 376.

[69]C. D. Needham, Organizing Knowledge in Libraries: An
Introduction to Information Retrieval 2nd ed. (London: Andre
Deutsch, 1971), p. 141.

many mnemonic features, such as the use of area codes and standard subdivisions, which makes the system flexible. However, since Arabic numerals are used for the notation, the flexibility is limited to the base number of ten. It is often criticized as being excessivily detailed, and having long and overcrowded notations in the area of science and technology. It is also criticized for separating certain subject fields, for example, language from literature.

The Dewey Decimal Classification has a changing policy for revising notations; and in addition to the changes from one edition to another, revised notations are announced in Dewey Decimal Classification, Additions, Notes, and Decisions.[70]

Similarities and Differences between
LCC and DDC

Both the Library of Congress and Dewey Decimal Classification systems are used in thousands of libraries all over the world. They have several similarities and differences:

(a) Similarities:

1. Both systems are 'general classification systems'

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[70]Jeanne Osborn, Dewey Decimal Classification 19th Editon: A Study Manual, With an Introduction by John P. Comaromi (Littleton, Colo: Libraries Unlimited, 1982), p. 23.

and are used mostly by general rather than special libraries.

2. Both systems were started in the latter part of the nineteenth century in the United States. Although both are used internationally around the world, they are biased toward American topics.

3. Both systems have practical usefulness in providing a location for books to be shelved. Libraries use them as a practical way of arranging their collections and providing a location for every item in the collection.

4. Both schemes provide relative locations for books classified. Each item being classified has a relative position in the continuum of class notations. Books can be added or withdrawn from the collection without affecting their relative position.

5. Both systems classify by discipline; in other words, divisions are based on academic field rather than by subject.[71]

6. Both are enumerative with limited synthesis capability and adhere generally to taxonomic and hierarchical principles.[72] Therefore, both are linear and unidimensional in nature.

7. Main classes of both systems reflect the areas of specialization. There are ten such specialized classes in

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[71] Lois Mai Chan, Cataloging and Classification: An Introduction (New York: McGraw-Hill, 1981) p. 223.

[72] Ibid, p. 210.

the Dewey Decimal Classification, and twenty-one in the Library of Congress, each representing a division of knowledge.

8. They have many problems in common. For instance, in both systems classes are not uniformly developed; their extension is limited to their bases, that is, ten in DDC and twenty-six in LCC.

(b) Differences:

1. DDC was based on the Harris Classification, which in turn was based on the Baconian classification; while in preparing LCC all schemes were reviewed and it is influenced by all of the previous schemes.

2. DDC is mostly used in smaller libraries, while LCC meet the need of large research libraries of several million books, although it can be used by a library of any size.

3. LCC has mixed notation, using both alphabet and numbers; while DDC has pure decimal notation with a few exceptions (for example, according to the instruction given under 822.33 in DDC schedule, works by and about Shakespeare may be subarranged alphabetically) it uses Arabic numerals.

4. The notational base of LCC is broader than that of DDC; that is, while in LCC there are twenty-six possible main classes, DDC has used its maximum potential of ten main classes.

5.. DDC was developed by one person, while LCC is a

product of group efforts.

6. DDC has a relative index while LCC does not have a general relative index.

7. DDC is hierarchical but not expressive while LCC is neither hierarchical nor expressive.[73]

8. DDC consists of three volumes (for the nineteenth edition) while LCC is in several volumes.

9. DDC has mnemonic features, while LCC is enumerative in type and has very few mnemonic features.

10. Finally, as the number of subdivisions increases, DDC notation becomes too long, and in practice, difficult to use, while LCC does not have this problem, at least not to the same degree as DDC.

Statement of the Problem

The above discussions indicated that each classification notation is a unidimensional representation of one or several subject headings. While theoretically a book can be listed under several subject headings in the card catalog and can be retrieved by any one of them, in actual practice there is normally one classification notation for each book being cataloged. Therefore, one approach is unidimensional and the other is multidimensional. While one can group bibliographic records according to the number of subject headings received,

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[73]Ibid, p. 223.

one cannot do so with respect to classification, for there is usually only one class notation for each bibliographic record. The number of subject headings in the card catalog has to be more than the total number of class notations used for the collection, unless all the bibliographic records have one and only one subject heading.

Considering the differences between these two tools of subject analysis, it is obvious that there could not be a one to one relation between any given subject heading and its corresponding class notation. If this is the case, what would be the association between each subject heading in the catalog and its corresponding class notation?

This study attempts to determine why all the identical subject headings in the card catalog usually do not have the same class notation. A theoretical explanation for this variation is that when subject headings from different bibliographic records with a different number of subject headings per bibliographic records are interfiled, they may not have necessarily the same class notation. Then, the logical question that follows is: Is there a direct relationship between number of subject headings per bibliographic record and variation in class notations? If so, would it be possible to find a fixed formula which describes the pattern of variations in class notations as the number of subject headings per bibliographic record increases? Would the degree of variation differ for the order or the position of

subject heading in the card catalog? Based on our past ex-
perience on cataloging and classification of library materi-
als, would it be possible to state a generalized law which
explains thes relationships?

The policy statement of the Library of Congress implies
that for any bibliographic record the degree of association
between the class notation and first subject heading will be
greater than the degree of association between it and the
second, third or fourth subject headings. The statement also
suggests that the degree of association between the subject
headings and class notations in single-subject heading
bibliographic records will be greater than the degree of as-
sociation between subject headings and class notations in
multiple-subject heading bibliographic records.

Given a database consisting of the last ten years of the
Library of Congress English monographic bibliographic records
arranged alphabetically by subject headings, and given the
ability to retrieve bibliographic records by the Library of
Congress Subject Headings, the Library of Congress Classfica-
tion notations, and Dewey Decimal Classfication notations,
what would be the chances that all the bibliographic records
retrieved by searching a subject heading such as 'Cataloging'
would have the same class notation '025.47' in DDC or have
the same class notation 'Z695' in LCC? The author checked
this subject heading and many other subject headings in the
huge subject card catalog of the Indiana University main

library and found that there was a great deal of variation
between class notations corresponding to various occurrences
of identical subject headings. The question is to know if
the cause of such variations can be identified.

Is such variation explained by the presence of biblio-
graphic records which have more than one subject heading? If
so, does the order of headings have an effect? Alterna-
tively, could the variation be the result of changes in class
notation in different editions of the classification system?
(As in the case of above example, in the eighteenth edition
of DDC the notation was 025.33 while in the nineteenth edi-
tion it is changed to 025.47). Could the variation also be
the result of the availability of more than one class nota-
tion for a given subject heading? Another possibility is
that of cataloger and/or classifier error in not being con-
sistent over time in assigning class notation. Also, would
the variation be different if a more specific subject heading
such as 'Cataloging--Manuscripts' is searched? Would the
results be significantly different if the database was ar-
ranged by classification notation rather than alphabetically
by subject headings?

The answers to the above questions are not specifically
provided by previous research. This study attempts to learn
more about the two subject approaches and identify certain
factors that may cause variations in the degree of asoocia-
tion between subject headings and class notations. It is an

attempt to answer some of the questions raised above by measuring the emprical probability between co-occurrence of LC Subject Headings and their corresponding class notations.

Justification for the Research

If librarianship is to be designated a 'science', it should demonstrate the charactristics of science; that is, in addition to a philosophical foundation, it should have systematization and predictability. Librarians often are criticised as being problem oriented people and less willing to consider theoretical problems:

> Librarianship in the United States has tradi-
> tionally been a problem oriented field. Librarians
> have tended to focus more attention on practical pro-
> blems in the "real world" than they have on the-
> oretical issues. This focus continues to be re-
> flected in the contemporary body of inquiry of the
> field.[74]

Even in practice oriented studies, without finding universal generalizations, the field cannot claim to be a science:

> Librarians have had extensive practical ex-
> perience and much of it has been recorded; there are
> reasonably large communications of raw data; and the
> literature records the results of many perceptive
> persons' thinking about our problems. But until we
> can state universal generalizations or laws, based on
> evidence and confirmable by further observations,
> librarianship will remain an art or a field of

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[74]Charles H. Busha and Stephen P. Harter, Research Methods in Librarianship: Techniques and Interpretation (New York: Academic Press, 1980), p. 4.

practice and will not be a science or a discipline.[75]

Generally, in the area of classification research the theoretical aspects of research have received little attention. Many of our future problems may be solved more easily if we can bring a theoretical perspective to our present problems. Theoretical research on the organization of knowledge, which may not have immediate application for libraries, has been recommended by experts in the field. Moberg indicates that more attention should be paid to the theoretical aspect of classification research:

> Impetus for research and development in automatic classification has grown from very practical considerations. Little research is undertaken in any field from purely theoretical interest--someone must be willing to pay for it, and this implies that the results should have potential value in application.[76]

For years, librarians have been using the Dewey Decimal Classification, the Library of Congress Classification, and Library of Congress Subject Heading list to organize library materials and facilitate subject access to documents. These systems have been revised and updated in the past to include advances in knowledge, but little effort has gone into studying the consistency of using these systems over time.

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[75]Herbert Goldhor, An Introduction to Scientific Research in Librarianship (Urbana, Ill.: University of Illinois, Graduate School of Library Science, 1972), p. 2.

[76]Zandra Moberg, "Automated Classification: Directions of Recent Research," Drexel Library Quarterly 10 (October 1974): 90-104.

Butler reports that there has been no comprehensive study of the degree of association between subject headings and co-occurrence of their corresponding class notations in the literature:

> The question remains regarding the empirical correlation between use of these two access systems in the cataloging of individual monographs. This correlation has not been reported in the literature for actual cataloging performed by the Library of Congress.[77]

This study is aimed at addressing this imbalance and seeks to determine from a theoretical perspective the probabilistic relationship between the Library of Congress Subject Headings assigned to monographs and their corresponding Dewey Decimal Classification and Library of Congress Classification notations.

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[77]Brett Butler, "Bibliographic Subject Access: A Measure of the relation between Use of Library of Congress Classification and Library of Congress Subject Heading Terms," in Proceedings of the American Society for Information Science Annual Meeeting (Washington, D. C.: American Society for Information Science, 1976) 13: 96.

Chapter 2

REVIEW OF LITERATURE AND RELATED RESEARCH

The literature on cataloging and classification is so
vast that even in four basic textbooks, very few works are
found to be commonly cited.[1] Although there are numerous
studies about different aspects of subject headings and clas-
sification, these studies generally deal with either classi-
fication or subject headings as a single entity, and without
considering the other. There are only a few studies that
consider specifically the relation of subject headings and
classification systems. As Svenonius states:

> Since Cranfield I, there has been a tendency
> moving away from the comparison of total systems
> toward singling out certain individual features of
> index languages and seeing how variations in these
> affect user satisfaction.[2]

This review attempts to summarize selectively the more
frequently cited works in this area. Primary attention is
given to the studies in the Library of Congress Subject Head-
ings, Library of Congress Classification, and Dewey Decimal
Classification, which are more related to the present study.

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[1]Donald J. Lehnus, "Who Cited What? A Citation Analysis
of the Four Basic Cataloging Texts," Journal of the American
Society for Information Science 23 (March-April 1972): 108.

[2]Elaine Svenonius, "Directions for Research in Indexing,
Classification, and Cataloging," Library Resources &
Technical Services 25 (January-March 1981): p. 90.

Below is a summary of studies related to the Library of Congress Subject Headings, Library of Congress Classification, and Dewey Decimal Classification.

Bibliographic and Bibliometric Studies

Lehnus investigated and analyzed citations found in the writings of previous catalogers for a period of 135 years (1835-1969) to determine whether the citation relationships connecting the writings that make up subject literature will point out the significant contribution to a field of study. He traced 63 writings cited to see which earlier writings were cited by it, and found that a small portion of authors (7 per cent) are responsible for a large percentage (50.12 per cent) of the citations.[3]

A fairly comprehensive review of the literature on the Library of Congress Subject Headings of post World War II to 1979 can be found in Cochrane and Kirtland.[4] They critically evaluated the literature on Library of Congress Subject Headings in items being cited in their bibliographic/bibliometric essay.

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[3]Donald J. Lehnus, Milestones in Catalogings: Famous Catalogers and Their Writings, 1835-1969 (Littleton, Colo.: Libraries Unlimited, 1974), p. 77.

[4]Pauline Cochrane, and Monika Kirtland, "Critical Views of LCSH--The Library of Congress Subject Headings; A Bibliographic and Bibliometric Essay and an Analysis of Vocabulary Control in Library of Congress List of Subject Headings (LC-SH)," ERIC ED 208 900 , 1971. See also Monika Kirtland, and

In another bibliometric study of cataloging and classification literature by Frohmann, it was found that cited articles in this area are predominantly English language sources (95.4 per cent), and are predominately non-scholarly works. The 1,865 articles cited appeared in 280 journals, and the journal of Library Resources & Technical Services was found to be the most frequently cited journal.[5]

Reviews of "Year's Work in Cataloging and Classification" are the annual feature of this journal. Since 1979 the reviews are mostly specialized to "Year's Work in Subject Analysis" to differentiate between activities in subject cataloging, classification, and indexing, and those activities related to descriptive cataloging. These reviews are good summary reports of research activities on subject analysis.

For instance, Clack reported that the year 1979 was "a rather lean year in the growth of the body of literature on subject analysis."[6] Wellisch stated that most contributions to the literature of subject analysis in 1980 were published by non-American sources.[7] Younger declared that: "Most of

Pauline A. Cochrane, "Critical Views of LCSH--Library of Congress Subject Headings; A Bibliographic and Bibliometric Essay," Cataloging & Classification Quarterly 1 (1982): 71-94.

[5]Bernd Frohmann, "A Bibliometric Analysis of the Literature of Cataloguing and Classification," Library Research 4 (Winter 1982): 364.

[6]Doris Hargrett Clack, "Year's Work in Subject Analysis: 1979," Library Resources & Technical Services 24 (Summer 1980): 235.

[7]Hans H. Wellisch, "Year's Work in Subject Analysis: 1980," Library Resources & Technical Services 25 (July-

the general or theoretical works appearing in 1981 reviewed diverse traditions from a historical perspective."[8]   Rinehart reported that: "The typical practice of subject analysis in libraries is changing dramatically as the online catalog becomes more prevalent and more sophisticated."[9]

General Surveys of Subject Headings

Morris explained the evolution of the alphabetico-classified catalog to the dictionary catalog, and identified the development of card catalog as an approach to subject analysis which is a truly American contribution to the art and science of librarianship. He mentioned four major forms of subject analysis, namely, library catalog, classification, indexing, and subject bibliographies, of which librarians had a direct participation on the first two:

> American librarians have shared significantly in all four developments. Their most direct participation and responsibilities are concerned with library cataloging and classification; in all probability

September 1981): 295.

[8]Jennifer A. Younger, "Year's Work in Subject Analysis: 1981," Library Resources & Technical Services 26 (July-September 1982): 263.

[9]Constance Rinehart, "Subject Cataloging in 1982," Library Resources & Technical Services 27 (July-September 1983): 269.

because these activities depend upon subject analysis of the actual holdings or collections of particular libraries. In contrast, journal indexing and many bibliographies are developed to cover the totality of existent, original communications without reference to the acquisitions or collections of any one library. On the whole, these activities have been recognized and accepted as being complementary rather than conflicting approaches to subject analysis.[10]

He described the process of subject construction as follows:

The process of subject heading construction proceeded by selecting the most appropriate word of greatest extension and least intension and progressively built up to the word of greatest intension and least extension. The level of analysis or degree of specificity, therefore, could be equal to any practiced in cataloging today.[11]

Lilley criticized the practice of subject cataloging by attempting to illustrate widespread weaknesses and dissatisfaction of the alphabetic subject catalog.[12] His study was designed to see if any evidence could be found to indicate whether the user's lack of success in manipulating the subject catalog has anything to do with level of specificity. He analyzed a series of subject headings, which were suggested by 340 library science students, to find out about users' lack of success in manipulating the subject catalog.

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[10]Jack C. Morris, "The Duality Concept in Subject Analysis," American Documentation 5 (August 1954): 119.

[11]Ibid, p. 119.

[12]Oliver L. Lilley, "Evaluation of the Subject Catalog: Criticisms and a Proposal," American Documentation 5 (April 1954): 41.

The analysis implied 373 different subject headings in a six item questionnaire. It was found that 50 per cent of the suggested subject headings were incorrect in format, terminology, and degree of specificity. He proposed a five step plan for improvement: (1) determining the function of the subject catalog; (2) setting up specific goals for the subject catalog; (3) developing alternative proposals of methodology for focusing on the problems to achieve the goals; (4) testing the alternative proposals; and finally, (5) construction of rules for subject cataloging.

Dhawan and Yerkey analyzed cataloging records for the period of 1974-1978 and determined the characteristics of subject headings to find the trends in subject assignment in bibliographic records through time.[13] This study showed that the assignment of subject headings was correlated not only with time but also with discipline. The average rate of as-signment of subject headings almost doubled during the period of study along with a growing rate of records in science and technology.

<div align="center">Standards for Subject Headings</div>

The need for a standard list of subject headings was discussed by many authors in earlier literature on subject

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[13]S. M. Dhawan and A. Neil Yerkey, "Trends in Subject Heading Assignment in Cataloging Records During 1974-1978," Information Processing & Management 19(1983):213.

analysis. Angell mentioned that standardization of subject
headings lies on the assumption that alphabetical subject
heading lists will continue to be essential to bibliographic
control, and there is a need to review the theory and methods
underlying the present list.[14] He asserted that for detailed
, scientific works the vocabulary of current subject headings
is inadequate, and he concluded that: "our most fundamental
requirement of the instruments by which we seek to make know-
ledge serviceable to mankind is perpetual responsiveness to
eternal change."[15]

Wright discussed problems of and opportunities for
developing standards for subject headings. Limitations of
language, shift in terminology, and the tendency to force new
subjects into old headings are the problems he cites in this
regard:

> Since subject headings are words, they suffer
> from the limitations of the language in which they
> are expressed. In order to fit easily into the
> system, a subject must have a definite name which is
> capable of clear and simple statement. Ideally that
> name should be a single word which is known and used
> by everyone. Since this ideal is not by any means
> always attained, several complex problems arise.
> Some terms are definite only when we see them in a
> certain context, but are confusing when removed from
> context. These we must define by a parenthetical
> explanation. Others are expressible only by a phrase
> and present us with alternative methods of expressing
> that phrase--by its straightforward form, its in-
> verted form, or by subdivisions in which punctuation

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[14]Richard S. Angell, "Standards for Subject Headings: A
National Program," Journal of Cataloging & Classification 10
(October 1954): 191.

[15]Ibid., p. 197.

takes the place of connecting particles. Here we
have followed a highly empirical course, choosing
among the three methods as we felt the emphasis of
subject to strike. In theory, since we are committed
to direct entry, all phrases should be in their
normal word order. Whether consistency in this
particular would give us a more useful catalog is
uncertain. It would, however, give us one that was
more understandable.[16]

General Survey of LC Subject Headings

Considering the future of the LC Subject Heading list,
Angell described the Library of Congress Subject Heading and
its application in libraries; suggesting an analytical review
of the following: The terminology, specificity, qualifica-
tions, subdivisions, accomodations of complex subjects, forms
and structure, reference provision, general complexity, size,
and maintenance of the Library of Congress Subject Head-
ings.[17]

To obtain data which reflect current cataloging
practices, O'Neill and Aluri studied characteristics of LC

[16]Wyllis E. Wright, "Standards for Subject Headings:
Problems and Opportunities," Journal of Cataloging & Classi-
fication 10 (October 1954): 177.

[17]Richard S. Angell, "Library of Congress Subject Head-
ings--Review and Forecast," in Subject Retrieval in the
Seventies: New Directions; Proceedings of an International
Symposium Held at the Center of Adult Education, University
of Maryland, College Park, May 14 to 15, 1971, ed. by Hans
Wellisch and Thomas D. Wilson (Westport, Conn.: Greenwood
Pub., 1972), p. 148.

Subject Headings occuring in OCLC bibliographic records.[18]
The aim of their study was to see how many subject access
points are available for any given bibliographic record. The
investigation was based on 33,455 OCLC cataloging records.
There were 50,213 subject headings in their study, of which
47036, or 93.7 per cent, were Library of Congress Subject
Headings.

The researchers found that topical subject headings were
the most common type of subject headings in the cataloging
records. Seventy per cent of subject headings were topical
subject headings, and 62 per cent contained at least one
topical subject heading. Geographical subject headings were
15 per cent of the total subject headings.

Nasatir discussed the feasibility of using Library of
Congress Subject Headings to describe machine-readable data
files.[19] She recommended that: (1) LCSH be used for subject
description of machine-readable data files (MARF), and be
supplemented by more thorough standardized content descrip-
tion; (2) to consider title words and use them as subject

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[18]Edward T. O'Neill and Rao Aluri, Research Report on
Subject Heading Patterns in OCLC Monographic Records (Colum-
bus, Ohio: OCLC, Inc., Research and Development Division,
1979). Also: Edward T. O'Neill and Rao Aluri, "Library of
Congress Subject Headings Patterns in OCLC Monographic
Records," Library Resources & Technical Services 25 (1981):
63.

[19]Marilyn Nasatir, "The Cataloging and Classification of
Machine-Readable Data Files, Part III: Subject Description of
Machine-Readable Data Files," Cataloging & Classification
Quarterly 2 (1982): 45.

headings; and (3) to draw up useful terms at all levels of the hierarchy and submit suggested changes to the Library of Congress.

LC Subject Headings and Other Lists

Cavender compared the Library of Congress Subject Headings for children with the Smith's List, a basic subject heading list for children's material, to determine the differences in various subject heading practices.[20] She said that children's librarians are often opposed to using the Library of Congress Subject Headings. Describing the advantages and disadvantages of each list, she recommended revision of the principles of subject headings, and suggested publication of a national code for the smaller libraries.

Cipolla compared subject heading usage for music monographs in the New York Public Library with that of the Library of Congress and found significant differences in terminology and structure of headings in the two lists. She found that subdivisions and inversions in the Library of Congress Subject Headings resulted more specific and direct subject entry and showed that the Library of Congress Subject Headings are more specific and direct than those used by the

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[20]Thera P. Cavender, "A Comparative Study of Subject Headings for Children's Materials," Journal of Cataloging & Classification 11 (January 1955): 13.

New York Public Library.[21]

Schadlich investigated factors that might be considered in changing from Sears to the Library of Congress Subject Headings. The availability, currency, specificity, and comprhensiveness of the Library of Congress Subject Headings were compared to those of Sears Subject Headings.[22] He selected a random sample of six months of Publishers Weekly, or total of 1,220 Library of Congress Subject Headings and compared them with the eleventh edition of Sears Subject Heading List. Each LC Subject Heading was assigned to three conflict types: (1) Exact match or a slight difference that would not affect filing; (2) No conflict, for instance, a case where one of the subject headings was more specific; and finally, (3) Conflict, that is, those headings to be changed. A chi square test at the .01 level showed a significant difference between the conflict groups. Schadlich concluded that many factors should be considered in switching from Sears to the Library of Congress Subject Headings. In converting Sears to LC, 10 to 14 per cent of the existing Sears Headings should be changed.

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[21]Wilma Reid Cipolla, "Music Subject Headings: A Comparison," Library Resources & Technical Services 18 (Fall 1974): 387.

[22]Thomas Schadlich, "Changing from Sears to LC Subject Headings," Library Resources & Technical Services 24 (Fall 1980): 361.

Specific Applicatons of LC Subject Headings

Ladenson described applications and limitations of sub-
ject headings to social science.[23] He argued that for many
years rules relating to subject entry, formulated by Charles
Ammi Cutter, have continued to govern the compilation of sub-
ject catalogs. In spite of dissatisfaction, he said, there
has been few critics of the theoretical basis of subject
cataloging. He checked 526 entries listed in the Ency-
clopedia of Social Sciences, and found that of this number,
only 415 entries are listed in the Library of Congress Sub-
ject Headings--that is, 111 entries were not found in the
list. He was convinced that a rethinking of the fundamental
basis of subject cataloging is necessary.

Wang analyzed Library of Congress Subject Headings for
Chinese literature.[24] The analysis was made in two
categories, the literary genres and chronological subdivi-

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[23]Alex Ladenson, "Application and Limitations of Subject
Headings: The Social Sciences," in Subject Analysis of Li-
brary Materials; Papers Presented at an Institute, June
24-28, 1952, Under the Sponsorship of the School of Library
Service, Columbia University, and the A.L.A. Division of
Cataloging and Classification, ed. with Introduction by
Maurice F. Tauber (New York: School of Liberary Service,
Columbia University, 1953), p. 64.

[24]Sze-Tseng Wang, "The Structure of Library of Congress
Subject Headings for Belles-Letters in Chinese Literature,"
Library Resources & Technical Services 17 (Spring 1973): 231.

sions. He noted that in establishing subject headings for Chinese literature the Library of Congress follows two principles: (1) the adoption of English terms whenever a satisfactory English term exists; and (2) use of romanized Chinese terms for concepts which are exclusively Chinese. Wang recommended that the Library of Congress should adopt more headings of romanized Chinese terms, and that more periodic subdivisions should be added.

Marshall studied LC Subject Headings applied to women and recommended that "subject descriptors must reflect the multiplicity of points of views that our users hold."[25] She stated six principles for establishing subject headings related to people and peoples: (1) If authentic names are not available for ethnic groups, one should establish a name that they themselves prefer; (2) one should avoid words which connote inferiority; (3) subject heading wording for a minority should not differ as compared with the wording used for the majority; (4) subject headings should be specific and correct; (5) one should not use subsuming terminology; and (6) one should not allow huge files of identical cards to be accumulated under one heading.

Petersen described a hierarchically arranged thesaurus for the field of arts. He discussed "the steps being taken within an art library community to improve the state of art

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[25]Joan K. Marshall, On Equal Terms: A Thesaurus for Non-sexist Indexing and Cataloging (New York: Neal-Schuman, 1977), p. 6-7.

indexing through the production of a comprehensive thesaurus based on the Library of Congress Subject Headings."[26] He mentioned several implications: (1) the Library of Congress Subject Headings can be restructured by experts, and then the vocabulary may be enriched by addition of new terms; (2) it is not possible to assign broader and narrower terms automatically to LCSH; (3) clear and consistent prescription for the use of subject lists must be formulated; and (4) a major restructuring of LCSH should be taken before a subject authority file is implemented.

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[26]Toni Petersen, "The AAT: A Model for the Restructuring of LCSH," The Journal of Academic Librarianship 9 (September 1983): 207.

[27]Sanford Berman, Prejudices and Antipathies: A Tract on the LC Subject Heads Concerning People, (Metuchen, N.J.: Scarecrow, 1971), p. 225.

LC Subject Heading Critics

Berman demonstrated objectionable subject headings related to race, religion, sex, ethnic groups, etc., and showed that many subject headings that reflect judgments were highly subjective. He gave some suggestions for improvements and recommended to "locate, examine and report--to library periodicals and LC itself--any further outlandish or un-justifiable forms, as well as recommending totally new heads required by fast changing times."[27]

In another study, Berman criticized Library of Congress Subject Headings as being outdated and commented that in spite of the fact that the LC Subject Heading is a fairly established list, it has several problems:

> Too often the vocabulary is archaic, inaccurate, and unpredictable, compelling often deadly second lookups. Too often the scheme fails to indicate genuinely related headings or to convert common synonyms into cross-references. Too often both old and new subjects go unrecognized. And too often not enough subject tracings are applied to make a work properly findable.[28]

Berman recommended a series of tools to be consulted for a 'Do-it-yourself' approach.

Frequent changes of subject headings could also be a

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[28]Sandford Berman, "Do-it-Yourself Subject Cataloging: Sources and Tools," Library Journal 107 (April 15, 1982): 785.

problem for large libraries because each change may involve a tremendous modifications in the files. However, White suggested that: "By introducing ample cross references and explanatory notes into the catalog, currency can be achieved without sacrificing previous subject approaches or requiring extensive redoing of [the subject] cards."[29] White added that a catalog would serves its users best when its makers are mindful of the fact that headings must be altered from time to time to reflect changes in the literature.

In spite of the problems associated with the Library of Congress Subject Headings, it is a useful list as stated by Pankin, "with all its problems, it is a wonderful thing if seen from the right angle."[30] Kanwischer's study indicated that most of the librarians felt that the subject headings were adequate for their usage.[31] Studying the librarians' view on the Library of Congress Subject Headings, she sent 120 questionnaires to university libraries with collections ranging from 125,000 to 300,000 volumes and asked about satisfaction with the headings provided by the Library of Congress. While 78.2 per cent of the respondents felt that the headings were adequate, only 35 per cent felt that they

[29]John B. White, "On Changing Subject Headings," Library Resources & Technical Services 16 (Fall 1972): 466.

[30]Mary Faith Pankin, "A Fresh Look at Library of Congress Subject Headings," West Virginia Libraries 32 (Fall 1979): 41.

[31]Dorothy Kanwischer, "Making Do With First Aid: Subject Headings Trauma," Wilson Library Bulletin 49 (May 1975): 651.

modified the subject headings in some way, 10.8 per cent felt that the subjects were inadequate, and 4.95 per cent indicated that the number of subject headings were assigned to works by the Library of Congress is not adequate.

Clack analyzed Library of Congress Subject Headings to determine the extent to which subject headings were satisfactory for retrieval of black resources.[32] She categorized the headings into seven levels of adequacy ranging from completely adequate to completely inadequate, and concluded that available provisions for blacks are inadequate and variy in degree of adequacy. Later, she conducted another study and concluded that the problem of inadequacy had improved.[33] She recommended that prescriptive measures are necessary and that the Library of Congress should create new subject headings to provide specificity for black studies.

Reviewing Chan's Library of Congress Subject Headings, Perreault examined many failings of the Library of Congress. He does not see the changes in LC Subject Headings as improvements: "LCSH is indeed undergoing radical changes, but

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[32]Doris Hargrett Clack, "An Investigation into the Adequacy of Library of Congress Subject Headings for Resources for Black Studies," (Ph.D. dissertation, School of Library and Information Science, University of Pittsburgh, 1973). Also: Doris Hargrett Clack, "The Adequacy of Library of Congress Subject Headings for Black Literature Resources," Library Resources & Technical Services 22 (Spring 1978): 137-144.

[33]Jessica L. Milstead Harris and Doris H. Clack, "Tr eatment of People and Peoples in Subject Analysis," Library Resources & Technical Services, 23 (Fall 1979): 378.

the lack of thoroughgoing principles for these changes make
it unsafe to call these changes improvements. . ."[34] He com-
mented that although the Library of Congress Subject Heading
is difficult to use, the difficulties have eased. "LCSH is a
difficult system to use, and a difficult system to under-
stand. To a very large extent these difficulties are now al-
leviated: those who need to see what is going on within LCSH
have a place to refer to where they will learn much of what
they need to know."[35]

Mischo reviewed the criticism leveled against the Li-
brary of Congress Subject Headings and attempted to il-
lustrate types of subject retrieval failure.[36] He identified
several problems: concepts for which no headings exists,
awkward subject headings, delays in accepting newer terms,
presence of current and old terms, confusion in topical sub-
division, and low levels of indexing exhaustivity.

He concluded that the Library of Congress Subject Head-
ings do not meet the complex needs of college and research
library users, and recommended more use of cross-references,
augmenting LC Subject Headings with added subject
descriptors, and using more sophisticated methods of acces-

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[34]Jean M. Perreault, "Library of Congress Headings: A
New Manual," International Classification 6 (1979): 159.

[35]Ibid., p. 168.

[36]William Mischo, "Library of Congress Subject Headings:
A Review of the Problems, and Prospects for Improved Subject
Access," Cataloging & Classification Quarterly 1 (1982): 105.

sing information.

LC Subject Heading Structure

Daily identified several problems with the structure of subject headings.[37] He studied the fifth edition of the Library of Congress Subject Headings to determine the function of each grammatical form in the structure of the list. A significant variation was found in the use of certain grammatical forms of the headings. He concluded that the choice of subject headings is largely governed by requirements to fit the heading into an existing structure.

Lilley studied subject headings' scope notes and references employed by 18 sources in the subject area of English literature.[38] He gathered information on some of the inherent characteristics of the alphabetical subject headings to identify the prevalent practices in this area. Among other things, she found that terminology and form were appropriate:

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[37]Jay Elwood Daily, "The Grammar of Subject Headings: A Formulation of Rules for Subject Heading Based on a Syntactical and Morphological Analysis of Library of Congress List," (DLS dissertation, School of Library Service, Columbia University, 1957), pp. 1-3.

[38]Oliver Linton Lilley, "Terminology, Form, Specificity and the Syndetic Structure of Subject Headings for English Literature," (DLS dissertation, School of Library Service, Columbia University, 1959), pp. 394-401.

A high degree of adaptability to variations of
terminology, form, and specificity, and to different
theories of syndetic needs, has been found to be a
characteristic of the basic sytem. . . . The
terminology used in the subject headings for English
literature has found to be appropriate for the topics
and for the forms of material to be presented; but
the special reasons for this condition (well
established names for age-old varieties of literary
composition), are unlikely to be duplicated.[39]

Lilley study also showed that the syndetic apparatus was
the most important feature in subject headings:

For English literature headings, the syndetic ap-
paratus has been found to be at once the most im-
portant element, and the one least adequately
provided for by modern subject heading practices.[40]

Richmond studied the synthetic structure of 'see also
references' in the Library of Congress Subject Headings, ex-
plicating a concealed classification in the references
involved.[41] In her study, the organization in the subject
heading's cross references was compared with the subject
norm. Her study was based on the assumption that the cross
reference structure should be parallel to the subject's in-
ternal classification. Using the subject heading 'Cats', she
logically demonstrated that in one type of organization, that
is, the 'see also' cross reference, there is a concealed
classification inherent in it. She argued that if classifi-

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[39]Ibid, pp. 394-6.

[40]Ibid, p. 401.

[41]Phyllis Allen Richmond, "Cats: An Example of Concealed
Classification in Subject Headings," Library Resources &
Technical Services 3 (Spring 1959): 102.

cation were used as a means of generic syndetic structure, great improvement in that structure would result.

Harris investigated the influence of several adminstrative factors on selected types of subject heading.[42] She studied 10 per cent of the headings used in the seventh edition of Library of Congress Subject Headings, and found that a positive correlation of 0.675 existed between the number of titles entered under a given heading. It was found that inversions and subdivisions are used to produce a classified subject arrangement, and that the size of the library does not affect the relative scope of the heading used.

Chan used the seventh editon of the Library of Congress Subject Headings to examine direct and inverted forms of subject headings. She identified all adjective-noun headings containing nominal adjectives, and found that there were 3,156 such headings in total. Harris' suggestion for determining the subject form was based on word frequency. The results of this study suggested a pattern based on subject matter—that is, having different rules for different subject areas.[43]

In two different studies, Sinkanks investigated the

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[42]Jessica Lee Harris, "Subject Headings: Factors Influencing Formation and Choice: With Special Reference to Library of Congress and H. W. Wilson Practice," (DLS thesis, Columbia University, 1969), pp. 1-2.

[43]Lois Mai Chan, "'American Poetry' but 'Satire, American': The Direct and Inverted Forms of Subject Headings Containing National Adjectives," Library Resources & Technical Services 17 (Summer 1973): 338.

syndetic structure of the Library of Congress and Sears Sub-
ject Heading lists. In the first study, he examined the 'see
also' references in the seventh edition of the Library of
Congress Subject Heading list. There were 36,468 subject
headings in the entire list, of which he selected 1,216 or
3.33 per cent in his study.[44] He concluded that the syndetic
structure does not perform any guiding function, and that the
connection may not be considered as a classification. Any
see-also link bears validity only between immediate members
and has no relation to any other link drawn in the structure.
Each link is an isolated event and cannot be considered as a
part of any relational set of links, or structures of links.

In another study, Sinkanks investigated the syndetic,
syntactic, and classificatory associative system in the
eighth edition of the Sears List of Subject Headings.[45] The
classificatory associative system was found to have
significantly greater numbers of association than the other
two systems, while the syndetic and syntactic systems were
found to overlap greatly in coverage.

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[44]George M. Sinkanks, A Study in the Syndetic Structure
of the Library of Congress List of Subject Headings (Pitts-
burgh, Pa: University of Pittsburgh, Graduate School of Li-
brary and Information Science, 1972), p. 51.

[45]George M. Sinkanks, "An Investigation and Comparison
of Three Associative Systems in a General Subject Heading
List," (Ph.D. dissertation, University of Pittsburgh,
Graduate School of Library and Information Sciences, 1974),
p. 77.

Wepsiec studied selected clusters of the Library of Congress Subject Headings from the eighth edition to analyze the syndetic structure of certain subject headings in the field of anthropology. She was primarily interested in the level of generalization and was concerned with subordinate and superordinate relationships among headings.[46] She concluded that there is unjustified proliferation of syndetic relationships. In other words, occasionally a heading was unnecessarily related to other headings on a different or distant level of generalization. It was also found that some subject headings related to anthropolgy duplicate others. She mentioned that scholars introduce new terms that better express the meaning of certain already known concepts. However, the Library of Congress is slow in changing terms partly because of the size of the system.

In another study, she analyzed the language of the Library of Congress Subject Headings related to society.[47] Using presence or absence of modifiers and the type of modifiers as criteria, she identified four groups of headings and subdivided each group by specific forms. In this way she established 22 different subject heading types.

Steinweg studied the punctuation used in the Library of

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[46] Jan Wepsiec, "Inquiry into the Syndetic Structure of the Library of Congress Subject Headings in Anthropology," Library Resources & Technical Services 22 (Winter 1978): 61.

[47] Jan Wepsiec, "Language of the Library of Congress Subject Headings Pertaining to Society," Library Resources & Technical Services 25 (April-June 1981): 196.

Congress Subject Headings.[48] . The study revealed that
punctuation used in the Library of Congress Subject Headings
are the commas, parentheses, hyphens, periods, apostrophes,
and dashes. Inspection of the Library of Congress Subject
Headings indicated that the comma is probably the most fre-
quently used punctuation marks in that list. The comma is
used mostly in inverted headings to denote national,
linguistic or ethnic adjectives; it is also used to separate
different parts of a series. Parentheses are used to explain
or clarify a subject; that is, when the terminology used in
the subject headings may have different meanings, parentheses
are used to show the correct usage of the headings. There
were 2,917 authorized headings with hyphens. Hyphens are
used with single letter numbers or letters. Periods are used
in the subject headings the same way as they are used in
ordinary texts, that is, to end the subject heading.
Apostrophes are used to indicate genetive case, ownership,
and relationships. Dashes are used to set off subject subdi-
visions.

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[48]Hilda Steinweg, "Punctuation in Library of Congress
Subject Headings," Library Resources & Technical Services 22
(Spring 1978): 145.

Specificity of the Library of Congress Subject Headings

Angell mentioned that specificity is determined by the document being analyzed as well as the nature of demand for information in a given situation.[49] Therefore, specificity has two aspects:

> The first [aspect] is the specificity that is possible. This is determined by the document in hand that is being analyzed; in other words, the document itself determines the degree of precision with which its own content can be described. The second aspect is the specificity that is desirable. This specificity is not determined by the document but by the characteristics of the demands which are made upon an information system in a particular application or installation.[50]

Lilley described the relative nature of subject specificity, and pointed out that the concept of specificity is not constant.[51] Specificity may vary, he said, because (1) specificity is in part a function of subject area, that is, the same word can vary from extremely general to the extremely specific depending on the context, and (2) specificity is a function of the library because the same book can be

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[49]Richard S. Angell, "Standards for Subject Headings: A National Program," Journal of Cataloging & Classification 10 (October 1954): 191.

[50]Ibid, p. 193.

[51]Oliver Linton Lilley, "How Specific is Specific?," Journal of Cataloging & Classification 11 (January 1955): 3.

described at various levels of specificity depending on the users of the library.

Part of his dissertation research was dealing with the question of specificity of subject heading in English literature. He found that "the headings at the same level of specificity may be employed for such a wide variety of purposes that their exact uses are highly unpredictable on the basis of terminology and form alone."[52]

A part of the Harris study as well was related to specificity of the subject.[53] She found that the choice between inversions and direct entry of adjectival phrases was strongly influenced by the phrase which specify the subject.

Steinweg, too, believes that "specificity of the subject covered by the work should be matched by the specificity of subject headings to cover it."[54] She examined the methods by which specificity is achieved in the Library of Congress Subject Headings. Specificity is achieved by using modifiers in parentheses, adjectival and phrase modifiers, dates, subdivisions by place, time, form, and topic; but the most obvious way to achieve specificity is to use the appropriate term for any given level of specificity.

Wilson supports the idea of specific entry, that is, an

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[52]Lilley, "Terminology, Form, Specificity," p. 400.

[53]Harris, "Subject Headings," pp. 246-248.

[54]Hilda Steinweg, "Specificity in Subject Headings," Library Resources & Technical Services (Winter 1979): 55.

entry under a heading which expresses the topic of a work precisely rather than a broader heading in general, and disapproves of the policy of the Library of Congress in providing duplicate entries at both specific and general levels.[55] He says that the specific entry does not mean to assign a single heading to a work. Whenever no single entry is available, he adds, instead of using a broader heading use two specific headings.

Greenberg examined characteristics of 1,892 scope notes in the eighth edition of the Library of Congress Subject Headings.[56] He identified three functions of scope notes as to ensure the consistency of usage by specifying the range of subject matter to which a subject heading can be applied; drawing necessary distinctions between related subject headings; and stating which of several meanings of a term is the one to which its usage in the library catalog is limited.

[55]Patrick Wilson, "The End of Specificity," Library Resources & Technical Services 23 (Spring 1979): 116.

[56]Alan M. Greenberg, "Scope Notes in Library of Congress Subject Headings," Cataloging & Classification Quarterly 1 (1982): 95.

Subject Access and Subject Search

Wellisch criticized the use of the dictionary catalog
for document retrieval. He discussed that the dictionary
catalog is both dificult and frustrating; in particular he
was concerned with subject retrieval and concluded that
"retrieval tools that we proudly called subject catalogs
somehow do not perform effectively."[57]   He mentioned the
fact that librarians use the Library of Congress and Dewey
Decimal Classifications to indicate the principal subject
matter of a document or at least the subject which seems to
be the cataloger's view; however this subject may or may not
coincide with that of prospective users.

He also pointed out the fact that not all documents deal
with one single subject. Two, three or more subject headings
and their interrelationships cannot be compressed into a
single notation. Bates examined the effects of subject
familiarity, and catalog familiarity on subject search
sucess. It was found that catalog familiarity was very
beneficial to search success, while subject familiarity had a

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[57]Hans (Hanan) Wellisch, "Subject Retrieval in the
Seventies: or Methods, Problems, Prospects," in Subject
Retrieval in the Seventies: New Directions; Procedings of an
International Symposium Held at the Center of Adult Education
University of Maryland, College Park, May 14 to 15, 1971, ed.
Hans (Hanan) Wellisch, and Thomas D. Wilson (Westport, Con-
n.: Greenwood Pub., 1972), p. 5.

slight but not significant effect on its sucess.[58]

Holley and Killheffer questioned the problem of subject access, arguing that the Library of Congress is slow in replacing old terms with new terms. Problems involved in subject access could be attributed to the fact that the Library of Congress Subject Heading is pre-coordinated and one element alone cannot lead to the term. They noted that the Library of Congress assigns subject headings in such a way that valuable information within many items is lost.[59]

Gratch, Settel, and Atherton studied characteristics of book indexes for subject retrieval in the humanities and social sciences.[60] As a part of their 'Subject Access Project', 113 books in nine disciplines of social sciences and humanities were measured , analyzed and compared with guidelines of American Standards Institute and British Standards Institution. All books were selected from English language materials. The criteria used were number of index pages, number of lines per index page, index density, arrangement of index, and the scope of indexing.

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[58]Marcia J. Bates, "Factors Affecting Subject Catalog Search Success," Journal of the American Society for Information Science, 161 (May 1977): 161.

[59]Robert p. Holley and Robert E. Killheffer, "Is There an Answer to the Subject Access Crisis?," Cataloging & Classification Quarterly 1 (1982): 125.

[60]Bonnie Gratch, Barbara Settel and Pauline Atherton, "Characteristics of Book Indexes for Subject Retrieval in the Humanities and Social Sciences," The Indexer 11 (April, 1978): 14.

Findings revealed some serious inadequacies of book indexes for subject retrieval. Fifty-five per cent of the sample drawn possesed an index, meaning that almost half of the the books in any library may not have an index at all.

In another study on augmenting subject descriptions for books for online catalogs, Settel and Cochrane found that for the online subject search the BOOKS record (a database on OR-BIT with augmented subject descriptors in each record) is better than the MARC record.[61]

Items retrieved by the BOOKS records were more relevant than the items retrieved by the MARC records:

> BOOKS records retrieved at least twice as many of the relevant items for the social science queries (31 versus 61) and three times as many as MARC for the humanities queries (25 versus 70).[62]

Hill discussed practical considerations of using the classification number in online subject access.[63] She mentioned several problems related to the use of the classification number as an access point in an online subject search including difficulty of use, changing from one edition to another, and inconsistency of its usage within a library. She concluded that:

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[61] Barbara Settel and Pauline A. Cochrane, "Augmenting Subject Descriptions for Books in Online Catalogs," Database 5 (December 1982): 29.

[62] Ibid, p. 36.

[63] Janet Swan Hill, "Online Classification Number Access: Some Practical Considerations," The Journal of Academic Librarianship 10 (March 1984): 17.

Online subject searching by classification number
would offer an approach to information well beyond
the capabilities of card catalogs, and it is undoub-
tedly worth aiming for.[64]

Classification Studies

Samore studied form divisions in all classes of the
Library of Congress and Dewey Decimal Classification schemes.
The analysis of forms was done with respect to the order or
position of the form divisions within each class, representa-
tion of the form divisions, relationship of the form
divisions to other categories, and comparative value of the
form divisions.[65] He described certain basic differences in-
herent in the organization and structure of the two schemes
and concluded that DC cannot match with LC in this regard and
that the disparity in the maximum use of form divisions is
the logical outcome of other differences in the two systems:

D.C. is unable to match L.C.'s use of form
divisions, because the scheme is limted by notational
and mnemonic considerations. In D.C., the form
divisions are simply subdivisions that are generally
suitable to the main classes.[66]

Casellas compared relative effectiveness of three clas-
sification systems for marketing collections: Harvard Busi-

[64]Ibid, p. 22.

[65]Theodore Samore, "Form Division in L.C. and D.C. Clas-
sification Schemes," Library Resources & Technical Services 6
(Summer 1962): 243.

[66]Ibid, p. 246.

ness, the Library of Congress, and Dewey Decimal classifications.[67] She evaluated them based on their characteristics, skeleton, form, geographic divisions, combination and indexes. It was found that the Dewey Decimal Classification is the least desirable choice because of its lack of detailed notation. The Harvard Classification was found to be the second choice and Library of Congress classification provided the detailed analysis which was unavailable in the other two classifications.

Lorenson briefly described a successful experiment conducted by the Indiana State College which affected a partial reclassification by adapting LC national literature schedules to DC notations.[68] He stated that conversion from either classification system can be done by substituting part of the notation in one classification with the corresponding part in the other:

> Conversion from mixed to pure notation is accomplished by substituting second summary DC figures for the LC class letters. . . .
> Conversion from numerical to decimal notation is accomplished by inserting zeros between the letters and figures of the LC classes in order to provide a base of six elements.[69]

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[67]Elizabeth Casellas, "Relative Effectiveness of the Harvard Business, Library of Congress, and the Dewey Decimal Classifications for a Marketing Collection," Library Resources & Technical Services 9 (Fall 1965): 417.

[68]Robert Lorenson, "Adapting LC Schedules to DC Notation," Library Resources & Technical Services 9 (Spring 1965): 210.

[69]Ibid, p. 210.

Henshaw attempted to correlate the Library of Congress and Dewey Decimal Classification schedules for the purpose of reclassification, emphasizing similarities rather than differences in the two classification systems.[70]

She mentioned that systematic arrangment of the subject contents of books and other materials is the common chararcteristic of all classification systems. She argued that there must be a relationship between systems of classification and that when a notation in one system is known, the notation for other systems may be derived from it.

> These classifications have one characteristic in common; i.e., they are systematic arrangements of the subject content of books and other written materials. This systematization of topics according to sequences of relationshps, processes, form, time, place, makes it possible for any written material to be classified according to all of the cited classification schemes. The classification of library materials is the only true science found in the entire discipline of "library science", and it is expected to display the characteristics of a science; i.e., philosophic foundations, systematization, predictability. It is obvious, therefore, that a relationship must exist between the systems of classification, so that if the notation of one system is available, all others may be derived from it. This proposition is evident on every catalog card and bibliographic entry which now carry the notations of more than one classification system.[71]

She also illustrated examples in which approximately 50

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[70]Marie Henshaw, "Conversion Sampler: Principles, Examples, and a Design for Developing Conversion Tables for Book Classification Schemes," Library Journal 92 (November 1, 1967): 3964.

[71]Ibid, p. 3964.

per cent of notations in the two classification systems have a one-to-one corresponding notation, and presented other situations in which a single notation in one system is stated by a span of notations in the other system.

Auld compared vocabulary used in the outline of the Library of Congress Classification with the summaries of the sixteenth and seventeenth editions of the Dewey Decimal Classification.[72] Using a KWOC (KeyWord Out of Contex) indexing program, an index was generated for each list. The three lists contained 2,546 words, of which 1,542 were unique. It was found that within the LC list approximately 41.4 per cent co-occurred with the sixteenth edition of DDC and 42.1 per cent co-occurred with the seventeenth edition of DDC. That is, only two-fifth of the words co-occur between LC and either of the DC lists.

Veryha cites some of the shortcomings of the Library of Congress Classification, such as inconsistency in details, and insufficient periodization. The study concluded that while the Library of Congress has a well elaborated sytem, the policy is not applied to all areas. He pointed out that the Library of Congress Classification was prepared in 1916, and since then little effort has gone into rectifying the schedules--and as a result they are inadequate and ob-

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[72]Larry Auld, "KWOC Indexes and Vocabulary Comparisons of Summaries of LC and DC Classification Schedules," Journal of the American Society for Information Science 22 (September-October 1971): 322.

solete.[73]

Svenonius explained the use of classification in online
retrieval. She argued that one way in which classification
can be used in an online system is to increase the number of
relevant documents retrieved by broadening a search.[74] She
identified eight uses of classification in online retrieval
sytems: To improve recall and precision, to save time in
keying search terms, to contextualize the meaning of vague
terms, enabling the computer to simulate part of the search,
providing a structure for meaningful browsing, to represent
and retrieve non-bibliographic information, to collect cita-
tions in ways not possible manually, and achieve compatibil-
ity of retrieval languages.

In another study, she also speculated on directions of
research in bibliographical control (that is, indexing, clas-
sification, and cataloging). With regard to the Library of
Congress and Dewey Classification, she stated that DDC is
going more toward a synthetic capability while LCC is moving
more toward enumeration:

> DDC is moving in the direction of assuming more of
> the synthetic capability that characterizes the Colon
> Classification. LCC, on the other hand, continues in

73Wasyl Veryha, "Library of Congress Classification and
Subject Headings Relating to Slavic Eastern Europe," Library
Resources Technical Services 16 (Fall 1972): 470.

74Elaine Svenonius, "Use of Classification in Online
Retrieval," Library Resources & Technical Services 27
(January-March 1983): 76.

its enumerative mode.[75]
She pointed out that although DDC is not a complete

hierarchical system, however, with respect to automation

adoptability, she feels that DDC has an advantage over LCC:

> Looking at the relative merits of DDC and LCC in an
> automated environment, it would seem at first sight
> that the Dewey hierarchical notation gives it an edge
> over LCC. However, if DDC were to be examined from
> the point of view of perfect hierarchy, where perfect
> hierarchy is defined in terms of mathematical
> properties associated with the inclusion relation
> (transitivity, antisymmetry, and reflexivity), it
> would soon be seen to be shot through with imperfec-
> tion.[76]

Hudson did a comparative study of searching using key-

words in the title and/or subject headings, the Library of

Congress Classification, Dewey Decimal Classification, and

If-Scan search (The 'If-Scan' function enables the users to

scan a specific field of the record for a given character or

character string; for instance, code '56' can be search as a

part of DDC notation to retrieve records related to the Mid-

dle East) by area code in the DDC.[77] A computer-based

laboratory, LEEP (Librarary Education Experimental Project)

at Syracuse University was used to search 8,000 MARC records.

The data base was searched for Middle East and Latin American

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[75]Elaine Svenonius "Directions for Research in Indexing, Classification, and Cataloging," Library Resources & Technical Services 25 (June-March 1981): p. 94.

[76]Ibid., p. 95.

[77]Judith A. Hudson, "Searching MARC/DPS Records for Area Studies: Comparative Results Using Keywords, LC, and DC Class Numbers," Library Resources & Technical Services 14 (Fall 1970): 534.

inquiries, and by using precison and recall ratios the
relevancy of each retrieved record was measured. The results
of the study showed that the keyword search was the optimum,
with 95 per cent relevance. If more than one attempt was
used, Library of Congress Classification and Dewey Decmial
Classification was recommended respectively. The analysis of
failure indicated that keywords resulting from homonyms and
human error in preparing key words were causes of false
drops. The study recommended some improvement in search
strategy; the If-Scan by area code was found not to be useful
and was not recommended.[78]

Relationship of Subject Heading and Classification

Dewey studied the relationship between subject headings
in the catalog and the classification number for books.[79] He
explored the question of the degree to which a subject
catalog could be satisfactorily substituted for three systems
of classification: Dewey Decimal Classification, Library of
Congress Classification, and Universal Decimal Classifi-

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[78]Ibid, p. 542.

[79]Harry Dewey, "The Relationships between the Headings
in the Subject Catalog and the Classification Numbers of the
Books," in Reclassification: Rationale and Problems;
Proceedings of a Conference on Reclassification, held at the
Center of Adult Education, University of Maryland, College
Park, April 4 to 6, 1968. Edited by Jean M. Perreault. (Col-
lege Park, Md.: School of Library and Information Services,
University of Maryland, 1968), p. 57.

cation. Since classification notations are a kind of head-

ing, he argued, some degree of substitution is possible. He

attempted to show that "a numerical subject catalog and a

corresponding shelf arrangement are almost by definition,

interchangeable." He concluded that both subject catalog and

shelf classification are needed to give the best service to

the users. He also mentioned that the Library of Congress

Classification has weaknesses which make it less effective

for the users than the Dewey Decimal Classification.

Immroth investigated the relationship between classifi-

cation schedules and their indexing on the one hand and sub-

ject headings and classification on the other.[80] He found

that about half of the class notations in the Library of Con-

gress Classification are indexed. He also noted that there

is a significant relationship between terminology of the Li-

brary of Congress Subject Headings and the Library of Con-

gress Classification System.

Patterson was concerned with determining the degree of

relationship between the Library of Congress Subject Head-

ings, LC schedules, and index to the LC.[81] The Library of

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[80]John Philip Immroth, An Analysis of Vocabulary Control
in Library of Congress Classification, Indexes and Subject
Headings (Littleton, Colorado: Libraries Unlimited, 1971),
pp. 144-145.

[81]Charles Donald Patterson, "A Graphemic, Morphological,
Syntactical, Lexical, and Contextual Analysis of the Library
of Congress Music Subject Headings and Their Relationship to
the Library of Congress Classification Schedule, Class M, as
Determined by a Comparative Sampling of Two Vocabularies"
(Ph.D. dissertation, University of Pittsburgh, 1971), p. 181.

Congress Subject Headings.were compared to index headings and

classification.headings on a graphemic, morphological,

syntactical, lexical and contextual basis. The results of

this study showed that most of the headings in the two lists

matched:

> Of the 73 music subject headings tested
> graphemically, 20 of the corresponding index headings
> match perfectly with the subject headings, 10 of the
> classification headings match perfectly with the sub-
> ject headings, and 13 of classification headings
> match perfectly with the index headings. The highest
> graphemic correlation is between the subject headings
> ad the index headings where 68 per cent of the 73
> subject headings either match or partial match.[82]

The highest graphemic correlation was found to be

between subject headings and index headings. The next

highest correlation was betwen the classification headings

and the subject headings. The morphological-syntactical

analysis showed that the degree of correlation present in the

vocabularies was high. The lexical and contextual analysis

revealed that that there was a high degree of closeness among

the subject headings themselves; also there was a high degree

of lexical and contextual synonymity between the subject

headings and the index headings, between the subject headings

and the classification headings and between the classifi-

cation headings and the index headings.

The overall conclusions of the study indicated that from

graphemic, morphologic, syntactical, lexical and contextual

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[82]Ibid, p. 181.

points of view the terms used in these three vocabularies are
identical or nearly identical.

Manheimer studied the relationship of classified Library
of Congress Subject Headings to the Library of Congress Clas-
sification Schemes.[83] She compared Class GR (Folklore) of
the Library of Congress with the Library of Congress Subject
Heading List, and found a close relationship between the sub-
ject headings and the class headings:

> When the special subjects in folklore are com-
> pared to the classified list, it can be seen that
> there is a very close relationship between the sub-
> ject headings and the classification scheme in that
> almost every class heading has at least one matching
> or equivalent subject heading. However, if it is as-
> sumed that the librarian first classifies the book
> and then attempts to go from the class heading to the
> subject heading, a number of problems related to
> terminology will be found. . . . approximately 90 per
> cent of the time the subject heading appears as the
> topic word, and approximately 70 per cent of the time
> it appears unglossed with only a class reference to
> Folklore.[84]

She concluded that in spite of the fact that there are
close relationships between subject headings and class head-
ings, these are two different systems of subject analysis,
and that "they are only tangentially related in an entirely

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[83]Martha L. Manheimer, "The Relationship of the Clas-
sified Library of Congress Subject Headings to the Library of
Congress Classification Scheme," in Classified Library of
Congress Subject Headings, 2 vol., ed. by James G. Williams,
Martha L. Manheimer, and Jay E. Daily (New York: Marcel Dek-
ker, 1972), 1: 13.

[84]Ibid., p. 16.

unpredictable way".[85]

Fenske studied the correlation between the National Library of Medicine classification notations and MeSH headings to determine which of the two alternative methods of utilizing the correlation would be best.[86]   She used 8,137 bibliographic records of books already being cataloged to investigate whether it would be better first to establish the classification number for a work and then try to find out the subject headings; or if it would be better to establish the subject headings and then try to link for classification.

Using the correlation between classification and subject heading, she concluded that in cataloging practice approaching from subject heading to classification is better than classification to subject heading:

> . . . going from subject heading to classification number would be better than going from classification number to subject heading, because going from subject heading to classification number would be more accurate.[87]

Butler studied the relationship between the use of the Library of Congress Classification and the Library of Con-

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[85] Ibid, p. 19

[86] Ruth E. Fenske, "Mechanization of Library Procedures in the Medium-Sized Medical Library: XIV. Correlations between National Library of Medicine Classification Numbers and MeSH Headings," Bulletin of the Medical Library Association 60 (April 1972): 319.

[87] Ibid, p. 323.

gress Subject Heading Terms.[88]   A small sample was selected

from the shelflist, and class notation and subject terms were

recorded. The results of the research suggested that

practical increase in the subject access to bibliographic

collection can be obtained through the use of computer based

cross-references between subject and class terms.

Harris and Black did a parallel investigation of the Li-

brary of Congress Subject Headings of minorities at St.

John's University and Florida State University.[89] They ran-

domly selected titles related to minorities and analyzed them

with respect to the Library of Congress Subject Headings, Li-

brary of Congress Classification, and Dewey Decimal Classifi-

cation to determine if vocabulary is objective, whether

analysis is offensive, and if these provide access to the

items related to minorities. The objective was to identify

areas in the Library of Congress Subject Headings, the

Library of Congress Classification, and the Dewey Decimal

Classification where the subject analysis might be

prejudiced.

They found that recent updating on subject headings have

corrected previous problems. DDC was found to be unbiased,

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[88]Brett Butler, "Bibliographic Subject Access: A Measure
of the Relation between Use of Library of Congress Clas-
sification and Library of Congress Subject Heading Terms," in
Proceedings of the American Society for Information Science
Annual Meeting (Washington, D.C.: American Society for In-
formation Science, 1976), 13: 96.

[89]Jessica L. Milstead Harris and Doris H. Clack, "People
and Peoples," p. 374.

while LC was found to be outdated and in need of some relocations. They suggested improvement and updating of vocabulary, removing biased LC subject headings and class number and relocating certain areas of Library of Congress Classification.

The author did a pilot study to analyze the association between subject headings and their corresponding class notations in science and technology monographs.[90] A sample of 1,893 LC bibliographic records was used to find the association between subject headings and their corresponding class notations. The results of analysis of 3,280 subject headings showed that as the number of subject headings in the bibliographic records increased, the degree of association between the subject headings and their corresponding class notations decreased. Except for the first subject listed in the bibliographic record, the order of subject headings was not statistically significant. Dewey Decimal Classification and Library of Congress were not significantly different with respect to the measures of association. Due to the size of the sample, it was not possible to make a generalization of findings, but the author was able to recommend the use of a large scale sample.

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[90]Abolghasem Khosh-Khui, Statistical Analysis of the Association between Subject Headings and Their Corresponding Class Notations in Science and Technology Monographs, (Syracuse, N.Y.: ERIC Document, ED 220 092, 1981), p. 1.

Chapter 3

METHODOLOGY AND DESIGN

This study attempts to find out the probable association
between subject headings and class notations, while con-
sidering the difference between the two entities; that is,
while there may be one or more subject headings in any given
biliographic record, there is usually only one class notation
corresponding to all subject headings in a bibliographic
record for any given classification scheme. This study in-
vestigates the degree of relationship between Library of Con-
gress Subject Headings and their corresponding Dewey Decimal
Class notations, and between LC Subject Headings and their
corresponding Library of Congress Classification notations.

Research Questions

This study attempts to answer the following questions:

1. Is there any statistically significant difference
between the degree of association between the Library of Con-
gress Subject Headings and the Library of Congress Clas-
sification notations among bibliographic records with a dif-
ferent number of subject headings per bibliographic record?

2. Is there any statistically significant difference

between the Library of Congress Subject Headings and the Library of Congress Classification notations among groups of subject headings listed in a different order in the bibliographic records?

3. Does the degree of association between the Library of Congress Subject Headings and the Library of Congress notations vary with respect to the main classes of the Library of Congress Classification?

4. Is there any statistically significant difference between the association of Library of Congress Subject Headings and Dewey Decimal Classification notations in groups of bibliographic records with a different number of subject headings per bibliographic record?

5. Is there any statistically significant difference between the Library of Congress Subject Headings and Dewey Decimal Classification notations among groups of subject headings listed in a different order in the bibliographic records?

6. Does the degree of association between the Library of Congress Subject Headings and Dewey Decimal Classification notations vary with respect to the main classes of the Dewey Decimal Classification?

7. Is there any statistically significant difference in the degree of association between the Library of Congress Subject Headings and the Library of Congress Classification when analysis is done in a shelf list catalog--that is, when

the the latter is the primary sort key and the former is the secondary sort key?

8. Is there any statistically significant difference in the degree of association between the Library of Congress Subject Headings and Dewey Decimal Classification notations when--instead of sorting variables first by alphabetical subject order, then by class notations--they are sorted first by class notations and then alphabetically by subject?

9. Is there a significant difference between the Library of Congress Classification and the Dewey Decimal Classification notations with respect to their association with the Library of Congress Subject Headings?

Hypotheses

To answer the above questions this study tests the following hypotheses:

1. Comparison of the identical subject headings in a list of bibliographic records which is sorted alphaetically by subject, such as a subject card catalog or an online subject catalog, would indicate that the probability of having identical class notations for identical subject headings in 'single-heading' bibliographic records is significantly greater than in 'multiple-heading' bibliographic records. In other words, fewer subject headings in bibliographic records will result in a significantly greater agreement between

class notations corresponding to various occurrences of a subject heading in a subject catalog, and more subject headings in bibliographic records will cause a significantly greater difference or disagreement between class notations corresponding to occurrences of a subject heading in a subject catalog.

This implies that the degree of association between subject headings and their corresponding class notations decreases as the number of subject headings per bibliographic record increases. The more the number of subject headings in bibliographic records, the more a significant decrease in the degree of association between subject headings and their corresponding class notations. This hypothesis will be tested with respect to two different classification systems:

1A) There is significantly more agreement between the Library of Congress Class notations corresponding to the Library of Congress Subject Headings in 'single-heading' bibliographic records than 'multiple-heading' bibliographic records. As the number of Library of Congress Subject Headings per bibliographic record increases, the degree of association between LC Subject Headings and their corresponding Library of Congress Classification notation decreases.

Null hypothesis: The alternative hypothesis, or the null hypothesis, would indicate that in bibliographic records with a different number of subject headings per bibliographic

record there is no difference between the frequency of LCC notations coressponding to the occurrence of identical Library of Congress Subject Headings.

1B) The probability of having identical Dewey Decimal Classification notations for identical Library of Congress Subject Headings in 'single-heading' bibliographic records is significantly greater than for 'multiple-heading' bibliographic records. As the number of Library of Congress Subject Headings per bibliographic record increases, the degree of association between LC Subject Headings and their corresponding Dewey Decimal Classification notations decreases.

Null hypothesis: The corresponding null hypothesis indicates that in bibliographic records with a different number of LC Subject Headings per bibliographic record there is no difference between the frequency count of DDC notations corresponding to various occurrences of identical Library of Congress Subject Headings.

2. There is significantly more agreement between class notations corresponding to subject headings listed first in multiple-heading bibliographic records than the same subject headings not listed first in such bibliographic records. In other words, the closeness of subject headings with their corresponding class notations depends upon the order or the position in which they are listed in bibliographic records; the sooner they are listed the more agreement between their corresponding class notations.

The degree of association between subject headings and
their corresponding class notations will vary significantly
with respect to the position of the subject headings in the
bibliographic records. The first subject heading will have a
significantly higher degree of association with its cor-
responding class notations than those not listed first. The
position of occurrence of subject headings or 'order of sub-
jects' will have an inverse correlation with class notations.
That is, the degree of association of the subject headings in
a bibliographic record will not be equally divided; rather,
over all, the subject headings with the order of one will
have a significantly higher degree of association than those
with the order of two; those with the order of two a
significantly higher degree of association than subject
headings with the order of three, etc. This hypothesis may
be stated with respect to each classification in this study
as follows:

2A) The probability of having identical Library of Con-
gress Class notations for identical Library of Congress Sub-
ject Headings in subject headings listed first in multiple-
heading bibliographic records is significantly greater than
for the same subject headings when they are not listed first
in bibliographic records. As the subject order of the
Library of Congress Subject Headings in the bibliographic
records varies, the degree of association between LC Subject
Headings and their corresponding Library of Congess Clas-

sification notations changes in the opposite direction.

Null hypothesis: The null hypothesis would state that there is no difference between the frequency counts of the Library of Congress Class notation corresponding to the identical Library of Congress Subject Headings when the headings are listed in different orders in the bibliographic records.

2B) For the Library of Congress Subject Headings listed first in multiple-heading bibliographic records there is significantly more agreement between Dewey Decimal Classification notations than the same subject headings when they are not listed first. As the subject order of the Library of Congress Subject Headings in the bibliographic records varies, the degree of association between LC Subject Headings and their corresponding Dewey Decimal Classification notations changes in an opposite direction.

Null hypothesis: The alternative hypothesis to be tested would indicate that there is no difference between frequency counts of Dewey Decimal Classification notations corresponding to occurrences of the Identical Library of Congress Subject Headings when the headings are listed in a different order in the bibliographic records.

3. There is a statistically significant difference between the probability of having identical class notations for identical subject headings in bibliographic records for documents classed in different divisions of knowledge.

Null hypothesis: The alternative hypothesis is to state that there is no difference between main divisions of knowledge. In other words, the degree of association between subject headings and their corresponding class notations will be the same in all main classes of both classification systems. That is to say, regardless of the subject area in which this analysis is done, the degree of association between variables will be expected to be the same.

With respect to the two classification systems in this study, the above research hypothesis can be stated as follows:

3A) There is a statistically significant difference between the probability of having identical class notations for identical subject headings in 21 main classes of the Library of Congress Classification. Subject headings in bibliographic records for science and technology documents, where there are more precise definitions of terms and a well developed calssification scheme, are expected to have a significantly greater degree of association with their class notations than those in other areas such as social sciences, where many terms would have less precise definitions. Since the main classes of the Library of Congress Classification are not equally developed, it is expected to find a statistically different degree of association betwen subject headings and class notations in science and technology bibliographic records.

Null hypothesis: The null hypothesis for this part would state that there is no significant difference between the frequency counts of the Library of Congress Classification notations corresponding to the Library of Congress Subject Headings in bibliographic records classed in different main classes of the Library of Congress Classification. (that is, Class 'A', 'B', 'C', . . . 'Z').

3B) There is a statistically significant difference between the probability of having identical class notations for identical subject headings among ten main classes of the Dewey Decimal Classification. The classes of science and technology in the Dewey Decimal Classification are well developed, and terms in these areas are usually well defined; there is relatively less ambiguity than in other areas such as literature, which has no precise definitions. Therefore, it is expected to find a statistically significant difference in the degree of association betwen LC Subject Headings and DDC notations for different classes of DDC.

Null hypothesis: There is no significant difference in the degree of association between the Library of Congress Subject Headings and their corresponding Dewey Decimal Classifications in the ten main classes of the Dewey Decimal Classification.

4. There is a statistically significant difference between the probability of having identical class notations for identical subject headings or identical subject headings

for identical class notations in bibliographic records from
an alphabetical subject index or a classified subject index
such as a shelf list. The one-to-one relation between the
subject headings and their corresponding class notations is
significantly different when bibliographic records are sorted
by class notations.

Null hypothesis: There is no difference between fre-
quency counts for class notations corresponding to identical
subject headings in bibliographic records listed in the sub-
ject catalog and the shelf list catalog. That is, the degree
of association between subject headings and corresponding
class notations will be the same regardless of the sorting
keys. In other words, if the variables are sorted by class
notation first, and then by corresponding subject heading,
the degree of association will not significantly vary from
the case in which the bibliographic records are first sorted
alphabetically by subject and then by the class notations.

The above research hypothesis can be stated more
precisely as follows:

4A) There is a statistically significant difference
between the probability of having identical class notations
for identical subject headings--or identical subject headings
for identical class notations--in bibliographic records
selected from a subject catalog, alphabetically arranged by
the Library of Congress Subject Headings, and bibliographic
records selected from a shelf list catalog which is arranged

by the Library of Congress Classification notations.
Selecting the Library of Congress Classification notation as
the primary sort key would significantly affect the degree of
association between the two variables as compared with the
situation where the Library of Congress Subject Heading is
the primary sort key.

Null hypothesis: There is no difference between the de-
gree of association of the LCSH and LCC in a subject catalog
arranged alphabetically by the Library of Congress and a
shelf list catalog arranged by the Library of Congress Clas-
sification notations.

4B)   There is a statistically significant difference
between the probability of having identical class notations
for identical subject headings--or identical subject headings
for identical class notations--between bibliographic records
from a subject catalog alphabetically arranged by the Library
of Congress Subject Headings and bibliographic records ar-
ranged by the Dewey Decimal Classification notations. If
variables are sorted first by the Dewey Decimal Classifica-
tion notations and then by the Library of Congress Subject
Headings, there will be a significant difference in the de-
gree of association between the two variables when the
sorting keys are reversed.

Null hypothesis: There is no difference between measures
of association between LCSH and DDC when the analysis is done
in a subject catalog alphabetically arranged by the Library

of Congress Subject Headings and a shelf list catalog where the entries are arranged by the Dewey Decimal Classification notations.

     5. The probability of having identical class notations for identical subject headings in bibliographic records for documents classed in the library of Congress Classification is statistically different from the ones classed in the Dewey Decimal Classification. That is, the Library of Congress Classification and Dewey Decimal Classification would be significantly different with respect to the degree of association of LC Subject Headings to them.

     Null hypothesis: There is no difference between the Library of Congress Classification and the Dewey Decimal Classification with respect to the measures of association in this study.

Research Design

(a) Database Size

Data analysis in this study is based on the frequency count of occurrences of each subject heading and its corresponding class notations. Therefore, it requires that each subject heading have sufficient occurrences to permit recognition of the variability of its corresponding class notations; the database has to be large enough to allow a sufficient occurrence of each subject heading.

Originally it was proposed to have a 20 per cent sample of one year's aggregate of LC MARC records, but it was found that when the analysis was done for each main class of both LCC and DDC, the frequency of occurrence of each subject heading was not sufficient. As a result, it was decided to analyze all the data. As will be described later, approximately 80 per cent of retrievable records were selected for the analysis.

(b) Method of Selecting Records

This study used LC MARC records to test the hypothesis. There were 101,347 records on two LC MARC tapes, for the year 1980-81 (as will be described in detail in chapter four), which were systematically read and tested by computer for accuracy and completeness. The criteria for dropping or rejecting a bibliographic record from the sample were as follows:

1. If the record had no LC Subject Heading;

2. If the record had no Library of Congress Classification;

3. If the record had no Dewey Decimal Classification;

4. If the Library of Congress Classification notation was designated by the word 'LAW' instead of a class notation in Class 'K';

5. If the Dewey Decimal Classification was represented by the letter 'F' (Fiction), 'E' (Easy Books), or 'B' (Biographies); or

6. If the record had any error due to the conversion of the tape to meet local formatting requirements.

(c) Variables

There are five variables in this study; these are as follows:

1. LC Subject Headings: Headings used in bibliographic records were asssigned by the Library of Congress. In this study no distinction was made with respect to various types of subject headings. A subject heading was operationally defined as a string of characters used to represent the sub-ject content of a document, and could be a word, a group of words, or symbols. Each subject heading is differentiated from another subject heading by at least one character.

2. Order of LC Subject Headings: This variable can be any number between one to four. In case the bibliographic records had more than four subject headings, they were combined with the group of subject headings with four headings to form a single group. This was done because these bibliographic records made up a relatively small percentage of all subject headings and there was not a sufficient occurrence for each subject heading.

3. Group of Bibliographic Records: Bibiliographic records in this study are grouped according to the number of subject headings per bibliographic record. The term group of bibliographic record refers to the total number of subject headings that each bibliographic record in the database had. Again this variable has a value between one and four in the

sample.

4. Class Notations: This variable is a combination of any fifteen digits and/or characters used by the Library of Congress to represent the Dewey Decimal Classification in field 082, or the Library of Congress Classification in field 051.

(d) Data Sources

The Library of Congress MARC tapes for books for the period 1980-1981 were used as the data source in this study. The above mentioned variables were retrieved for each record in the database. To do so the following fields were retrieved for each record:

Field	Field Name
050	Library of Congress Call Number
082	Dewey Decimal Classification Call Number
600	Personal Names as Subject Headings
610	Corporate Names as Subject Headings
611	Conference or Meetings as Subject Headings
630	Uniform Titles as Subject Headings
650	Topical Subject Headings
651	Geographic Subject Headings
654	Reversed Geographic Subject Headings

(e) Arrangement of Variables

To count the frequency of occurrence of subject headings
and their corresponding class notations, the data were ar-
ranged in four different ways to create the desired input for
a COBOL program to calculate probability of occurrence in
each group of bibliographic records, that is, records with
one, two, three, and four or more subject headings. Using
the SORT/MERGE Program of the CDC 6600, the retrieved file
was sorted into the following four lists:

TABLE 1
Order of Sort Keys Used to Sort Retrieved Records
===

Order of Sort Keys	List No 1 (SL Sort)	List No 2 (SD Sort)	List No 3 (LS Sort)	List No 4 (DS Sort)
1st Sort Key	LCSH	LCSH	LCC	DDC
2nd Sort Key	LCC	DDC	LCSH	LCSH
3rd Sort Key	No of LCSH	No of LCSH	No of LCSH	No of LCSH
4th Sort Key	LCSH Order	LCSH Order	LCSH Order	LCSH Order

===

Each list was used for analyzing a different question in
this study. The lists were used for the following analyses:

1. List number one (SL Sort) was a simulation of a sub-
ject catalog in a library using the Library of Congress Sub-
ject Heading and Library of Congress Classification. It was

used to analyze the degree of association between the Library
of Congress Subject Headings and their corresponding LCC
notations in four groups of bibliographic records. There-
fore, these two variables were the first and the second sort
key in this list respectively; then the records were further
sorted by the number of subject headings per bibliographic
record, and finally by the order of subject heading in the
bibliographic records. A sample of this list is printed in
appendix B.

2. List number two (SD Sort) was a simulation of a sub-
ject catalog using the Library of Congress Subject Headings
and the Dewey Decimal Classification. This list was used to
analyze the degree of association between the Library of Con-
gress Subject Headings and their corresponding DDC notations
in four groups of bibliographic records. Therefore, the
records in this list first were sorted by subject headings,
then by DDC notations, then by the group of bibliographic
records, and finally by the order of subject headings in the
bibliographic records. Part of the list is given in appendix
C.

3. The third list (LS Sort) was very similar to list
one except that the first key in this list was LCC notation.
In other words, it was a simulation of shelf list catalog in
a library which using LCC system. This list was used to
analyze changes in the degree of association between the
Library of Congress Classification and Subject Headings, due

to the sorting of variables. A portion of this list is shown in appendix D.

4. The fourth list (DS Sort) was similar to list number two (DS Sort) except that the first key for the sort was the Dewey Decimal Classification. This list was a simulation of the shelf list arrangement of cards in a library using DDC. It was used to analyze the changes according to the degree of association between the Library of Congress Subject Headings and Dewey Decimal Classification notations due to changes in the sort keys. Part of the sorted list is printed in appendix E.

Measures of Association

The degree of association between a subject heading and its corresponding class notation or notations is measured by a frequency count of the occurrence of that subject heading and comparing the score obtained with the frequency count of the corresponding most frequent identical class notation for the same subject heading. The correlation between those scores and the probability of occurrence in various groups of bibliographic records with different subject headings are the two measures of association being used in this study.

The degree of association between variables was measured by computing the probability of co-occurrence of a class notation with a given subject heading. The probability was

computed for all subject headings in four groups of biblio-
graphic records and with respect to four possible subject
orders of subject headings. The probability of co-occurrence
was calculated by the following formula:

$$pCg = \frac{SUM \ of \ fCg}{SUM \ of \ fSg}$$

where:

pCg is the empirical probability of having the
identical class notation 'C' for occurrences of any identical
subject heading 'S' in group of bibliographic records 'g',
that is, records with one, two, three, and four or more
headings.

fCg is the frequency count of occurrences of identical
class notations 'C' for various occurrences of subject
heading 'S' in any of the four groups of bibliographic
records 'g'.

fSg is the frequency count of occurrences of any
identical subject heading 'S' in a group of bibliographic
records 'g', when they are alphabetically sorted.

In addition to the probability measure, Pearson's Cor-
relation and regression analysis were used to further analyze
the data.

Operational Definitions

To have a clear understanding of the problem in this
study, operational definitions are presented below for some
of the terms used in this study:

Subject Heading: A subject heading is defined as any
string of characters or symbols in LC MARC tags 600, 610,
611, 630, 650, 651, and 652, which is used to represent a
Library of Congress Subject Heading in the database of this
study. Each subject heading may be distinguished from any
other subject heading by at least one character. For the
purpose of defining the maximum length of a subject heading
in the database, the upper limit of the string was set to 80
characters; that is, if any of the retrieved subject headings
was longer than 80 characters, only the first 80 characters
were selected for comparison.

It should be noted that according to the summary
statistics for five years of the MARC database, the average
length of subject field tags is 34.[1] Since the fixed length
Heading is more than double the average length, it is quite

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[1]Martha E. Williams, and Stephen W. Barth., "Summary
Statistics for Five Years of the MARC Data Base," Journal of
Library Automation 12 (December 1979): 324.

sufficient to meet the need for more than 99 per cent of the subject headings. In fact, examination of a portion of the retrieved records showed that almost 99 per cent of the subject headings are listed without any concatenation.

The string of characters could be only one word, or a group of words and symbols. Therefore, according to this study the programs used to analyze the data would identify the following as four different subject headings:

> Book
> Books
> Books--History
> Books--History--Antiquity and Middle Ages

Class notation: Class notation is defined as the 15 characters assigned to represent LCC or DDC notations. The mean for the LCC and DDC (field tags 50 and 82 respectively) is 20.1, and 14.2 characters.[2] Considering that this study uses only class notation and not the whole call number, the size seems to be adequate to include almost all class notations.

Association: The degree of association between a subject heading and class notation pair is defined as:

$$P(C/S)$$

where P is the empirical probability of having the same class notation 'C' for occurrence of the same subject heading

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[2]Ibid, p. 324.

'S', in the database.

Empirical Probability: Empirical probability is defined as the frequency count of the most frequent value of the dependent variable (for instance classification notation in subject catalog analysis) over the frequency count of their corresponding value of each occurrence of the independent variable (for example subject heading in subject catalog analysis).

The most frequent dependent variable: The most frequent dependent variable is the largest frequency count of identical values corresponding to a given value of the independent variable. In other words, it is the frequency count of the 'mode' notation. The following two examples illustrate the method by which the largest frequency count is measured:

1. The subject heading 'Accounting' (without any subdivision), in appendix B is repeated 40 times, but it has 9 different class notations. These observations are summarized in the following table:

TABLE 2
Frequency Count for Subject Heading Accounting
and its Corresponding LCC Notations
==

LC Subject Heading	LCSH Occurrence	LCC Notation	LCC Occurrence
Accounting	40	HF5621	1
		HF5625	1
		HF5635	30
		HF5642	1
		HF5645	1
		HF5657	1
		HF5681.B2	3
		HF5686.B3	1
		HF5686.I56	1
Total	40		40

==

The modal LCC notation in this case is 'HF5635'; there-fore, the most frequent class notation is the frequency count of 'HF5635', which is 30. As a result, the overall empirical probability of this subject heading (without considering other variables) is:

$$p = (C/S) = (30/40) = 0.75$$

2. The frequency count for the same subject heading and its corresponding DDC notations are given in the following table:

TABLE 3
Frequency Count for Subject Heading Accounting
and its Corresponding DDC Notations
===

LC Subject Heading	LCSH Occurrence	DDC Notation	DDC Occurrence
Accounting	40	657	19
		657.01	1
		657.024344	1
		657.024658	3
		657.044	2
		657.046	3
		657.2	1
		657.3	2
		657.33	1
		657.48	3
		657.9042	1
		657.95	1
		658.1511	1
		658.15904	1
Total	40		40

===

The most frequent dependent variable (class notation) is Dewey class notation '657', with a frequency count of 19. Therefore, without considering the category and the order of subject heading, the overall probability in this case is:

$$P = (C/S) = (19/40) = 0.475$$

Bibliographic Record Groups: The term bibliographic record groups refers to four categories of bibliographic

records with a different number of subject headings in each record, the first category having only one subject heading, the second category two subject headings, the third category three subject headings, and the fourth having four or more subject headings.

Subject Order: The term subject order is defined as the position of each subject heading in a bibliographic record. A subject heading listed first has the order value of one, the next subject heading listed has the order value of two, and so on.

Main Classes: The main classes in this study, in regard with LCC and DDC schedules, are defined as the very first letter or digit of LCC and DDC notations, such as classes 'A', 'H', 'P', and 'Z' in the Library of Congress Classification, and Class '0' '5' and '9' in the Dewey Decimal Classification. The exceptions to this definition are the notations which are identified by the word 'LAW' and Dewey Decimal Classifications identified by the letter 'F' (Fiction) or letter 'E' (Easy Books), which are all dropped from the database because these are not classification notations; rather, they are designations used to show the general category or format, and in some cases specific location of the material.

Primary Sort Key: The primary sort key refers to the data element of a record which is chosen as the main sort

criterion. The LC Subject Headings in appendices B and C comprise the primary sort key, while LCC and DDC are the primary sort keys in appendix D and E respectively.

Secondary Sort Keys: The secondary sort keys are the data elements other than the primary key, which are used to further sort the data. For instance, the Group and Order codes for subject headings in appendices B through F are the secondary sort keys.

Limitations

This study has the following limitations:

1. This study has used only LC MARC tapes for monographs. The Library of Congress catalogs other forms of library materials which are not included in the LC MARC tapes for monographs; therefore, bibliographic records for serials and audiovisual materials were not included in this study. The subject analysis process for these materials may not necessarily be the same as that of monographs. For instance, serials may take a broad subject heading to represent the main trend, the main theme, or the main topics generaly covered by them.

2. The Library of Congress does not assign subject headings to fictional works, except for literary forms which require the distinction of subject.[3] One of the criteria for

selecting bibliographic records in this study was the availability of at least one subject heading in the bibliographic records. This means that most of the fiction works were not selected in this study.

3. Some of the titles which are cataloged by the Library of Congress have alternative LCC and/or DDC notations. For instance, the Library of Congress provides an alternative class notation for most bibliographies. Such alternative notations appear inside brackets in the Library of Congress bibliographic records. In such cases, only the first class notations were selected and the alternative class notations, if any, were disregarded.

4. Some of the titles which are cataloged by the Library of Congress have more than one set of subject headings. For instance, the subject headings and class notations assigned by the National Library of Medicine and specific subject headings for juvenile literature are added to bibliographic records for those libraries who may prefer using them. In the Library of Congress MARC records these are given in fields 660 and 019. However, these fields were not included in this study; that is, the first set of subject headings and class notations were included in the study.

5. Library of Congress generally does not assign DDC notations to non-English monographs. The selection of

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[3]Library of Congress, Subject Cataloging Division, "Fiction in Subject Heading Practice," Catloging Service Bulletin 122 (Spring 1977): 11-14.

bibliographic records was limited to those records which had both DDC and LCC notations and at least one subject heading. Therefore, the results of this study are limited to the English language monographs.

6. Finally, this study does not differentiate between various types of Subject Headings. Wespiec has identified fifteen types of subject headings;[4] however, except for alphabetical sorting, subject headings used in this study were not differentiated with respect to their internal structure.

Assumptions

This study has used one year of LC MARC records to analyze the bibliographic records and generalize the findings. However, there is no study to confirm that the subject cataloging practice of the Library of Congress does not significantly vary from one year to another. This study assumes that the subject cataloging practice of the Library of Congress does not differ from one year to another. In the absence of such an assumption it would be necessary to select the database randomly from different years.

2. Similarly, the Library of Congress Subject Headings, Library of Congress Classification, and the Dewey Decimal Classification constantly are updated to reflect the changes

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[4] Jan Wespiec, "Language of the Library of Congress Subject Headings Pertaining to Society," Library Resources and Technical Services 25 (April-June 1981): 196.

in human knowledge. This study implicitly assumes that within the year when the records in this study were cataloged, such changes in all three variables were insignificant.

3. Finally, this study has used the Library of Congress bibliographic records to analyze the data and generalize the findings to subject cataloging practice in the field. It was assumed that, with respect to the association of the variables in this study, the practice of the Library of Congress and other libraries does not significantly differ.

Chapter 4

GENERAL ANALYSES OF THE DATA

Introduction

The purpose of this chapter is to give an overall idea of
the processes of obtaining the data source and creating the
database, and to present a general picture of the distribution
of variables in the selected bibliographic records. The
analyses in this chapter include: determining the number of LC
Subject Headings per bibliographic record, grouping biblio-
graphic records in the database according to the number of LC
Subject Headings per bibliographic record, and demonstrating
the distribution of bibliographic records by the main classes
of the Library of Congress Classification and the Dewey
Decimal Classification systems.

Although the source tapes used for this study are LC MARC
tapes, the original selection choices were not limited to the
use of LC MARC tapes. It was originally proposed to use
either OCLC tapes or the Library of Congress MARC tapes as the
source of data. For reasons of availability and access to the
OCLC tapes through the Indiana University Libraries, the first
choice was to use the Indiana University Libraries' OCLC
archival tapes. Upon request, the Main Library generously
provided them to the author; however, after much examination

of the contents of the tapes, they were not used for two main
reasons:

(1) The content of these tapes were limited to the sub-
ject areas covered by Indiana University's academic programs,
and were not as general as the Library of Congress MARC tapes;
and

(2) The records on OCLC tapes are not limited to the
records cataloged by the Library of Congress. Therefore, it
is possible that the subject headings or class notations used
for non-LC records may not necessarily be the same as the ones
used by the Library of Congress. In other words, the ex-
istence of non-LC MARC records on the OCLC tapes meant inter-
filing a different set of subject headings with LC Subject
Headings--that for a given topic they may not necessarily be
the same in structure and format. The same argument may be
applied to the classification notations.

Any effects on the association between subject headings
and their corresponding class notations due to using different
subject heading from diffrent subject heading lists, or dif-
ferent editions of the same classification scheme may be
called the 'non-homogeneity factor'. With regard to the vari-
ables in this study, the 'non-homogeneity factor' of using
OCLC tapes could have been either 'Subject non-homogeneity',
'LCC notation non-homogeneity'; or 'DDC notation non-
homogeneity'--factors which are avoided by not using OCLC
records.

Therefore, if OCLC tapes were used, there could have been additional interference in measuring the true association of variables in this study, that is, introduction of a classification non-homogeneity factor in the measuring of the association of subject headings and their corresponding class notations.

To prevent this and to have more uniformity between subject headings and class notations, it was therefore decided to use LC MARC records. The researcher then turned to the Library of Congress to borrow their tapes to be used in this research. Correspondence with the Library of Congress, however, revealed that the policy of the Library does not permit lending their tapes for research purposes and that they had to be purchased at considerable expense.

Among other options was that of turning to those institutions who use LC MARC tapes; and finally, with the assistance of the part of the chairman of the writer's Research Committee, two sets of LC MARC tapes were accessed, one from the University of Minnesota and the other from the University of Chicago. The latter tapes were more comprehensive and were thus used to select the bibliographic records.

The tapes were 'Labled Tapes', 9-track, with a density of 6,250 bytes per inch, and were written in ASCII code. The maximum block size was 4,096, with a variable record length. Each record had a 30-character internal identification number; these ID numbers had been added to the beginning of each

record by the University of Chicago Computer Center. The
tapes were not completely compatible with the CDC system, so
the first task was to convert the tapes to the required format
of Indiana University's Bloomington Academic Computing
Services (BACS). Each tape was considered as a 'Stranger
Tape' for the purpose of conversion.

The two tapes were deblocked (that is, records copied off
the tapes using deblocking commands) and the internal ID
numbers were removed from the beginning of each bibliographic
record. There were 1,050,540 unit records (80-character
cards) on the two tapes. Examination of the printout of the
first 5,000 unit records showed that any record positioned at
the end of a block, that is, every 52 unit records or ap-
proximately every 5 bibliographic records, was unreliable.
This situation caused the CPU (Central Processing Unit) to
lose its place. In other words, whenever reaching the end of
the block the 'Address Out of Range' message was issued by the
computer. To avoid this problem such records were not
selected.

Retrieved Bibliographic Records

The University of Chicago MARC Tapes were in two physical volumes. The two tapes which were used as the data source covered a period of one year--in other words, a cumulation of LC records for the period of March 1980 to March 1981--and were used to create a database to work with.

For the purpose of the subject heading frequency count it was necessary to have sufficient occurrences for any given LC Subject Heading; although it was originally proposed to use a 20 per cent sample, the first run of the analysis showed that it was not possible to have a sufficient occurrence of any given LC Subject Heading if only a 20 per cent of the records was to be used. Particularly, when analysis was done for each individual main class of DDC or LCC, in effect the 20 per cent sample is divided by ten (for DDC analysis) or 22 (in LCC analysis); therefore, it was found to be more appropriate to use the entire data source.

In the first phase of the analysis, A COBOL program was written to read each LC MARC record, remove its internal ID, and drop records which were found to be incomplete and rejected by the program due to the error in converting and/or recording. Using this systematic method of testing, 101,347 (83.38 per cent) of the bibliographic records--from a total of

121,546--were selected for the analysis. Table 4 shows the number of records selected from each tape.

TABLE 4
Usable LC Bibliographic Records from
the Two LC MARC Tapes

Tapes	No of Records on Each Tape	Records Retrieved From Each Tape	Per Cent of Records
Vol 1	98677	82366	83.47
Vol 2	22869	18981	82.99
Total	121546	101347	83.38

In the second phase of the analysis another COBOL program was developed to retrieve the Libraray of Congress Classification notations, Dewey Decimal Classification notations, and the Library of Congress Subject Headings. LC Subject Headings in each retrieved bibliographic record were coded in such a way that they could be identified by the total number of LC Subject Headings in a bibliographic record; and by the order in which they were listed in the bibliographic records.

Table 5 shows the codes added to the LC Subject Headings of four bibliographic records, having one to four subject headings, to identify the total number of subject headings in each record and to recognize the order in which they were listed in the bibliographic records: The first digit of the

code represents the total number of LC Subject Headings for a record; and the second digit (one, two, three, and four) represents the order of headings in the bibliographic record. Therefore, with regard to the first bibliographic record in the following table, codes one and one were added to the subject heading 'Accounting'; in the second bibliographic record, codes two and one were added to subject heading 'Soils--Testing' and codes two and two to subject-heading 'Soil--Mechanics'. With regard to th bibliographic record number three in the same table, the subject heading 'Statistics', which is the first heading listed in the bibliographic record with three subject headings, had codes three and one respectively, the next subject heading for the same bibliographic record had codes three and two, and finally, the third subject heading had codes three and three to identify all three subject headings in that bibliographic record. The same process of coding was done for all LC Subject Headings in all bibliographic records. A portion of unit records for selected bibliographic records in the database is given in appendix A.

TABLE 5

Codes Added to LC Subject Headings in Four Bibliographic
Records to Identify the Total Number of Subject
Headings in Each Record and Their Order

Notation LCC	Notation DDC	As Listed in Records Subject Headings	Group Codes	Order Codes
Bibliographic Record No. 1:				
HF5635	657	Accounting	1	1
Bibliographic Record No. 2:				
TA710	624.1513	Soils-Testing	2	1
TA710	624.1513	Soil-Mechanics	2	2
Bibliographic Record No. 3:				
HA29	519.5	Statistics	3	1
HA29	519.5	Psychometrics	3	2
HA29	519.5	Educational tests and easurement	3	3
Bibliographic Record No. 4:				
HF5635	658.15904	Accounting	4	1
HF5635	658.15904	Financial statements	4	2
HF5635	658.15904	Small business--Finance	4	3
HF5635	658.15904	Small business--Taxation	4	4

Retrieved LC Subject Headings

Upon analyzing the resulting data aggregates to determine the number of subject headings in each bibliographic record, it was found that of 101,347 bibliographic records only 92,097 (90.87 per cent) had subject headings. The mean of the number of subject headings per bibliographic record was 1.93, and one subject heading per bibliographic record was the mode.

Bibliographic records were grouped according to the number of subject headings per bibliographic record. However, in this respect the number of bibliographic records in each group was not equal; that is, 34,538 (37.50 per cent) had only one subject heading, 30,722 (33.36 per cent) had two subject headings, 15,506 (16.84 per cent) had three subject headings, 6,743 (7.32) had four, and 4588 (4.98 per cent) bibliographic records had more than four subject headings. To have a more balanced distribution in selected groups, all bibliographic records with more than three subject headings were combined to form the fourth group. As a result there were 11,331 (12.30 per cent) bibliographic records in the fourth group. Table 6 presents the distribution of selected bibliographic records in the database according to the number of subject headings in the bibliographic records.

TABLE 6
Distribution of the Retrieved LC Bibliographic Records
by the Number of Subject Headings

No of Subject Headings	No of Bibliographic Records	Per Cent of Retrieved Records	Per Cent of Records With LCSH	Accumulated Per Cent
With 1 LCSH	34538	34.08	37.50	37.50
With 2 LCSH	30722	30.31	33.36	70.86
With 3 LCSH	15506	15.29	16.84	87.70
With 4 LCSH	6743	6.65	7.32	95.02
With 5 LCSH	3069	3.03	3.33	98.35
With 6 LCSH	867	0.86	0.94	99.29
With 7 LCSH	270	0.27	0.29	99.58
With 8 LCSH	143	0.14	0.16	99.74
With 9 LCSH	78	0.07	0.08	99.82
10 or More	161	0.16	0.17	99.99
Total	92097	90.87	100.00	100.00

The total number of subject headings in 92,097 biblio-
graphic records was 195,365, of which 195,305 were listed as
the first to fourth subject heading in the bibliographic
records and only 7,541 were listed as the fifth or more sub-
ject heading in the bibliographic records. The latter were
combined with the fourth group and therefore, 195,365 LC Sub-
ject Headings were used for the analyses in this study. Of
the selected subject headings 34,538 (17.68 per cent) were
from 'single-heading' bibliographic records, 61,444 (31.45 per
cent) were from 'double-heading' bibliographic records, 46,518
(23.81 per cent) were from 'triple-heading' bibliographic
records, and finally, 52,865 (27.06 per cent) were from the

group of bibliographic records with 'four or more subject
headings'.   Table 7 gives the distribution LC Subject Headings
in four groups of bibliographic records.

TABLE 7
Distribution of LC Subject Headings in Four Groups
of Bibliographic Records
==

Groups of Bibliographic Records	No of Records	No of Subject Headings	Per Cent of Subject Headings	Accumulated Per Cent
With 1 LCSH	34538	34538	17.68	17.68
With 2 LCSH	30722	61444	31.45	49.13
With 3 LCSH	15506	46518	23.81	72.94
With 4 LCSH	6743	26972	13.81	86.75
With 5 LCSH	3069	15345	7.85	94.60
With 6 LCSH	867	5202	2.66	97.26
With 7 LCSH	270	1890	0.97	98.23
With 8 LCSH	143	1144	0.59	98.82
With 9 LCSH	78	702	0.36	99.18
10 or More	161	1810	0.82	100.00
Total	92097	195365	100.00	100.00

==

Distribution of Data by LCSH Tags

Upon analyzing selected subject headings in the database
to determine their distribution according to the LC MARC Tags,
it was found that 147,129 (75.31 per cent) subject headings
had Tag 650 (Topical Subject Headings), 25,065 (12.83 per
cent) subject headings had Tag 651 (Geographic Names), while
Tags 600 (Personal Names), 610 (Corporate Names), 611 (Con-

ference and Meetings), 630 (Uniform Titles), and 652 (Inverted Geographic Names) made up 11.86 per cent of the headings in the database. Table 8 shows the distribution of subject headings according to their LC MARC tags.

TABLE 8
Distribution of Retrieved Library of Congress
Subject Headings According to Subject Tags
===

LCSH Tags	No of LCSH	Per Cent of Total LCSH	Rank
600	14359	7.35	3
610	7346	3.76	4
611	156	0.08	6
630	1153	0.59	5
650	147129	75.31	1
651	25065	12.83	2
652	137	0.07	7
Others	20	0.01	8
Total	195365	100.00	

===

Distribution of Data by LCC Notations

To find the distribution of records according to the Library of Congress Classification, all LCC notations of the bibliographic records were recorded. Class 'P' (Language and Literature) with 18,793 (18.54 per cent) had the largest number of records, and next to that was Class 'H' with 14,968 (14.77 per cent) of the records. At the bottom of the ranking was Class 'V' (Naval Science) with only 332 (0.33 per cent).

Table 9 shows the distribution of bibliographic records according to the various main classes of the Library of Congress Classification.

TABLE 9
Distribution of Retrieved Bibliographic Records
by Library of Congress Main Classes

Main Classes of Library of Congress Classification	No of Records in Each Class	Per Cent	Rank
A (General Works)	681	0.67	19
B (Philosophy, Psychology, Religion)	6635	6.55	7
C (Auxiliary Sciences of History)	1347	1.33	16
D (History: General and Old World)	7251	7.15	3
E (History: America)	1192	1.18	18
F (History: United States)	3947	3.89	10
G (Geography, Anthroplogy, Recr.)	3859	3.81	11
H (Social Sciences)	14968	14.77	2
J (Political Science)	2558	2.52	14
K (LAW)	7045	6.95	6
L (Education)	2905	2.87	12
M (Music)	1263	1.25	17
N (Fine Arts)	4033	3.98	9
P (Language and Literature)	18793	18.54	1
Q (Science)	7198	7.10	5
R (Medicine)	4824	4.76	8
S (Agriculture)	1748	1.72	15
T (Technology)	7224	7.13	4
U (Militatry Science)	669	0.66	20
V (Naval Science)	332	0.33	21
Z (Bibliography, Library Science)	2875	2.84	13
All Classes	101347	100.00	

Distribution of Data by DDC Notations

Similarly, to find the distribution of records according to the Dewey Decimal Classification all DDC notations of the bibliographic records were recorded. There were 67,641 (66.74 per cent) of records with DDC notation, of which 21,158 (31.28 per cent of all DCC notations) were in Class '300' (Social Sciences), the largest class in size of the records, and 9,637 (14.25 per cent) were in class '600' (Applied Sciences and Technology). There were 600 bibliographic records which were identified by 'E' (Easy Books), and 708 (1.05 per cent) were marked as 'F' (Fiction). Table 10 shows the distribution of the bibliographic records according to the the main classes of the the Dewey Decimal Classification.

TABLE 10
Distribution of Retrieved Bibliographic Records
by Dewey Decimal Classification

Main Classes of Dewey Decimal Classification	No of records In Each Class	Per Cent	Rank
000 (Generalities)	3390	5.01	7
100 (Philosophy & Related Disciplines)	1577	2.33	9
200 (Religion)	2918	4.43	8
300 (Social Sciences)	21158	31.28	1
400 (Language)	1101	1.63	10
500 (Pure Sciences)	4539	6.71	6
600 (Technology: Applied Sciences)	9637	14.25	2
700 (The Arts)	5775	8.54	5
800 (Literature (Belles-Lettres)	8009	11.84	4
900 (General Geography & History)	8229	12.17	3
E (Easy Books)	600	0.89	12
F (Fiction)	708	1.05	11
All Classes	67641	100.00	

All the bibliographic records which were identified by class designation 'LAW', or marked as 'F' or 'E' were removed from the database, because these are not classification notations; rather, they are a kind of designation which is used to mark the format or the general group of the record. Upon dropping such records, 131,263 subject headings were identified which had both Dewey Decimal Classification and the Library of Congress Classification.

To further analyze the data, all 131,263 records were sorted in four ways. As a mnemonic way to recognize each sorted list by its name, the four lists were identified by the initials of the first two sort keys; therefore, four sorted lists were created with the following names: 'SL Sort' (sorted first by LC Subject Headings then by LCC notations); 'SD Sort' (sorted first by LC Subject Headings and then by DDC notations); 'LS Sort' (sorted first by LCC notations and then by LC Subject Headings); and, 'DS Sort' (sorted first by DDC notations and then by LC Subject Headings).

Summary

Bibliographic records on two LC MARC tapes were used to create the database of this study. There were 101,347 (83.38 per cent) bibliographic records in the database which were selected from two LC MARC tapes through a systematic testing. Subject headings, LCC, and DDC notations were retrieved and a two-digit code was added to 131,263 subject headings in these records to show the total number of subject headings per bibliographic record and the order of headings listed in the bibliographic records. The data were analyzed to show the distribution of records by the subject headings and class notations. The retrieved records were sorted in four different ways to simulate the card catalog and the shelf list catalog to be used for the statistical analysis.

Chapter 5

ANALYSIS OF LCSH AND LCC NOTATIONS

Association of LCSH AND LCC in Four Groups of
Bibliographic Records

The purpose of this analysis was to test part A of the
first hypothesis. The analysis was done to determine the de-
gree of association between the Library of Congress Subject
Headings and their corresponding Library of Congress Clas-
sification notations in four groups of bibliographic records--
that is, groups of records that had one to four subject
headings. The question was to verify if there was a
statistically meaningful difference between the association of
the Library of Congress Subject Headings and their cor-
responding Library of Congress Classification notations among
bibliographic records with a different number of LC Subject
Headings per bibliographic record.

To find the answer to the above question, a series of
analyses were performed: Using sorted list number one (SL
Sort), the frequency of each subject heading which had an oc-
currence of two or more was counted, then the frequency of the
most frequent indentical class notation corresponding to
various occurrences of each LC Subject Heading was determined.
These analyses were done for four different groups of biblio-

graphic records with one to four subject headings, then the sum of frequencies for each group was divided by the sum of LCSH frequencies of the same group to find the probability in each group. In addition, correlation measures were computed for each group of subject. The results of this analysis are summarized in table eleven:

TABLE 11
Probability and Correlation between Subject
Headings and LCC Notations in Four
Groups of Bibliographic Records

Groups of Bibliographic Records	LCSH Frequency Counts	LCC Frequency Counts	P	r	Significance of r
With 1 LCSH	6142	5010	0.82	0.74	0.001
With 2 LCSH	11400	6939	0.61	0.82	0.001
With 3 LCSH	7476	4036	0.54	0.91	0.001
With 4 LCSH	4070	2587	0.64	0.82	0.001
Total	29088	18572	0.64		
All Groups	61766	27188	0.44	0.0085	0.113

Except for the fourth group, the probability of having identical LCC notations for identical LC Subject Headings decreased as the number of LC Subject Headings per bibliographic record increased. To verify if the differences between groups were statistically significant, the number of subject headings in each group had to be equal, because one

may argue that if the number of subject headings in a group is less than another group, then the frequency count of the class notations would be less than the other group as well. Therefore, the frequencies for all groups were adjusted, and then the chi square test was applied to determine whether the difference was statistically significant.

This was done by computing the frequency counts of LCC notations with respect to the mean of the frequency counts for LC Subject Headings. The reason for using the mean of the four groups was that it is "the truest, most representative measure of central tendency,"[1] and all values are represented in direct proportion to their weight.

The mean frequency counts for all subjects was 7,272. This was used to compute the adjusted observed frequency counts of the Library of Congress Classification notations in each group. Theoretically, if there was no difference between each group the expected frequency counts of the Library of Congress Classification notations should have been 4,727 for all groups. The differences between observed and expected values were the results of differences in the number of LC Subject Headings per bibliographic record. In other words, the reduction in LCC notation frequencies is due to the increment in the number of LC Subject Headings per bibliographic records. Table 12 shows the adjusted values for figures given

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[1] Ray L. Carpenter and Ellen Storey Vasu, _Statistical Methods for Librarians_ (Chicago: American Library Association, 1978), p. 14.

in the above table.

TABLE 12
Chi Square Test of Differences for Adjusted Values
in Four Groups of Bibliographic Records

Groups of Bibliographic Records	LCSH Frequency Counts	LCC Frequency Counts	Adjusted LCSH Frequency	Observed LCC Frequency	Expected LCC Frequency
With 1 LCSH	6142	5010	7272	5932	4727
With 2 LCSH	11400	6939	7272	4426	4727
With 3 LCSH	7476	4036	7272	3926	4727
With 4 LCSH	4070	2587	7272	4622	4727

Chi Square = 463.946   df = 3   p < .001

The chi square test of difference indicated that the dif-
ference between each group was statistically significant at
the 0.001 level. Therefore, the null hypothesis of no dif-
ference was rejected and the research hypothesis was accepted
that there is a significant difference among association
between LC Subject Headings and their corresponding LCC nota-
tions in four groups of bibliographic records with a different
number of LC Subject Headings per Bibliographic record, and
that as the number of LC Subject Headings in the bibliographic
records increases, the probability of having identical LCC
notations for identical LC Subject Headings decreases.

To determine the pattern of change, regression analysis
was done for each group. Regression analysis of the frequency
of Library of Congress Subject Headings and the frequency of
their corresponding Library of Congress Classification nota-

tions with respect to the variations in the number of LC Subject Headings per bibliographic record showed that when there was more than one LC Subject Heading in the bibliographic record, the pattern of variation in LCC notations with respect to variations in the number of subject headings would not be predictable. However, an increase in the constant for each formula was an indication that when the number of subject headings per bibliographic record increased, other factors that were not considered in this study would affect the degree of association between the two variables.

This indicated that while there was a statistically significant difference between the degree of association between the Library of Congress Subject Headings and their corresponding Library of Congress Classification notations, the variation in the number of subject headings per bibliographic record was not a predictor of the variations in the Library of Congress Classification notations. The results of regression analysis in the four groups are given in the following table.

TABLE 13

Regression Equations for Variability of the
Frequency of LC Notations Due to Variation
in the Number of Subject Headings in
Bibliographic Records

Groups of Bibliographic Records	LCC Frequency	Constant Si1	Si2	Si3	Si4
With 1 LCSH	LF1j =	0.0108 + 0.47(S11)			
With 2 LCSH	LF2j =	0.64 − 0.0009(S21)+	0.13(S22)		
With 3 LCSH	LF3j =	3.29 + 0.24(S31) +	0.14(S32) +	0.18(S33)	
With 4 LCSH	LF4j =	5.99 + 0.19(S41) +	0.30(S42) +	0.33(S43) +	0.15(S44)
All Groups	LFij =	0.42 + 0.19(SH1) −	0.01(SH2) −	0.009(SH3)	−0.008(SH4)

$LFij$ = Library of Congress Classification Frequency counts in group i and for subject order j.

SH1, SH2, SH3, and SH4 groups of bibliographic records with one to four subject headings

Discussion

The above three tables indicate that in the group of bibliographic records with a single subject heading, there was a higher degree of association between LC Subject Headings and their corresponding LCC notations. However, the fact that there was not a 100% probability for the single-heading group showed that LCC notations were not consistently assigned to bibliographic records with the same LC Subject Headings. Alternatively, there could be more than one LC Subject Heading corresponding to each LCC notation representing a given topic.

As more LC Subject Headings were assigned to bibliographic records the probability of having the same LCC notations for the same LC Subject Headings decreased. While the probability of having an identical class notation for an identical subject heading in single-subject heading bibliographic records was 82 per cent, it reduced to 61 per cent for the double-heading group, 54 per cent for the triple-heading group, and 64 per cent for the group of bibliographic records with four or more subject headings. The reason that the fourth group had a higher probability than the previous group could be due to the fact that the frequency of subject headings in these groups was generally less than preceeding groups: therefore, the analysis of data was done with a smal-

ler number of subject headings, and the less occurrence of identical subject headings in this group may have caused unexpected increase in the probability.

Although the probability of having identical LCC notations for identical LC Subject Headings in group one was higher than the succeeding groups, the pattern of decreasing correlation and probability was not found to be fixed. However, as the number of LC Subject Headings per bibliographic record increased, both the frequency of having identical LC Subject Headings and that of having identical LCC notations decreased. The only exception was found to be in group four, where the correlation and probability was higher than in the previous groups.

Association of LCSH and LCC When Order of
Subject Headings Varies

The aim of this part of the analysis was to test hypothesis 2A. The question to be answered was: Is there any statistically significant difference between the Library of Congress Subject Headings and the Library of Congress Classification notations among groups of subject headings with a different order in the bibliographic records? Therefore, the study had to control for the orders, and then measure the probability as specified above. This was done to determine whether there was any meaningful variation in the degree of

association between Library of Congress Subject Headings and
their Corresponding Library of Congress Classification nota-
tions when the order of LC Subject Headings listed in the
bibliographic records varies. Using the same sorted list, the
data were analyzed for various orders of LC Subject Headings
in four groups of bibliographic records, and frequency of
identical LC Subject Headings and their corresponding
identical LCC notations were counted to examine the variation
of their association with respect to the variations in the
order of LC Subject Headings. The analysis showed that as the
order of LC Subject Headings increased the probability of
having identical LCC notations for identical LC Subject
Headings decreased. Table 14 shows the results of this
analysis:

TABLE 14
Probability and Correlation between Subject
Headings and LCC Notations in Four
Groups of Bibliographic Records

Order of Subject Headings	LCSH Frequency Counts	LCC Frequency Counts	P	r	Significance of r
Listed 1st	21754	16373	0.75	0.44	0.001
Listed 2nd	10259	4649	0.45	0.71	0.001
Listed 3rd	3429	1603	0.47	0.89	0.001
Listed 4th	924	515	0.56	0.74	0.001
Total	36366	23140	0.64		
All Orders	61766	27188	0.44	0.0085	0.113

Similarly, the values were adjusted to have an equal base for all the frequencies, then the test of difference was done. to see if there is any statistically significant difference between values for different orders. The average for the LC Subject Headings frequency counts for all subject headings with an order of one, two, three, and four or more was 9,092. Based on this the LCC adjusted frequency counts in four different orders of LC Subject Headings were computed. If there was no difference between observed LCC frequency counts for four subject orders, the frequency counts should have been 5,070 for all subject orders. Table 15 shows the results of adjusted values:

TABLE 15
Chi Square Test of Differences for Adjusted Values
for Four Different Orders of Subject Headings
in Bibliographic Records

Order of Subject Headings	LCSH Frequency Counts	LCC Frequency Counts	Adjusted LCSH Frequency	Observed LCC Frequency	Expected LCC Frequency
Listed 1st	21754	16373	9092	6843	5070
Listed 2nd	10259	4649	9092	4120	5070
Listed 3rd	3429	1603	9092	4250	5070
Listed 4th	924	515	9092	5068	5070

Chi Square = 929.912   df = 3 $p < .001$

Regression analysis of the frequency of Library of Congress Subject Headings and the frequency of their corresponding Library of Congress Classification notations with respect to the variations in the order of LC Subject Headings in the bibliographic records showed that LC Subject Headings listed first have the highest share in the variability of LCC notations. However, there was no recognizable pattern for variations in LCC notations when the order of LC Subject Headings changed. The results of regression analysis are given in the following table:

TABLE 16

Regression Equations for Variability of the
Frequency of LC Notations Due to Variation
in the Order of Subject Headings
in the Bibliographic Records

Order Of LCSH	LCC Frequency	Constant	1 LCSH	2 LCSH	3 LCSH	4 LCSH
Listed 1st	$LF1 =$	3.24	+ 0.037(S11)	+ 0.004(S21)	+ 0.01(S31)	− 0.0002(S41)
Listed 2nd	$LF2 =$	18.84		+ 0.69(S22)	+ 0.54(S32)	+ 0.59(S42)
Listed 3rd	$LF3 =$	14.48			+ 0.99(S33)	+ 0.87(S43)
Listed 4th	$LF4 =$	5.27				+ 0.97(S44)
All Orders	$LF =$	0.40	+ 0.36(SH01)	+ 0.02(SH02)	− 0.01(SH03)	−0.004(SH04)

LF = Library of Congress Classification notation frequency for all subject
headings.

SH01, SH02, SH03, and SH04 are order of LC Subject Headings in four groups of
bibliographic records.

Discussion

The association between LC Subject Headings and their corresponding LCC notations in subject headings listed first in the bibliographic records was higher than the association of LC Subject Headings and their corresponding LCC notations in subject headings listed second, third, etc. While the probability for the LC Subject Headings lited first was 75 per cent, it was 45 per cent for the subject headings listed second, 46 per cent for those listed third, and 55 per cent for the subject headings listed fourth or more in the bibliographic records.

However, the correlation coefficient was 0.44 for the subject headings listed first, 0.71 for the headings listed second, 0.86 per cent for those listed third, and 0.74 per cent for the subject headings listed fourth or more in the bibliographic records.

Association of LCSH and LCC When Both Number and
Order of Subject Headings Vary

The aim of this part of the analysis was to determine the
variations in the degree of association between the two varia-
bles when both order of LC Subject Headings and the number of
LC Subject Headings in bibliographic records vary. The
bibliographic records in the database were analyzed for the
cases when both variables, that is, order and the number of
subject headings for bibliographic records, vary.

The results indicated that in all groups of bibliographic
records with more than one LC Subject Heading, there was a
higher association between LC Subject Headings and their cor-
responding LCC notations in subject headings listed first in
the bibliographic records than that of the succeeding subject
headings. There was no significant difference between the LC
Subject Headings with equal order of listing in bibliographic
records with a different number of LC Subject Headings per
bibliographic record. The results of this analysis is given
in table 17:

TABLE 17

Probability and Correlation between Subject Headings
and LCC Notations in Four Groups of
Bibliographic Records When Both Order and
Number of Subject Headings Change

Order	With 1 LCSH				With 2 LCSH				With 3 LCSH				With 4 LCSH				All Groups			
	SF	LF	P	r	SF	LF	P	r	SF	LF	P	r	SF	LF	P	r	SF	LF	P	r
1st	6142	5010	0.82	0.44	4844	4089	0.84	0.74	1933	1669	0.86	0.93	772	701	0.91	0.81	21754	16373	0.75	0.74
2nd					4469	2391	0.54	0.83	1570	1017	0.65	0.79	656	509	0.78	0.78	10259	4649	0.45	0.82
3rd									1770	956	0.54	0.95	616	476	0.77	0.91	3429	1603	0.47	0.91
4th													679	471	0.69	0.93	924	515	0.59	0.82
Total	6142	5010	0.82	0.44	11400	6939	0.61	0.71	7476	4036	0.54	0.89	4070	2587	0.64	0.74	61188	27188	0.37	0.41

SF = Library of Congress Subject Heading Frequency Counts.
LF = Library of Congress Classification Frequency Counts.

Discussion

In all groups of bibliographic records with more than one LC Subject Heading, there was a higher association between the Library of Congress Subject Headings and their corresponding Library of Congress Classification notations for LC Subject Headings listed first in the bibliographic records than LC Subject Headings not listed first in the bibliographic records.

For all LC Subject Headings with the same order but from different groups with a different number of LC Subject Headings per bibliographic record, there was no significant difference between their corresponding LCC notation frequency counts.

Association of LCSH and LCC in Main Classes of LCC

The aim of this analysis was to test hypothesis 3A. The question in this hypothesis was to determine if there is any significant difference between the Library of Congress Subject Headings and their corresponding LCC notations in different main classes of the Library of Congress Classification system. The analysis of the association was repeated for the LC main classes and the results for each class was recorded. As it is

evident from table 18, the 25 per cent sample of bibliographic records was not enough to give an adequate frequency count for each subject. To solve this problem the complete set of bibliographic records which had at least one LCSH, LCC, and DDC, were sorted according to their main classes of LCC, and then the analysis was made for each class.

The complete record of the analysis of this part is given in appendix F. However, to illustrate the comparison of each class, the data for LC Subject Headings listed first in the bibliographic records are shown in table eighteen. Classes 'F' (History: United States), 'G' (Geography, Anthropology, Recreation), 'L' (Education), 'R' (Medicine), 'S' (Agirculture), and 'T' (Technology) had probabilities over 80 per cent, while classes 'A' (General Works), 'C' (Auxiliary Sciences of History), 'N' (Fine Arts), and 'P' (Language and Literature) had probabilities below 65 per cent.

TABLE 18
Comparison of Probability and Correlation between Subject
Headings and LCC Notations in Main Classes of LCC

LCC Main Classes	LCSH Frequency Counts	LCC Frequency Counts	P	r	Significance of r
A	127	53	0.42	0.93	0.001
B	2006	1481	0.74	0.61	0.001
C	214	137	0.64	0.60	0.001
D	1349	986	0.73	0.33	0.001
E	367	285	0.78	0.59	0.001
F	395	339	0.86	0.41	0.001
G	806	644	0.80	0.46	0.001
H	3816	2832	0.74	0.49	0.001
J	746	484	0.65	0.46	0.001
K	1080	614	0.57	0.25	0.001
L	678	543	0.80	0.65	0.001
M	372	271	0.73	0.33	0.001
N	579	370	0.64	0.83	0.001
P	2320	1482	0.64	0.29	0.001
Q	2080	1645	0.79	0.59	0.001
R	1782	1502	0.84	0.35	0.001
S	293	239	0.82	0.40	0.001
T	2109	1833	0.87	0.66	0.001
U	120	91	0.76	0.82	0.001
V	64	44	0.69	0.80	0.001
Z	418	342	0.82	0.28	0.001
All Classes	6142	5010	0.82	0.70	0.001

To compare the frequencies of variables in main classes, values were adjusted for unequality in the base frequency and then the chi square test of difference was applied. The mean of subject frequency counts for all LCC main classes was 1,034. This was used to proportionately adjust the observed LCC frequency counts for each LCC main class. The expected LCC frequency counts for identical LC Subject Heading frequency counts was 754. It was found that there is a significant difference between main classes; Class 'T' (Technology) had the highest association, while Class 'J' (Political Science) had the lowest probability of having identical LCC notations for identical LC Subject Headings. This may be due to the fact that in technical areas terms are defined more precisely than in the social sciences and humanities. The findings also confirmed the author's earlier study on science and technology monographs. The results of comparison of ajusted values are given in the following table:

TABLE 19
Chi Square Test of Differences for Adjusted Values
of LCSH and LCC in Main Classes of LCC

LCC Main Classes	LCSH Frequency Counts	LCC Frequency Counts	Adjusted LCSH Frequency	Observed LCC Frequency	Expected LCC Frequency
A	127	53	1034	432	754
B	2006	1481	1034	763	754
C	214	137	1034	662	754
D	1349	986	1034	756	754
E	367	285	1034	803	754
F	395	339	1034	887	754
G	806	644	1034	826	754
H	3816	2832	1034	767	754
J	746	484	1034	671	754
K	1080	614	1034	588	754
L	678	543	1034	828	754
M	372	271	1034	753	754
N	579	370	1034	661	754
P	2320	1482	1034	661	754
Q	2080	1645	1034	818	754
R	1782	1502	1034	872	754
S	293	239	1034	843	754
T	2109	1833	1034	899	754
U	120	91	1034	784	754
V	64	44	1034	711	754
Z	418	342	1034	846	754

Chi Square = 335.643   df = 20   p < 0.001

Summary

The alphabetical subject list simulating a subject
catalog using the Library of Congress Subject Headings and the
Library of Congress Classification was used to test the ef-
fects of the variation in number of LC Subject Headings per
bibliographic record and the order of LC Subject Headings in
each record on the association between LC Subject Headings and
their corresponding LCC notations. The analyses in this
chapter showed that there was a significant difference between
the degree of association for 1C Subject Headings and their
corresponding LCC notations in four groups of bibliographic
records with a different number of subject headings per
bibliographic record. The LC Subject Headings listed first
had a greater association with respect to their corresponding
LCC notations, which was statistically significant from that
of the LC Subject Headings not listed first. However, the
pattern of variation was not found to be fixed and thus was
not predicatable. The degree of association between LC Sub-
ject Headings and their corresponding classes of notations in
various main classes of LCC was found to be statistically
significant.

Chapter 6

ANALYSIS OF LCSH AND DDC NOTATIONS

Association of LCSH AND DDC in Four Groups of
Bibliographic Records

The purpose of the analysis in this part was to test hypothesis 1B. The question was to determine if the association between the Library of Congress Subject Headings and their corresponding Dewey Decimial Classification notations significantly varies with the number of LC Subject Headings per bibliographic record. The research hypothesis for this part states that the probability of having an identical Dewey Decimal Classification for identical Library of Congress Subject Headings in single-heading bibliographic records is significantly greater than for multiple-heading bibliographic records. That is, there is an inverse relationship between the two variables. Therefore, the null hypothesis of no difference had to be tested to accept or reject the hypothesis.

The alphabetically sorted subject list, (SD Sort List), which was a simulation of a card catalog using the Library of Congress Subject Headings and the Dewey Decimal Classification system, was used to do the analyses of this part. The same analyses that were made to test association between LC Subject Headings and their corresponding LCC notations were repeated

for LCSH and DDC. The selected list of bibliographic records
was sorted first alphabetically by LC Subject Headings, then
by their corresponding DDC notations. The list was further
sorted by the number of LC Subject Headings per bibliographic
record and by the order of subject headings in each biblio-
graphic record. Using the same procedure described earlier,
the probability and correlation between LC Subject Headings
and their corresponding Dewey Decimal Classification notations
was computed; the results of this analysis are summarized in
table 20:

TABLE 20
Probability and Correlation between Library of Congress
Subject Headings and DDC Notations in Four
Groups of Bibliographic Records

Groups of Bibliographic Records	Subject Frequency Counts	DDC Frequency Counts	P	r	Significance of r
With 1 LCSH	5841	4530	0.78	0.76	0.001
With 2 LCSH	11096	6404	0.58	0.81	0.001
With 3 LCSH	7355	3734	0.51	0.88	0.001
With 4 LCSH	3978	2441	0.61	0.78	0.001
Total	28270	17109	0.61		
All Groups	61766	24535	0.40	0.0097	0.084

One may argue that part of the difference can be attributed to the inequality of the number of subject headings in each group; thus, to avoid such criticism the number of LC Subject Headings in each group was equalized and then the differences were tested. To determine whether the differences are statistically significant, the frequencies for all groups were adjusted with respect to the mean of the LC Subject Heading frequency counts and the chi square test was then applied. The subject frequency count average in four groups of bibliographic records was 7,068, a figure which was used to calculate the adjusted observed frequency count for DDC notation frequencies. With an equal number of subject headings in each group, the expected DDC notations frequency counts in all groups was 4,372. Thus, any difference between the DDC notation frequency counts was due to the differences in the number of LC Subject Headings per bibliographic record. Table 21 shows the adjusted values for the above table:

TABLE 21
Chi Square Test of Differences for Adjusted Values
in Four Groups of Bibliographic Records

Groups of Bibliographic Records	Subject Frequency Counts	DDC Frequency Counts	Adjusted LCSH Frequency	Observed DDC Frequency	Expected DDC Frequency
With 1 LCSH	5841	4530	7068	5882	4372
With 2 LCSH	11096	6404	7068	4079	4372
With 3 LCSH	7355	3734	7068	3588	4372
With 4 LCSH	3978	2441	7068	4337	4372

Chi Square = 441.864   df = 3 $p < .001$

There was a significant difference between the four groups of bibliographic records at the 0.001 level. The null hypothesis of no difference was rejected at the 0.001 level. The research hypothesis was accepted that as the number of LC Subject Headings per bibliographic record increases, the probability of having an identical DDC notation for the same LC Subject Heading will decrease.

The regression analysis of the frequency counts of the Library of Congress Subject Headings and the frequency counts of their corresponding Dewey Decimal Classification in four groups of bibliographic records with one, two, three, or four and more LC Subject Headings showed that 'single-heading' bibliographic records have the highest share in the variability of DDC notations. However, as shown in the following table, there was no recognizable pattern for variations of DDC

TABLE 22

Regression Equations for Variability of the Frequency
of DDC Notations Due to Variation in the Number
of Subject Headings in Bibliographic Records

Groups of Records	DDC Frequency	Constant Si1	Si2	Si3	Si4i4
With 1 LCSH	$DF1j$	=	-0.031	+	$0.50(S11)$
With 2 LCSH	$DF2j$	=	0.55	$-$ $0.0079(S21)$	+ $0.13(S22)$
With 3 LCSH	$DF3j$	=	2.64	+ $0.26(S31)$	+ $0.12(S32)$ + $0.11(S33)$
With 4 LCSH	$DF4j$	=	5.35	+ $0.17(S41)$	+ $0.39(S42)$ + $0.25(S43)$ + $0,17(S44)$
All Groups	$DFij$	=	0.25	+ $0.20(SH1)$	+ $0.003(SH2) -$ $0.01(SH3)$ $-$ $0.001(SH4)$

$DFij$ = DDC Notation Frequency Counts in group of Bibliographic
Record i for Subject Headings with order j.

notations when the number of LC Subject Headings per biblio-
graphic records increased. It seems that other factors, such
as the indterdisciplinary nature of the subject headings, has
some effect on the association between the two variables.

Discussion

As in the case of LC analysis, in the group of biblio-
graphic records with a single LC Subject Heading there was a
higher association between the Library of Congress Subject
Headings and their corresponding Dewey Decimal Classification
notations. That is, as the number of LC Subject Headings per
bibliographic record increased, the probability of having
identical DDC notations for identical LC Subject Headings
decreased. The probability of having identical DDC notations
for identical LC Subject Headings in single-subject heading
bibliographic records was 78 per cent, 58 per cent for the
double-headings group, 51 per cent for the triple-headings,
and 61 per cent for the group of bibliographic records with
four or more LC Subject Headings per bibliographic record.
The reason that the fourth group had a higher probability may
be due to the fact that all the bibliographic records with
more than three LC Subject Headings per bibliographic records
have been combined to form the fourth group. This group had
fewer LC Subject Headings, and as a result the frequency
counts for each variable was less than in preceding groups.

The probability of having identical DDC notations for identical LC Subject Headings in single-subject heading bibliographic records was higher than the succeeding groups. However, the pattern of decreasing correlation and probability was not found to be fixed. As the number of LC Subject Headings per bibliographic record increased, the frequency of having identical LC Subject Headings and DDC notations varied in opposite directions. The only exception was in group four, where the correlation and probability was higher than its preceding group.

Association of LCSH and DDC When Order of
Subject Headings Varies

The purpose of this part of the analysis was to test hypothesis 2B. The hypothesis states that for the Library of Congress Subject Headings listed first in multiple-heading bibliographic records there is significantly more agreement between Dewey Decimal Classification notations than the same subject headings when they are not listed first; that is, as the order of the Library of Congress Subject Headings in the bibliographic records increases, the degree of association between LC Subject Headings and their corresponding Dewey Decimal Classification notations decreases. Therefore, the question was to verify if there was a statistically significant difference between the association of LC Subject

Headings and DDC notations among subject headings with a dif-
ferent order in the bibliographic records.

Using the same sorted list, that is, the SD Sort, for
various orders of LC Subject Headings in four groups of
bibliographic records with one to four subject headings, the
frequency of LC Subject Headings and their corresponding DDC
notations was measured to determine the variation of their as-
sociation with respect to the variations in the order of LC
Subject Headings the bibliographic records. The analysis
showed that as the order of LC Subject Headings increased, the
probability of having identical DDC notations for identical LC
Subject Headings decreased. Table 23 shows the results of
this analysis:

TABLE 23
Probability and Correlation between Subject
Headings and DDC Notations in Four
Groups of Bibliographic Records

Order of Subject Headings	LCSH Frequency Counts	DDC Frequency Counts	P	r	Significance of r
Listed 1st	20652	12649	0.61	0.45	0.001
Listed 2nd	9956	4678	0.47	0.68	0.001
Listed 3rd	3348	1572	0.47	0.81	0.001
Listed 4th	888	502	0.57	0.73	0.001
Total	34844	19401	0.56		
All Orders	61766	24535	0.40	0.0097	0.084

Similarly, the values were adjusted to have an equal base for all the frequencies; the test of difference was applied to verify whether there was any statistically significant difference between the association of the Library of Congress Subject Heading frequency counts and their corresponding DDC notation frequency counts in LC Subject Headings with a different order of listing in the bibliographic records.

The average subject frequency counts for four subject orders was 8,711; using this figure, the adjusted observed DDC frequency counts were computed. With no difference between the order of LC Subject Headings listed in the bibliographic records, the DDC notations frequency counts was expected to be 4,611. Therefore, any difference between adjusted and observed DDC notation frequency counts is due to the differences

in the order of LC Subject Headings in the bibliographic records. Table 24 shows the results of adjusted values.

TABLE 24
Chi Square Test of Differences for Adjusted Values
in Four Different Orders of Subject Headings
in Bibliographic Records

Orders of Subject Headings	LCSH Frequency Counts	DDC Frequency Counts	Adjusted LCSH Frequency	Observed DDC Frequency	Expected DDC Frequency
Listed 1st	20652	12649	8711	5335	4611
Listed 2nd	9956	4678	8711	4093	4611
Listed 3rd	3348	1572	8711	4090	4611
Listed 4th	888	502	8711	4924	4611

Chi Square = 251.564   df = 3 $p < .001$

The difference between the various orders of LC Subject Headings was found to be significantly different at the 0.001 level. This means that the degree of association decreases as the order of LC Subject Headings increases. In other words, the DDC notations represent LC Subject Headings listed first rather than those being listed second, third, etc.

Regression analysis of the frequency counts of the Library of Congress Subject Headings and the frequency counts of their corresponding Dewey Decimal Classification notations with respect to the increment in the order of LC Subject Headings in the bibliographic records showed that the LC Subject Headings listed first have the highest share in the variability of DDC notations, as shown in the following table:

TABLE 25

Regression Equations for Variability of the Frequency of
DDC Notations Due to Variation in the Order of
Subject Headings in the Bibliographic Records

Order of Subject Headings	DDC Frequency	Constant Si1	Si2	Si3	Si4
Listed 1st	$DF1j$ =	3.03	+ 0.008(S11)	+0.013(S21)	- 0.0007(S41)
Listed 2nd	$DF2j$ =	15.29	+ 0.73(S22)	+ 0.68(32)	+ 0.50(42)
Listed 3rd	$DF3j$ =	11.07		+ 0.93(S33)	+ 0.85(S4)
Listed 4th	$DF4j$ =	5.05			+ 1.10(S44)
All Orders	$DFij$ =	0.35	+ 0.004(S1)	+0.02(S2)	- 0.01(S3) + 0.01(S4)

$DFij$ = DDC Notation Frequency Counts in group of Bibliographic
Record i for Subject Headings with order j.

Discussion

The association between LC Subject Headings and their corresponding DDC notations in LC Subject Headings listed first in the bibliographic records was higher than the association of LC Subject Headings and their corresponding DDC notations in LC Subject Headings listed second, third, etc. While the probability for the subject headings listed first was 61 per cent, it was 36 per cent for the subject headings listed second, 26 per cent for the headings listed third, and 37 per cent for the subject headings listed fourth or more. Similarly, the correlation coefficient was 0.65 for the first group, 0.55 for the second, 0.43 for the third, and 0.58 per cent for the fourth group.

This finding implies that when the card catalog is consulted to find a DDC notation corresponding to a given subject to advise a patron for browsing shelves, paying attention to the order of subject headings would result in a more accurate suggestion of a DDC notation.

Association of LCSH and DDC When Both Number and
Order of Subject Headings Vary

The above records were analyzed for the cases when both
variables, that is, order and the number of LC Subject
Headings per bibliographic records, vary. In other words, the
above two analyses were combined to verify the variation in
the degree of association between the Library of Congress Sub-
ject Headings and their corresponding DDC notations in situa-
tions where both the number of LC Subject Headings per
bibliographic record and the order of each subject in the
bibliographic records vary. The results of this analysis is
given in table 26:

TABLE 26

Probability and Correlation between The Library of Congress Subject
Headings and Dewey Decimal Classification Notations in Four Groups
of Bibliographic Records When Both Order and Number
Subject Headings in Bibliographic Records Change

Groups:	With 1 LCSH				With 2 LCSH				With 3 LCSH				With 4 LCSH				All Groups			
Order	SF	DF	P	r	SF	DF	P	r	SF	DF	P	r	SF	DF	P	r	SF	DF	P	r
1st	5841	4530	0.78	0.76	4383	3159	0.72	0.78	1687	1242	0.74	0.86	677	560	0.83	0.86	20652	12649	0.61	0.45
2nd					4337	2502	0.58	0.84	1557	992	0.64	0.80	627	488	0.78	0.79	9956	4678	0.47	0.68
3rd									1686	953	0.57	0.87	623	461	0.74	0.93	3348	1572	0.47	0.88
4th													658	446	0.68	0.91	888	502	0.57	0.48
Total	5841	4530	0.78	0.76	11096	6404	0.58	0.81	7355	3734	0.51	0.88	3978	2441	0.61	0.78	61766	24535	0.40	0.0097

SF = Library of Congress Subject Heading Frequency Counts
DF = Dewey Decimal Classification Frequency Counts

Discussion

In all groups of bibliographic records with more than one
LC Subject Heading, there was a higher association between LC
Subject Headings and DDC notations for subject headings listed
first in the bibliographic records than succeeding subject
headings. However, between all LC Subject Headings with the
same order but from different groups of bibliographic records,
there was no significant difference among the association
between LC Subject Headings and their corresponding DDC nota-
tions.

Association of LCSH and DDC in Main Classes of DDC

The aim of this analysis was to test hypothesis 3B. The
question in this hypothesis was to verify if there is any
significant difference between the Library of Congress Subject
Headings and their corresponding Dewey Decimal Calssification
notations in various main classes of DDC. The analysis of the
association was repeated for each DDC main class, and the
results were recorded. The complete records of the analyses
of this part are given in appendix G; however, to briefly com-
pare the ten DDC main classes, the data for LC Subject
Headings listed first in the bibliographic records are given

in table 27.

Classes '600' (Applied Science: Technology) and '900' (History) had probabilities over 65 per cent, while classes '200' (Religion) and '300' (Social Science) had probabilities below sixty per cent.

TABLE 27

Comparison of Probability and Correlation between Subject Headings and DDC Notations in Main Classes of DDC

DDC Main Classes	LCSH Frequency Counts	DDC Frequency Counts	P	r	Significance of r
000	1026	641	0.62	0.44	0.001
100	894	534	0.60	0.44	0.001
200	1136	673	0.59	0.50	0.001
300	6363	3508	0.55	0.31	0.001
400	428	274	0.64	0.40	0.001
500	1639	989	0.60	0.59	0.001
600	4055	2660	0.66	0.46	0.001
700	1816	1166	0.64	0.65	0.001
800	1506	914	0.61	0.65	0.001
900	1892	1269	0.67	0.25	0.001
All Classes	20652	12649	0.61	0.45	0.001

To test if the difference between scores for each main class was statistically significant, the frequency counts of LC Subject Headings in each main class had to be equal. Therefore, the frequencies for all main classes were adjusted and then the chi square test was applied to verify whether the difference was statistically significant. The average LC Sub-

ject Headings frequency counts in ten main classes of DDC was
2,076. This was used to compute the adjusted observed DDC
notation frequency counts in each class. With an equal number
of LC Subject Headings in each main class the expected DDC
notation frequency count was 1,284. The differences between
adjusted observed values may be then attributed to the dif-
ferences in the main classes. Table 28 shows the adjusted
values for the Library of Congress Subject Headings and their
corresponding Dewey Decimal Classification notations in ten
main classes of DDC.

· TABLE 28
Chi Square Test of Differences for Adjusted Values of
LCSH and DDC Notations in Ten Main Classes of DDC

DDC Main Classes	LCSH Frequency Counts	DDC Frequency Counts	Adjusted LCSH Frequency	Adjusted DDC Frequency	Expected DDC Frequency
000	1026	641	2076	1297	1284
100	894	534	2076	1240	1284
200	1136	673	2076	1230	1284
300	6363	3508	2076	1145	1284
400	428	274	2076	1329	1284
500	1639	989	2076	1253	1284
600	4055	2660	2076	1362	1284
700	1816	1166	2076	1333	1284
800	1506	914	2076	1260	1284
900	1892	1269	2076	1392	1284

Chi Square = 037.424   df = 9 $p < 0.001$

Summary

The alphabetically arranged list of LC Subject Headings, simulating a subject catalog of a library using the Library of Congress Subject Headings and the Dewey Decimal Classification, was used for analyzing association between LC Subject Headings and their corresponding DDC notations. The same analyses described in chapter five for computing the association between LC Subject Headings and their corresponding LCC notations was repeated with respect to DDC notations. The findings in chapter five were reaffirmed for the DDC system. That is, there was a statistically significant difference between the degree of association of the Library of Congress Subject Headings and their corresponding Dewey Decimal Classification notations in four groups of bibliographic records with a different number of LC Subject Headings per bibliographic record. The order of LC Subject Headings in bibliographic records did affect significantly the degree of association between LC Subject Headings and DDC notations. There was a statistically significant difference between the degree of association in ten main classes of DDC.

Chapter 7

COMPARISON OF ALPHABETICAL AND CLASSIFIED CATALOGS

The purpose of the analysis described in this chapter was
to test the difference between association of the Library of
Congress Subject Headings and their corresponding class nota-
tions in an alphabetical subject catalog and a classified
catalog. Hypothesis number four states that there is a
statistically significant difference between probability of
having identical class notations for identical LC Subject
Headings or identical subject headings for identical class
notations in bibliographic records selected from an al-
phabetically arranged subject catalog and a shelf list
catalog.

The analyses described in this chapter were done to ver-
ify whether there was any significant variations in the
measures of association between the Library of Congress Sub-
ject Headings and their corresponding class notations when a
different order of sort keys is used to arrange and analyze
the data. In fact, this was used to double check the findings
in the preceding two chapters and to gain a better under-
standing of the other variables involved in the association
between LC Subject Headings and their corresponding class
notations.

For the purpose of this analysis, the data were sorted

first by the class notations, second alphabetically by the LC
Subject Headings, third by the number of LC Subject Headings
per bibliographic record, and finally by the order of LC Sub-
ject Headings in the bibliographic records. Samples of the
sorted data for the two classification systems are given in
appendices D and E.

In fact, the class notation was considered to be an in-
dependent variable, and the variation of subject headings was
considered to be dependent upon the variation in class
notations. This list was a simulation of the shelf list
catalog in libraries, except that the shelf list is arranged
by call number, but these two lists were arranged by class
notations. In other words, a shelf list catalog is arranged
first by class notation and then subarranged by book numbers,
while in the arrangement described here the bibliographic
records were arranged first by class notation and then subar-
ranged by LC Subject Headings and the codes which were used to
denote the number of LC Subject Headings per bibliographic
record and the order of subject headings in each record.

Using list number three (LS Sort) and list number four
(DS Sort), the analyses described in chapters five and six
were repeated. This time, however, instead of using al-
phabetical subject simulation a shelf list simulation was
used. The following is a comparison of findings for different
sort keys:

Association of LCC and LCSH

The question to be answered by this part of the study was
to verify if there was any statistically meaningful difference
in the degree of association between the Library of Congress
Classification notations and their corresponding Library of
Congress Subject Headings when instead of sorting biblio-
graphic records alphabetically by subject headings they are
sorted first by LCC notation and then by the other sort keys.

(a) Comparison of Alphabetic and Classified Catalogs in
    Four Groups of Bibliographic Records

The association between the Library of Congress Clas-
sification notations and their corresponding Library of Con-
gress Subject Headings in four groups of bibliographic
records, having one to four LC Subject Headings, was computed
in the same way as described earlier. The findings were com-
pared with the results of the analysis of the 'SL Sort' list
to determine whether there was any significant variation
between the measures of associations when data were sorted
differently. The comparison of findings for 'SL Sort' list
and 'LS Sort' list is given in table 29. For each value in
the alphabetical subject catalog the corresponding value in
the shelf list catalog was computed to show the comparable
values in each list.

TABLE 29

Comparison of Probability and Correlation between Subject
Headings and LCC Notations in Four Groups of
Bibliographic Records for Two Differently
Sorted Lists

Groups of Bibliographic Records	Alphabetical Subject Catalog			Classified Catalog		
	LCSH Frequency Counts	LCC Frequency Counts	P1	LCC Frequency FrCounts	LCSH Frequency Counts	P3
With 1 LCSH	6142	5010	0.82	7509	4913	0.65
With 2 LCSH	11400	6939	0.61	15742	4734	0.30
With 3 LCSH	7476	4036	0.54	8234	2079	0.25
With 4 LCSH	4070	2587	0.64	3882	1117	0.29
Total	29088	18572	0.64	35367	12843	0.36
All Groups	61766	27188	0.44	54588	18104	0.33

p1 = The probability in list one.
p3 = The probability in list three

Generally, the probability values in the classified list (shelf list catalog) were less than the corresponding probability values in the alphabetical subject list (subject catalog). However, the values varied in the same direction in both lists. The probability for bibliographic records with a single-subject LC Subject Heading was higher than the second, and the second was higher than the third in both catalogs. In 'LS Sort' list, the fourth group was an exception, just as it was in the 'SL Sort' list.

To verify whether the differences were statistically significant, the number of LC Subject Headings in each list had to be equal. Therefore, the frequency counts for all groups of bibliographic records for both lists were adjusted, then the chi square test was applied to determine if the difference was statistically meaningful. The average LC Subject Heading frequency counts in the alphabetical subject list was 7,272. The same figure was used for the classified list, so that in both lists and for all groups in each list there would be equal subject heading frequency counts. The observed frequency counts for the LCC notations in each list were computed and tested. As table 30 shows, the tests of differences were applied both horisontally and vertically: The horizontal tests were to measure the differences between two corresponding values in the two lists; the vertical tests, on the other hand, were used to measure the differences between four groups of bibliographic records for each list.

TABLE 30

Chi Square Test of Differences for Adjusted Values
in Four Groups of Bibliographic Records for
Two Differently Sorted Lists

Groups of Bibliographic Records	Alphabetical List		Classified List		Chi Square Test values	Significance of Difference
	Adjusted LCSH Frequency	Adjusted LCC Frequency	Adjusted LCC Frequency	Adjusted LCSH Frequency		
With 1 LCSH	7272	5932	7272	4758	128.712	0.001
With 2 LCSH	7272	4426	7272	2187	757.394	0.001
With 3 LCSH	7272	3926	7272	1836	757.362	0.001
With 4 LCSH	7272	4622	7272	2092	952.613	0.001
Chi Square = 463.946 df = 3 p < 0.001			Chi Square = 2063.56 df = 3 p < 0.001			

Discussion

The above two tables indicate that in both sorted lists for the group of bibliographic records with a single LC Subject Heading there was a higher association between LC Subject Headings and their corresponding class notations. The comparison of both lists indicated that the order of sort keys had a significant effect on the probability measure; that is, not only the number of LC Subject Headings per bibliographic record affected the degree of association, but the selection of the sort keys for sorting data caused a significant effect on the frequency counts.

In both lists the probability of having identical LCC notations for identical LC Subject Headings in single-heading bibliographic records was higher than that for the succeeding groups. However, the pattern of decreasing correlation and probability was not found to be fixed. The absolute frequency count of identical subject headings and their corresponding identical class notations decreased as the number of LC Subject Headings per bibliographic record increased. However, for group four the probability was higher than its preceding group.

(b) <u>Comparison of Alphabetic and Classified Catalogs in</u>
<u>Subject Headings With a Different Order</u>

The association between LCC and LCSH for subjects with
different orders in bibliographic records was computed in the
same way as described earlier. In this analysis, the associa-
tion between LCSH and LCC in the 'LS Sort' list was measured
with respect to the changes in the order of LC Subject
Headings in the bibliographic record. The results were com-
pared with the order analysis values in the 'SL Sort' list.

The comparison of findings for the 'SL Sort' list and the
'LS Sort' list is given in table 31.

TABLE 31

Comparison of Probability and Correlation between LCC
Notations and LCSH for Subject Headings with Different
Orders in Bibliographic Records for Two
Differently Sorted Lists

Subject Headings	Order of Alphabetical Subject List			Classified List		
	LCSH Frequency Counts	LCC Frequency Counts	P1	LCC Frequency Counts	LCSH Frequency Counts	p3
Listed 1st	21754	16373	0.75	28624	15015	0.52
Listed 2nd	10259	4649	0.45	11330	4355	0.38
Listed 3rd	3429	1603	0.47	3418	1529	0.45
Listed 4th	924	515	0.56	859	511	0.59
Total	36366	23140	0.64	44231	20410	0.46
All Orders	61766	27188	0.44	54587	18104	0.33

p1 = Probability in list one.
p3 = Probability in list three.

To determine if the differences were statistically significant, the number of LC Subject Headings in each group had to be equal. Therefore, the frequencies for all groups were adjusted, then for each corresponding pair of values in both lists the chi square tests were applied to verify if the difference was statistically significant. In additon, the difference between the order analysis values for 'LS Sort' list was compared to determine if they themselves were significantly different.

The subject frequency count for the alphabetical subject list was 9,092, a figure which was used as the basis to adjust the values in both lists. As shown in table 32, the differences between the degree of association measured in the two lists were significantly different at the 0.001 level for subject headings listed first and second in the bibliographic records but were not significantly different for the headings listed as the third, or fourth LC Subject Headings.

Therefore, the null hypothesis of no difference was partly rejected and the research hypothesis was accepted that between the LC Subject Headings and their corresponding LCC notations in bibliographic records, in an alphabetically arranged subject catalog and bibliographic records such as in a shelf list catalog, there existed a significant difference between LC Subject Headings listed first and second in the bibliographic records.

TABLE 32

Chi Square Test of Differences for Adjusted Values
in Four Subject Orders of the Bibliographic Records
for Two Differently Sorted Lists

Order of Subject Headings	Alphabetical List		Classified List		Chi Square Test Values	Significance of Difference
	Adjusted LCSH Frequency	Adjusted LCC Frequency	Adjusted LCC Frequency	Adjusted LCSH Frequency		
Listed 1st	9092	6843	9092	4769	370.077	0.001
Listed 2nd	9092	4120	9092	3995	1.895	0.001
Listed 3rd	9092	4250	9092	4067	3.983	0.50
Listed 4th	9092	5068	9092	5409	11.034	0.20

Chi Square = 929.912 df = 3, $p < 0.001$ Chi Square = 290.491 df = 3, $p < 0.001$

Association of DDC and LCSH

The question to be answered by this part of the study was to find out if there was any statistically significant difference in the degree of association between Dewey Decimal Classification notations and their corresponding Library of Congress Subject Headings when data were sorted first by DDC notations and then by other sort keys--in other words, when instead of using bibliographic records in an alphabetically arranged subject catalog they are selected from a shelf list catalog and then analyzed.

(a) <u>Comparison of Alphabetic and Classified Catalogs in Four Groups of Bibliographic Records</u>

The association between the Dewey Decimal Classification notations and the Library of Congress Subject Headings in four groups of bibliographic records, having one to four LC Subject Headings, was computed in the same way as was described earlier. The comparison of findings for the subject catalog (SD Sort List) and the shelf list catalog (DS Sort List) is given in table 33.

TABLE 33

Comparison of Probability and Correlation between DDC
Notations and LCSH in Four Groups of Bibliographic
Records in Two Differently Sorted Lists

Groups of Bibliographic Records	Alphabetical Subject List			Classified List		
	LCSH Frequency Counts	DDC Frequency Counts	P2	DDC Frequency Counts	LCSH Frequency Counts	P4
With 1 LCSH	5841	4530	0.78	7807	4117	0.53
With 2 LCSH	11096	6404	0.58	15259	4215	0.28
With 3 LCSH	7355	3734	0.51	7998	1873	0.23
With 4 LCSH	3978	2441	0.61	3757	1023	0.27
Total	28270	17109	0.60	34821	11228	0.32
All Groups	61766	24535	0.40	55841	14734	0.26

p2 = The probability in list number two.
p4 = The probability in list number four.

To verify if the differences were statistically significant, the frequency of LC Subject Headings in all groups in both lists had to be equal. Therefore, the frequencies for all groups were adjusted and then the chi square test was applied to determine if the difference was statistically meaningful. The average frequency count for the alphabetically arranged list was 7,068, and the values in the two lists were adjusted with respect to this figure. The adjusted observed frequency counts for the dependent variables in the two lists were computed and were tested both horizontally and vertically. The degree of association measured in two lists were statistically significant at the 0.001 level. Since both lists had an equal number of cases, the difference can be attributed to the difference in sorting the records.

Therefore, the null hypothesis of no difference between the two types of sorting records was rejected and the research hypothesis was accepted since the association between LCSH and DDC in alphabetical subject catalog and the classified catalog for bibliographic records with a different number of LC Subject Headings was found to be significantly different at the 0.001 level. Table 34 shows the adjusted values for the above table.

TABLE 34

Chi Square Test of Differences for Adjusted Values
in Four Groups of Bibliographic Records
for Two Differently Sorted Lists

Groups of Bibliographic Records	Alphabetic List		Classified List		Chi Square Test Values	Significance of Difference
	Adjusted LCSH Frequency	Adjusted DDC Frequency	Adjusted DDC Frequency	Adjusted LCSH Frequency		
With 1 LCSH	7068	5882	7068	3723	484.848	0.001
With 2 LCSH	7068	4079	7068	1950	751.10	0.001
With 3 LCSH	7068	3588	7068	1653	713.672	0.001
With 4 LCSH	7068	4337	7068	1922	931.043	0.001

Chi Square = 457.365 df = 3 p< 0.001 Chi Square = 1170.21 df = 3 p< 0.001

Discussion

The above two tables indicate that in both lists whenever the group of bibliographic records had a single LC Subject Heading, there was a higher correlation between LC Subject Headings and their corresponding notations. While the probability of having identical class notations for identical subject headings in single-LC Subject Heading bibliographic records was 65 per cent, it was reduced to 41 per cent for the double-heading groups, 36 per cent for the triple-heading group, and 47 per cent for the group of bibliographic records with four or more LC Subject Headings. The reason that the fourth group has a higher probability may be due to the fact that the frequency of LC Subject Headings in these groups was generally less than other groups; therefore, the analysis of data was done with a smaller number of LC Subject Headings.

The probability of having identical DDC notations for identical LC Subject Headings in single-heading bibliographic records was higher than for the succeeding groups. However, the pattern of decreasing correlation and probability was not found to be fixed: As the number of LC Subject Headings per bibliographic record increased, both the frequency of having identical LC Subject Headings and the frequency of having identical DDC notations decreased. The only exception was in

group four, where the correlation and the probability were higher than its preceding group.

(b) Comparison of Alphabetic and Classified Catalogs in Subject Headings With a Different Order

The association between the Dewey Decimal Classification notations and the Library of Congress Subject Headings in LC Subject Headings listed in a different order in bibliographic records was computed in the same way as described earlier. The purpose of this analysis was to verify if the degree of association between the Library of Congress Subject Headings and their corresponding Dewey Decimal Classification notations with respect to the variations in the order of LC Subject Headings in the bibliographic records vary significantly when instead of selecting bibliographic records from an alphabetically arranged subject catalog they selected from a shelf list catalog.

The comparison of findings for the simulated card catalog (SD Sort List) and the simulated shelf list catalog (DS Sort List) is given in table 35.

TABLE 35

Comparison of Probability and Correlation between DDC
Notations and LCSH for Different Subject Heading
Orders in Bibliographic Records for Two Differently
Sorted Lists

Order of Subject Headings	Alphabetical Subject List			Classified List		
	LCSH Frequency Counts	DDC Frequency Counts	P2	DDC Frequency Counts	LCSH Frequency Counts	P4
Listed 1st	20652	12649	0.61	27029	10634	0.39
Listed 2nd	9956	4678	0.47	11130	4092	0.37
Listed 3rd	3348	1572	0.47	3317	1459	0.44
Listed 4th	888	502	0.57	872	488	0.56
Total	34844	19403	0.56	42348	16673	0.39
All Orders	61766	24535	0.40	55841	14734	0.26

P2 = Probability values in list number two.
P4 = Probability values in list number four.

To determine if the differences were statistically significant, the number of LC Subject Headings in each group had to be equal. Therefore, the frequencies for all groups were adjusted, then the chi square test was applied to determine if the difference had statistical significance. The average subject frequency counts of 8,711 for the alphabetical list was used to compute the adjusted values in both lists. As table 36 shows, for the LC Subject Headings listed first and second there was a statistically significant difference between adjusted Dewey Decimal Classification notations frequency counts in the two lists. Since there were equal values for independent variables in each group, the difference proved to be the result of using a different sorting pattern.

TABLE 36

Chi Square Test of Differences for Adjusted Values
in Four Groups of Bibliographic Records
for Two Differently Sorted Lists

Order of Subject Headings	Alphabetical List		Classified List		Chi Square Test Values	Significance of Difference
	Adjusted Frequency LCSH	Adjusted Frequency DDC	Adjusted Frequency DDC	Adjusted Frequency LCC		
Listed 1st	8711	5335	8711	3427	415.048	0.001
Listed 2nd	8711	4093	8711	3203	108.323	0.001
Listed 3rd	8711	4090	8711	3832	8.337	0.20
Listed 4th	8711	4924	8711	4875	0.235	0.02

Chi Square = 251.564 df = 3 p< 0.001   Chi Square = 429.136 df = 3 p< 0.001

Summary

The effect of sorting data on the variation of association between the Library of Congress Subject Headings and their corresponding Library of Congress and Dewey Decimal Classification notations was tested in this chapter. Comparison of the alphabetical subject list with the classified list arranged by the Library of Congress Classification notations showed that the difference between association measures in four groups in the two lists was significant at the 0.001 level. However, with respect to the order of LC Subject Headings the difference was only significant for the LC Subject Headings listed first and second in the bibliographic records.

Comparison of the two differently sorted lists with respect to the Dewey Decimal Classification notations showed similar results: The values in the two lists were significantly different at the 0.001 level for all four groups of bibliographic records and for the LC Subject Headings listed first and second in the bibliographic records. The analyses suggest that using the probability measures in this study to develop an algorithm to automatically assign class notations or subject headings to a document when either one of these two is known, going from subject heading to compute class nota-

Chapter 8

COMPARISON OF ASSOCIATION MEASURES FOR LCC AND DDC

The purpose of the present analysis was to determine whether there was any statistically significant difference between association measures for the Library of Congress Subject Headings and the Library of Congress Classification notations on the one hand, and association between the Library of Congress Subject Headings and Dewey Decimal Classification notations on the other. Hypothesis five states that the probability of having identical class notations for identical LC Subject Headings in bibliographic records for documents classed in the Library of Congress Classification is statistically different from that of the biliographic records for documents classed in the Dewey Decimal Classification.

The hypothesis implies that the Library of Congress Classification and Dewey Decimal Classification are significantly different with respect to the degree of association of LC Subject Headings to either one of them. Therefore, the question was to compare the measures computed for both of them and test the differences to determine whether they are significantly different. The idea behind such comparison was to learn which one of these two classification systems would potentially be suitable for considering in an automatic classification programs.

Comparison of LCC and DDC Systems in
Four Groups of Bibliographic Records

The aim of this analysis was to verify if there is a statistically significant difference between the association of LC Subject Headings and LCC notations and LC Subject Headings and DDC notations in four groups of bibliographic records with a different number of subject headings per bibliographic record.

The association between LCC and LCSH in four groups of bibliographic records having one to four LC Subject Headings was computed in the same way as described earlier. For both classification systems the degree of association in the LC Subject Headings and their corresponding class notations in single-heading bibliographic records was higher than in multiple-heading bibliographic records. Except for the fourth group, the probability of having identical class notations for identical subject headings decreased as the number of LC Subject Headings per bibliographic records increased. In all groups of bibliographic records, the association of LC subject headings and their corresponding LCC notations was higher than association of the same subject headings with respect to DDC notations. The comparison findings for analyses of the 'SL Sort' list and the 'SD Sort' list is given in table 37.

TABLE 37

Comparison of Probability and Correlation between Subject
Headings and Class Notations in Four Groups of
Bibliographic Records for the Two
Classification Systems

Groups of	LCC System			DDC System		
Bibliographic LCSH Records Frequency Counts	LCSH Frequency Counts	LCC Frequency Counts	P(LCC)	LCSH Frequency Counts	DDC Frequency Counts	P(DDC)
With 1 LCSH	6142	5010	0.82	5841	4530	0.78
With 2 LCSH	11400	6939	0.61	11096	6404	0.58
With 3 LCSH	7476	4036	0.54	7755	3734	0.51
With 4 LCSH	4070	2587	0.64	3978	2441	0.61
Total	29088	18572	0.64	28270	17109	0.62
All Groups	61766	27188	0.44	61766	24535	0.40

To determine whether the differences were statistically significant, the frequency of LC Subject Headings in each group had to be equal. Therefore, the frequencies for all groups were adjusted, then the chi square test was applied to verify if the difference was statistically significant. The adjustment of the values in the two lists was done by computing the average frequency count in the first list and using that as a base for calculating other adjusted values. The average frequency count was 7,272.

The LC Subject Headings in both lists were set at the above figure and the frequency counts for the Library of Congress Classification and Dewey Decimal Classification notations were computed. Since the subject frequency counts in the two lists were equal, the frequency count for class notations were expected to be equal as well. The variations in the two lists can be attributed to differences in the classification systems. In other words, if the the Library of Congress Classification and Dewey Decimal Classification were equal with respect to measures of association in this study, for an equal number of LC Subject Headings they should have had equal frequency counts for the class notations; but the chi square test showed that the difference between frequency counts in the two lists were siginificant at the 0.001 level. Table 38 shows the adjusted values for the above table.

TABLE 38

Chi Square Test of Differences for Adjusted Values
in Four Groups of Bibliographic Records for the
Two Classification Systems

Groups of Bibliographic Records	LCC System		DDC System		Chi Square Test Values	Significance of Difference
	Adjusted LCSH	Adjusted LCC	Adjusted LCSH	Adjusted DDC		
With 1 LCSH	7272	5932	7272	3857	439.419	0.001
With 2 LCSH	7272	4426	7272	4197	6.029	0.001
With 3 LCSH	7272	3926	7272	3692	7.126	0.001
With 4 LCSH	7272	4622	7272	4462	2.783	0.001

Chi Square = 463.496 df = 3 p< 0.001   Chi Square = 87.769 df = 3 p< 0.001

Discussion

The above two tables indicate that for both classification systems there was a higher degree of association between the Library of Congress Subject Headings and their corresponding DDC and LCC notations in single-LC Subject Heading bibliographic records. For both classification systems there was a statistically significant difference between association between LC Subject headings and their corresponding class notations in bibliographic records with a different number of LC Subject Headings.

In bibliographic records with a single LC Subject Heading, there was a higher degree of association between LC Subject Headings and their corresponding notations. While the porbability of having identical class notations for identical subject headings for single-LC Subject Heading bibliographic records in LCC was 82 per cent, for DDC it was 78 per cent. Similarly, for the double-LC Subject Heading group the probability in LCC was 68 per cent, while for DDC it was 58 per cent.

In both classification systems the frequency counts varied in the same direction. As the number of LC Subject Headings increased in the bibliographic records the probability of having identical class notations for identical LC Sub-

ject Headings decreased; however, the values computed for DDC were always less than the corresponding values for LCC. In other words, there was more harmony between LC Subject Headings and their corresponding LCC notations than between LC Subject Headings and their corresponding DDC notations. The reason that the fourth group had a higher probability in both classification systems may be due to the fact that the frequency counts of LC Subject Headings in the fourth group were generally less than its preceeding three groups; therefore, the analysis of data was made with a smaller number of LC Subject Headings.

In spite of the fact that the probability of having identical class notations for identical LC Subject Headings in group one was higher than for the succeeding groups, the pattern of decreasing correlation and probability was not found to be fixed. As the number of LC Subject Headings per bibliographic record increased, both the frequency of having identical LC Subject Headings and the frequency of having identical class numbers decreased. The only exception was in group four, where the correlation and probability was higher than the preceeding group.

The difference in the degree of association between LCSH and LCC, and LCSH and DDC, is due to the fact that these two classification systems do not have an equal base. While there are 26 possible classes in LCC, there are only 10 main classes in DDC. This implies that more topics have to be compressed

into each class of DDC as compared with LCC. In other words, the class notations have to be longer in terms of digits used to express a class notation for a given LC Subject Heading.

The fact that LCC has a higher association than DDC can be interpreted to mean that in formulating a strategy for searching by class notation, or developing an algorithm to automatically assign class notations to LC Subject Headings list, LCC would be a better choice. That is, according to the findings of this study, using a classification system with more specific and detailed notations for each topic would yield a better correlation with the corresponding LC Subject Headings. It may even be appropriate to consider a different numbering system, such as hexadecimal, and then translate each notation to the desired and more familiar notation such as LCC or DDC.

Comparison of LCC and DDC Systems When the Order of Subject Headings Varies

The association between LCC and LCSH for subjects with different orders in bibliographic records was computed in the same way as described earlier. The comparison of findings for LCC and DDC is given in table 39; in both lists the probability of the LC Subject Headings listed first was more than the probability for the other headings. However, while this probability was 0.75 for LCC, it was 0.65 for DDC. For other

subject orders the probability values in LCC were higher than those of DDC.

To determine whether the differences were statistically significant, the frequency of LC Subject Headings in each group had to be equal. Therefore, the frequencies for all groups were adjusted, then the chi square test was applied to find if the difference was statistically significant. The average subject frequency count for all LC Subject Headings with various subject orders was 9,092. This was used to compute other adjusted values. The two classification systems were significantly different at the 0.001 level for LC Subject Headings listed first and second in the bibliographic records. They were not, however, significantly different for LC Subject Headings listed third or more in bibliographic records classed in both classification systems. The comparison of adjusted values for both classification systems are given in table 40.

TABLE 39

Comparison of Probability and Correlation between LCSH
and Class Notations for Subject Headings with
Different Orders in Bibliographic Records for
The Two Classification Systems

Order of Subject Headings	LC Classification System			DC Classification System		
	LCSH Frequency Counts	LCC Frequency Counts	P(LCC)	LCSH Frequency Counts	DDC Frequency Counts	P(DDC)
Listed 1st	21754	16373	0.75	20652	12649	0.61
Listed 2nd	10259	4649	0.45	9956	4678	0.47
Listed 3rd	3429	1603	0.47	3348	1572	0.47
Listed 4th	924	515	0.59	888	502	0.57
Total	36366	23140	0.64	34844	19403	0.56
All Orders	61766	27188	0.44	61766	24535	0.40

TABLE 40

Chi Square Test of Differences for Adjusted Order
Analysis Values for the Two Classification
Systems

Order of Subject Headings	LCC System		DDC System		Chi Square Test Values	Significance of Difference
	Adjusted Frequency LCSH	Adjusted Frequency LCC	Adjusted Frequency LCSH	Adjusted Frequency DDC		
Listed 1st	9092	6843	9092	5569	130.561	0.001
Listed 2nd	9092	4120.	9092	4272	2.717	0.001
Listed 3rd	9092	4250	9092	4269	0.038	0.20
Listed 4th	9092	5068	9092	5140	0.494	0.20

Chi Square = 929.912 df = 3 p< 0.001   Chi Square = 262.839 df = 3 p< 0.001

Summary

The Library of Congress Classification and the Dewey Decimal Classification Systems were compared to determine if they were significantly different with respect to their association with their corresponding LC Subject Headings. The degree of association between the Library of Congress Subject Headings and their corresponding LCC and DDC notations was significantly different for the two classification systems in four groups of bibliographic records and for the LC Subject Headings listed first and second in the bibliographic records.

CHAPTER 9

SUMMARY AND CONCLUSIONS

Subject analysis of library materials involves the use of both classification and subject headings. While multiple subject headings can be assigned to a bibliographic record, there is generally only one class notation corresponding the several subject headings in a bibliographic record. This study attempts to determine why all the identical subject headings in the card catalog generally do not have the same class notation. One explanation would be the difference in the number of subject headings assigned to each bibliographic record.

The policy statement of the Library of Congress implies that the degree of association between the class notation and first subject heading will be greater than the degree of association between it and the second, third or fourth subject heading. Therefore, the degree of association between subject headings and class notations in single-subject heading bibliographic records would be expected to be greater than that between subject heading and class notations in multiple-subject heading bibliographic records.

Two LC MARC tapes for the period of March 1980 to March 1981 were used to select the bibliographic records of this study and create a database to work with. To have a suf-

ficient occurrence of each subject heading it was decided to use all of the retrievable records on these two tapes. Using a systematic method of testing each record, 101,347 (83.38 per cent) records were selected as the corpus of the study. The Library of Congress Classification notations, Dewey Decimal Classification notations, and Library of Congress Subject Headings were retrieved from those bibliographic record which had all three elements. Each Library of Congress Subject Heading in the database was coded in such a way that it could be identified by its group, that is, the total number of subject headings in the bibliographic record, and by the order in which they are listed in the bibliographic records.

Analysis of the records showed that 34,538 (37.50 per cent) of the selected records had only one subject heading, 30,722 (33.36 per cent) of the records had two subject headings, 15,506 (16.84 per cent) had three subject headings, 6,743 (7.32 per cent) had four, and 1,684 (4.98 per cent) had more than four subject headings. The analysis indicated that 87.70 per cent of records had one to three subject headings, and 7.32 per cent had four headings, while only 4.98 per cent of the records had more than four subject headings; that is, 87,750 (95.02 per cent) of the records had one to four subject headings. Therefore, all bibliographic records with four or more subject headings were combined to form a single group.

The total number of subject headings in 101,347 biblio-graphic records was 195,368, of which 34,538 (17.68 per cent) were subject headings from 'single-heading' bibliographic records, 61,444 (31.45 per cent) were from 'double-heading' bibliographic records, 46,518 (23.81 per cent) were from 'triple-heading' bibliographic records, and finally, 52,865 (27.06 per cent) were from the group of bibliographic records with 'four or more subject headings'.

Furthermore, the selected subject headings in the sample were analyzed to find their distribution according to the LC MARC tags. It was found that 147,129 (75.31 per cent) of the subject headings had tag 650 (Topical Subject Headings) while tags 600 (Personal Names), 610 (Corporate Names), 611 (Con-ference and Meetings), 630 (Uniform Titles), and 651 (Geo-graphic Names) made up 48,216, or 24.68 per cent, of the sub-ject headings in the database.

To learn about the distribution of records by the LC Classification, the frequency of the bibliographic records with LCC notations was determined. It was found that the majority of bibliographic records were classed in Classes 'P' and 'H' of the Library of Congress Classification. Similarly, to find the distribution of records according to the Dewey Decimal Classification, all DDC notations of bibliographic records were tested and results were recorded. Classes '300' and '600' were found to be the more frequently assigned classes for the bibliographic records.

The selected subject headings in the sample were sorted into four different lists to simulate subject and shelf list catalogs in a library environment in which LCC or DDC is used as a classification system respectively.

Summary of Findings

The data were then analyzed to test the hypotheses in this study:

1. The first question was to determine if there was any statistically significant difference between the Library of Congress Subject Headings and their corresponding Library of Congress Classification notations among bibliographic records with a different number of subject headings per bibliographic record.

Using the alphabetically sorted subject list, the frequency of each subject heading which had an occurrence of two or more was counted. Then the frequency of the most frequent indentical class notation corresponding to each subject heading was determined. These analyses were made for four different groups of bibliographic records with one to four LC Subject Headings. The frequencies for all groups were adjusted with respect to the mean frequency counts in each group, then the chi square test was applied to determine if the difference between groups was statistically meaningful. The difference between each group of bibliographic records was found to be significant at the 0.001 level.

In the group of bibliographic records with a single subject heading, there was a higher association between LC Subject Headings and their corresponding LCC notations. While the probability of having identical LCC notations for identical LC Subject Headings in the 'single-subject heading' bibliographic records was 82 per cent, the probability reduced to 61 per cent for the 'double-heading' group, 54 per cent for the 'triple-heading' group, and 64 per cent for the group of bibliographic records with 'four or more' subject headings per bibliographic record.

Although the probability of having identical class notations for identical subject headings in single-subject heading bibliographic records was higher than that for succeeding groups, the pattern of decreasing correlation and probability was not found to be fixed. It was found that as the number of LC Subject Headings per bibliographic record increases, both the frequency of having identical LC Subject Headings and identical LCC notations decreases. The only exception was in bibliographic records with four or more subject headings, where the correlation and probability was higher than the previous groups.

In spite of the fact that the probability for the first group was higher than that for the succeeding groups, regression analysis of the frequency counts of the Library of Congress Subject Headings and the frequency counts of their corresponding Library of Congress Classifications with respect

to the variations in the number of subject headings per
bibliographic record showed that the pattern of variation
from one group to another was totally unpredictable and did
not follow a fixed pattern.

2. The second question to be answered was to verify if
there was any statistically significant difference between
the Library of Congress Subject Headings and the Library of
Congress Classification notations among LC Subject Headings
with a different order of listing in the bibliographic
records. The study controlled the order of subject headings
and measured the association between the variables as
specified above. This was done to determine if there was any
significant variation in the degree of association between
the Library of Congress Subject Headings and their cor-
responding Library of Congress Classification, when order of
subject headings listed in the bibliographic records varies.

Using the same subject sorted list, the frequency of LC
Subject Headings and their corresponding LCC notations for
the subject headings listed first in the bibliographic
records and for those not listed first in bibliographic
records was counted to determine the variations in their as-
sociation with respect to the variations in the order of
their listing in the bibliographic records. The analysis
showed that as the order of subject headings increased the
probability of having identical class notations decreased.

Similarly, the values were adjusted to have an equal

base for all the LCC frequency counts, then the test of dif-
ference was applied to verify whether there was any
statistically meaningful difference between the values for
different LC Subject Heading orders. The measured values for
different LC Subject Heading orders were significantly dif-
ferent at the 0.001 level.

However, the regression analysis of the frequency of the
Library of Congress Subject Headings and the frequency of
their corresponding Library of Congress Classification nota-
tions with respect to the variation in the order of subject
headings in the bibliographic records showed that there was
no recognizable pattern for various subject heading orders.
Although there was a higher probability of having identical
LCC notations for identical LC Subject Headings listed first,
the order of subject headings by itself was not found to be a
reliable predictor of the variations in the LCC notations.

The association between LC Subject Headings and their
corresponding LCC notations in LC Subject Headings listed
first in the bibliographic records were higher than the as-
sociation of LC Subject Headings and their corresponding LCC
notations in subject headings listed second, third, etc.
While the probability for the subject headings listed first
was 75 per cent, it was 45 per cent for the subject headings
listed second, 47 per cent for the subject headings listed
third, and 56 per cent for the subject headings listed fourth
or more in the bibliographic records. The correlation

measures between the Library of Congress Subject Headings and their corresponding Library of Congress Classification was not found to be in the same direction.

The records then were analyzed for the cases in which both variables, that is, order and the number of LC Subject Headings per bibliographic record, change. It was found that in all groups of bibliographic records with more than one LC Subject Heading there was a higher association between LC Subject Headings and LCC notations for subject headings listed first in the bibliographic records than those headings following the first subject heading. However, between all subject headings with the same order but from different groups of bibliographic records, there was no significant difference.

3. The third question was to determine if there was a statistically significant difference in the degree of association between LC subject headings and their corresponding LCC notations in different main classes of the Library of Congress Classification; therefore, the data were analyzed with respect to each LCC main class. The problem in this hypothesis was to verify whether there was any meaningful difference between the Library of Congress Subject Headings and their corresponding LCC notations when the analysis is done in bibiliographic records for documents classed in different main classes of the Library of Congress Classification. The analysis of the association was repeated for

each LC main class; the results showed that there was a statistically significant difference between LC main classes at the 0.001 level. Class 'T' (Technology), with a probability of 87 per cent, had the highest degree of association. Next to that was class 'F' (History: United States), with a probability of 86 per cent. In the lower end was Class 'A' (General Works) with a probability of 42 per cent.

4. The same analyses described for LCSH and LCC were repeated for the Library of Congress Subject Headings and their corresponding Dewey Decimal Classification notations, to determine if the association between LCSH and DDC is significantly different in bibliographic records with a different number of subject headings. The data were sorted first by LC Subject Heading, then by DDC notation, and finally by the code describing the group and order of each LC Subject Heading.

The analysis of LC Subject Headings and their corresponding Dewey Decimal Classification notations in the bibliographic records with one, two, three, and four or more subject headings showed that the probability of having identical DDC notations for identical LC Subject Headings decreases as the number of subject headings per bibliographic record increases. The only exception was in bibliographic records with four or more subject headings, which had a higher probability than its preceding group; that could have been the result of combining other bibliographic records with

more than four subject headings in this group.

The values were adjusted with respect to the mean frequency counts for LC Subject Headings so that in each group there was an equal number of subject headings, and the probability in each group was computed accordingly. The chi square test of differences between adjusted measured values in each group was found to be significant at the 0.001 level. However, regression analysis for all groups did not provide a recognizable pattern of variation. While the degree of association between the Library of Congress Subject Headings and their corresponding Dewey Decimal Classification notations was significantly different in bibliographic records with a different number of LC Subject Headings for each, the variation in the number of LC Subject Headings per bibliographic record by itself was not a predictor of the variations in DDC notations. It seems that rather than the number of subject headings per bibliographic record, the subject content of the document being cataloged caused the variation in the degree of association between the two variables.

5. Similarly, the analysis of the data with respect to the order of LC Subject Headings in the bibliographic records indicated that the probability of having identical DDC notations for identical LC Subject Headings among subject headings listed first was significantly higher than that of subject headings listed second, third, etc. The difference between adjusted values for various subject orders was

significantly different at the 0.001 level. Regression analysis did not provide a recognizable pattern of variations in DDC notations with respect to the increment in the order of LC Subject Headings.

The retrieved records were analyzed for the cases when both order and number of LC Subject Headings per bibliographic records vary. In all groups of bibliographic records with more than one LC Subject Heading per bibliographic record, there was a higher association between LC Subject Headings and DDC notations for subject headings listed first in the records than succeeding headings. However, between all subject headings with the same order but from different groups of records, there was no meaningful difference.

6. The data were analyzed with respect to each main class of the DDC system to determine if there was any significant difference between the Library of Congress Subject Headings and their corresponding Dewey Decimal Classification notations in the ten main classes of DDC. The analysis of association was repeated for each DDC main class, and the results showed that the difference between DDC main classes was significant at the 0.001 level. Class '900' (History and Geography), with a probability of 67 per cent, had the highest, and Class '300' (Social Sciences), with a probability of 55 per cent, had the lowest association.

7. The data were sorted by classification notation to test hypothesis number seven, in order to verify whether

there was any meaningful difference in the measures of association when a different order of sort keys is used to sort and analyze data. In other words, the effects of the subject catalog and the shelf list catalog arrangements on measuring the association between LC Subject Headings and their corresponding class notations were tested to verify the significance difference between an alphabetical and a classified subject catalog. To simulate a shelf list catalog, the data were sorted first by class notation, then alphabetically by subject heading, then by the number of subject headings per bibliographic record, and finally by the order of subject headings in the bibliographic records. The class notations were considered to be the independent variable and the subject headings dependent upon the variation in class notations.

The comparison of the alphabetically sorted subject list and the classified list showed that the probability of having identical class notations for identical subject headings in the alphabetically sorted subject list (subject card catalog) was higher than having such in the classified list (shelf list catalog); the differences between the adjusted values in both lists were significant at the 0.001 level. The order analysis in both sorted lists showed that except for the subject headings listed first in the bibliographic records, the differences between values of subject headings with a different order of listing in bibliographic records for both

lists were not significantly different. However, the probability values in the alphabetically sorted subject list were higher than the corresponding values in the classified list.

8. The same analysis was done to compare the alphabetically sorted subject list and the DDC sorted list. As in the case of LCC, the difference between the two sorted lists was significant at the 0.001 level in bibliographic records with a different number of subject headings. The difference between order of subject headings in both lists was significant for subject headings listed first and second in the bibliographic records, but was not significant for the subject headings listed third or more in the bibliographic records.

The above two analyses indicated that in both sort forms and in the two classification systems the bibliographic records with a single LC Subject Heading had a significantly higher association than those with more than one heading. The comparison of the lists with different sort keys indicated that the order of sort keys had a significant effect on the magnitude of association between subject headings and their corresponding class notations; that is, not only the number of subject headings per bibliographic record had an effect on the degree of association, but the selection of the sort keys for sorting data had a significant effect on the degree of association between variables.

9. The values of the association between LC Subject Headings and their corresponding class notations for the Library of Congress Classification and Dewey Decimal Classification systems were compared to determine if any statistically significant difference existed between association measures for LCSH and LCC and those for LCSH and DDC. The hypothesis for this part stated that there was a significant difference between these two classification systems in this respect.

The comparison of the two classification systems with respect to the measures of association in this study indicated that the association between LC Subject Headings and their corresponding LCC notations and the association of the same subject headings with their corresponding DDC notations were significantly different at the 0.001 level in bibliographic records with a different number of subject headings per bibliographic record. However, with respect to the order of subject headings in the bibliographic records, the two classification systems were significantly different for the subject headings listed first and second in the bibliographic records, but not significant for the subject headings listed third or more. The association measures for LCC notations were always higher than the corresponding values for the DDC notations.

Similarly, the values for the order analysis in both classification systems were compared to verify if they were

statistically different from each other. The chi square test of difference for the adjusted values showed that the difference between the two classification systems was significant at the 0.001 level only in subject headings listed first or second, but not for the subject headings listed third, fourth, etc.

Conclusions

1. The two parts of the first hypothesis were found to be true: There is a significant difference in degree of association between the Library of Congress Subject Headings and their corresponding class notations among bibliographic records with a different number of subject headings per bibliographic record, and the probability of having identical class notations for identical subject headings in single-heading bibliographic records is significantly higher than in multiple-heading bibliographic records. As the number of subject headings per bibliographic record increases, the degree of association between subject headings and corresponding class notations, DDC or LCC, decreases. The fact that the probability of having identical class notations for identical subject headings in single-subject headings is not 100 per cent suggests that the same notation is not consistently used for the same subject headings.

2. The two parts of the second hypothesis were ac-

cepted; that is, there is significantly more agreement between class notations and subject headings listed first in multiple-heading bibliographic records than the same subject headings not listed first in such records. The degree of association between LC Subject Headings and their corresponding LCC or DDC notations decreases as the order of subject headings listed in bibliographic records increases.

3. The third hypothesis was also accepted, that is, that there is a statistically significant difference between the probability of having identical class notations for identical subject headings in bibliographic records for documents classed in different divisions of knowledge. In both classification systems there is a significant difference between the main classes of the Library of Congress and the Dewey Decimal Classifications. In the Library of Congress Classification main classes, Class 'T' (Technology) had the highest association, and Class 'A' (General Works) had the lowest levels of association. Similarly, in the Dewey Decimal Classification, Class '900' (History and Geography) had the highest association, and Class '300' (Social Sciences) had the lowest levels of association.

4. Hypothesis number four was partly accepted. There is a difference between probability of having identical class notations for identical subject headings in bibliographic records selected from an alphabetically arranged subject catalog and a classified catalog. However, this difference

is statistically significant only for bibliographic records with a single subject heading or subject headings listed first or second in bibliographic records.

5. Finally, the fifth hypothesis was also partially accepted. The probability of having identical class notations for identical subject headings in bibliographic records for documents classed in the Library of Congress Classification is significantly different from that of the ones classed in the Dewey Decimal Classification. However, the difference is statistically significant only for bibliographic records with one subject heading and for subject headings listed first in multiple-heading bibliographic records; for all other cases the difference is not statistically significant. That is, the measures of association differ significantly in the two classification systems if the bibliographic records have only one subject heading or if one considers only the first subject headings listed in the multiple-heading records, but the two classification systems do not significantly differ when one considers bibliographic records with more than two subject headings or subject headings listed as the second, third or more subject in the records.

Applications of Findings

Although this research falls within the realm of basic research--and thus immediate applications were not its prime focus--there are several potential applications for the findings of this study:

1. The study showed that the probability of having identical class notations for identical subject headings in single-heading bibliographic records is not 100 per cent. This indicates that classification notations are not consistently assigned to subject headings. Work should be done to remove such inconsistency by improving the vocabularies of the indexes to the two classification systems so that they match with the actual subject headings used to represent the content of a document.

2. A clear guideline should be developed for cases in which a work deals with multiple subjects or a subject is treated from several different points of view, but there is not a comprehensive subject heading or a class notation to cover all the topics in or all points of view of the subjects covered in the document. The findings of this study suggest that in such cases the class notation could be the one which represents the first subject heading in the bibliographic record.

3. This study showed that there is a significant relationship between the number of subject headings per bibliographic record and the association of of the subject headings with their corresponding class notations. The measure of probabilities can be used as a basis to develop an algorithm to assign classification notation to a subject heading or several subject headings based on the past occurrence of such headings in a large database--of the past ten years, perhaps--of bibliographic records.

4. The fact that subject headings listed first have a higher association with their corresponding class notations suggests that in advising patrons to browse, the suggested notation may be that one which corresponds to the subject headings listed first, because that would be the one which would more likely represent the desired class notation. Furthermore, in manual subject catalogs, or dictionary catalogs, identical subject headings are subarranged by the main entry in the bibliographic records. According to this study it would be more logical to subarrange them by the number of subject headings per bibliographic record and by the order of the subject headings in the record, because in doing so patrons would be directed to class notations which would more likely be associated with the subject headings they are searching.

5. The results of this study indicate that the degree of association between the Library of Congress Subject

Headings and their corresponding LCC and DDC notations vary significantly in different main classes of both classification systems. This means that some main classes are less specific in using terms than the others, and work should be done to improve those main classes of LCC or DDC which have a lower association.

Recommendations for Further Research

1. The present study was concerned with the association between the Library of Congress Subject Headings and their coorresponding class notations. During the processing of data and analyzing the results, a number of ideas for further research came to the author's attention which may be shared with readers.

2. This study used frequency counts for subject headings and class notations without differentiating what subjects are being counted. In other words, what was considered was the form and not the substance of each heading. Therefore, it is possible that the subject headings in one group of bibliographic records may not necessarily be the same headings in another group. There was no control to select identical subject headings in four groups. The results may be different if one provides such a control and imposes some restriction on sampling to ensure selection of identical subject headings in the four groups of biblio-

graphic records. The findings of such research could be more generalized because of the elimination of subject inequality effects.

3. In the present study, subject headings were defined operationally in such a way that each subject heading could be differentiated from any other heading by a single character. Therefore, 'Buildings--Terminal Properties' and 'Building--Terminal Properties--Testing' were considered to be two different subject headings. However, it is possible to define a cluster of subject headings with the same root and to study them as a family of subject headings rather than considering them individually--in other words, developing a more intelligent program to not only compare each subject heading with its following heading but to identify subject headings that are related to each other and can be considered as the member of the same family.

4. In present study, bibliographic records were selected and grouped according to the number of subject headings per bibliographic record. Therefore, the unit for selecting subject headings for the database in this study was a bibliographic record and not the subject heading itself. Therefore, the number of subject headings in each group was not equal. Switching the unit of sample from bibliographic records to subject headings themselves would help to have an equal number of subject headings in each group of study. In other words, instead of the four groups used in this study,

in a future study one could have at least ten $(1+2+3+4=10)$ groups.

5. An experimental research study could be designed in such a way that the computer would perform the following steps: (1) Search for all headings in a given document in a database, such as the one used in this study; and (2) find the corresponding class notations for all of them. Then (3), based on the order of headings and probability of occurrence of class notations for each subject, it could assign a class notation to a document, then finally, (4) compare that with the actual class notation assigned by a human classifier to determine if there is any pattern which could be used for automatic classification.

6. In this study the association between the Library of Congress Subject Headings and their corresponding Library of Congress Classification and Dewey Decimal Classification notations was measured. There are other subject heading lists, such as Sears Subject Headings, which are used by other libraries. The same analysis could be done for other subject heading lists and the results compared with the findings in this study to determine what differences if any, exists between them.

7. Similarly, there are other classification schedules, such as Universal Decimal Classification, Colon Classification, etc. , that are used by some other libraries outside the United States. The same analysis may be applied for

other classification systems and the results could be compared with the findings for the two classifications in this study.

8. Using the method described in this study, one may generate an index for either LCC or DDC and create a specific alaphabetical listing of LC Subject Headings with their equivalent LCC or DDC notations. The effectiveness of such classified lists for both library users and library professionals can be studied. Such an index would be a list similar to appendix B or C, except that repetition of subject headings and codes would not be necessary.

9. Finally, the same method of frequency counts can be used to generate all possible class notations corresponding to subject headings and the retrieved notations for each subject heading can be arranged from the most frequent to the less frequent notations, then, whenever a subject heading is assigned to a document the most frequent class notation corresponding to it can be considered as the notation which is assigned as the main notation--which could be used for the shelf arrangement as well--and depending on the number of topics disscussed in that document, other notations could be used in an online environment as additional access points for retrieving the same document. This could be a practical method for determining possible class notations corresponding to subject headings used in the catalog. The recall and precision of documents retrieved by this method could be com-

pared with other methods of document retrieval to test its effectiveness.

LCC NOTATIONS	DDC NOTATIONS	LIBRARY OF CONGRESS SUBJECT HEADINGS	LCSH CODES
HF5629.	170.9657	ACCOUNTANTS, PROFESSIONAL ETHICS FOR	
AM7	061.64	MUSEUMS--ACCREDITATION	
QA76.5	001.64	ELECTRONIC DATA PROCESSING--CONGRESSES	
QA76.5	001.64	ELECTRONIC DIGITAL COMPUTERS--CONGRESSES	
QA76.5	001.64	ELECTRONIC DATA PROCESSING	
QA76.5	001.5023	DIGITAL COMPUTER SIMULATION	
P91.5023	001.5023	DIGITAL COMPUTER SIMULATION--CONGRESSES	
P91.5023	001.5023	COMMUNICATION--VOCATIONAL GUIDANCE	
P91.5023	001.5023	GRAPHIC ARTS--VOCATIONAL GUIDANCE	
P91.5023	001.5023	GRAPHIC ARTS--VOCATIONAL GUIDANCE--JUVENILE LITERATURE	
P91.202	001.5023	COMMUNICATION--VOCATIONAL GUIDANCE	
QA76.5	001.5023	VOCATIONAL GUIDANCE	
QA76.5	001.64	GRAPHIC ARTS AS A PROFESSION	
QA76.5	001.64	MINICOMPUTERS--JUVENILE LITERATURE	
QA76.5	001.64	MICROCOMPUTERS--JUVENILE LITERATURE	
QA76.5	001.64	ELECTRONIC DATA PROCESSING--JUVENILE LITERATURE	
QA76.5	001.64	MINICOMPUTERS	
QA76.5	001.64	MICROCOMPUTERS	
QA76.5	001.5436	COMPUTERS	
QA76.5	001.5436	COMPUTERS	
Z103	001.5436	ELECTRONIC DATA PROCESSING	
Z103.5	001.5436	CRYPTOGRAPHY--JUVENILE LITERATURE	
Z103.5	001.5436	CIPHERS--JUVENILE LITERATURE	
AM101	001.5436	CRYPTOGRAPHY	
AM101	954.008	CIPHERS	
AM101	954.008	COINS, ISLAMIC--INDIA--DECCAN	
AM101	954.008	COIN HOARDS--MEDAK (DISTRICT)	
AM101	954.008	COINS, INDIC--DECCAN, INDIA	
AS36	954.008	GOLD COINS--INDIA--DELHI (SULTANATE)	
AS36	954.008	SILVER COINS--INDIA	
AS36	954.008	DELHI (SULTANATE)	
AS36	081	MEDAK (DISTRICT)--ANTIQUITIES	
AS36	081	ANDHRA PRADESH GOVERNMENT MUSEUM, HYDERABAD, INDIA	
AS36	081	MEDICAL COLLEGES--UNITED STATES--ADMISSION	
AS36	081	AFFIRMATIVE ACTION PROGRAMS--UNITED STATES	
AS36	081	UNITED STATES--HEALTH RESOURCES ADMINISTRATION	
AS36	081	MINORITIES IN MEDICINE--UNITED STATES	
AS36	081	DISCRIMINATION IN MEDICAL EDUCATION--UNITED STATES	
AS36	081	EDUCATION, MEDICAL--UNITED STATES	
AS36	081	SCHOOLS, MEDICAL--UNITED STATES	
AS36	081	EDUCATIONAL MEASUREMENT	
AS35	081	MINORITY GROUPS--EDUCATION--UNITED STATES	

LCC NOTATIONS	DOC NOTATIONS	LIBRARY OF CONGRESS SUBJECT HEADINGS	LCSH CODES
BD111	110	METAPHYSICS	3
BD111	110	BUCHLER, JUSTUS, 1914- --METAPHYSICS OF NATURAL COMPLEXES	3
BD111	110	ORDER (PHILOSOPHY)	3
AS36	610	MEDICAL COLLEGES--UNITED STATES--ADMISSION--MATHEMATICAL MODELS	3
AS36	610	MEDICAL COLLEGE APPLICANTS--UNITED STATES--MATHEMATICAL MODELS	3
AS36	610	OUT-OF-STATE STUDENTS--UNITED STATES--MATHEMATICAL MODELS	3
AS36	610	HEALTH ATTITUDES--TESTING	3
AS36	610	HEALTH ATTITUDES--ADDRESSES, ESSAYS, LECTURES	3
AS36	610	VALUES--TESTING--ADDRESSES, ESSAYS, LECTURES	3
AS36	610	HEALTH SURVEYS--UNITED STATES--ADDRESSES, ESSAYS, LECTURES	4
AS36	610	HEALTH ATTITUDES--UNITED STATES--ADDRESSES, ESSAYS, LECTURES	4
QA76.73.C25	001.6424	COBOL (COMPUTER PROGRAM LANGUAGE)	2
QA76.73.C25	001.6424	COBOL (COMPUTER PROGRAM LANGUAGE)	2
QA76.73.C25	001.642	STRUCTURED PROGRAMMING	2
KF27	353.007223584	ACTION (SERVICE CORPS)--APPROPRIATIONS AND EXPENDITURES	4
QA76.5	001.6403321	MICROCOMPUTERS--DICTIONARIES	4
QA76.5	001.6403321	MICROCOMPUTERS--DICTIONARIES	4
QA76.5	001.6403321	ENGLISH LANGUAGE--DICTIONARIES--GERMAN	4
QA76.5	001.6403321	MICROCOMPUTERS--DICTIONARIES--GERMAN	4
QA76.5	001.6403321	GERMAN LANGUAGE--DICTIONARIES--ENGLISH	4
F1038	971.6	ACADIA--HISTORY	4
DC718.A44	309.436	AMERICANS IN PARIS	2
DC718.A44	309.436	PARIS--INTELLECTUAL LIFE--20TH CENTURY--HISTORY AND CRITICISM	2
QA76.73.M23	001.6424	AMERICAN LITERATURE--20TH CENTURY	3
QA76.73.M23	001.6424	MACROS (COMPUTER PROGRAM LANGUAGE)	3
QA76.6	001.6424	ELECTRONIC DIGITAL COMPUTERS--PROGRAMMING	3
QA76.9.D35	519.4	DATA STRUCTURES (COMPUTER SCIENCE)	3
BC135	511.3	LOGIC, SYMBOLIC AND MATHEMATICAL	3
Q179.9	001.4	RESEARCH--CONGRESSES	3
Z665.A25	001.64	BIBLIOGRAPHY--CONGRESSES	3
QA76.9.A25	001.64	COMPUTERS--ACCESS CONTROL--CONGRESSES	3
QA76.9.A25	001.64	PRIVACY, RIGHT OF--CONGRESSES	3
QA76.9.D3	001.64	DATA BASE MANAGEMENT--CONGRESSES	3
HF5635	657	ACCOUNTING	1
Z733.A25	001.2	TEXAS--UNIVERSITY AT AUSTIN--HUMANITIES RESEARCH CENTER	2
Z733.A25	001.2	LEARNING AND SCHOLARSHIP--TEXAS	2
KF3771.A6	344.7304	ABORTION--LAW AND LEGISLATION--UNITED STATES	1
QA76.73	001	ECSS (COMPUTER PROGRAM LANGUAGE)	3
AS36	610	PETROLEUM INDUSTRY AND TRADE--MEXICO	3
AS36	610	UNITED STATES--FOREIGN ECONOMIC RELATIONS--MEXICO	3
AS36	610	MEXICO--FOREIGN ECONOMIC RELATIONS--UNITED STATES	3
QA279	434	INCOMPLETE BLOCK DESIGNS	1
QA76.73.B3	6424	BASIC (COMPUTER PROGRAM LANGUAGE)	1
QA76.9.F38	642	FAULT-TOLERANT COMPUTING	1
QA76.6	642	MICROPROCESSORS--PROGRAMMING	2
QA76.6	642	ASSEMBLER LANGUAGE (COMPUTER PROGRAM LANGUAGE)	2
HF5661	657.3076	ACCOUNTING--PROBLEMS, EXERCISES, ETC.	2

A SAMPLE OF SUBJECT CATALOG SIMULATION

SLSORT (LIST NO L)

LIBRARY OF CONGRESS SUBJECT HEADINGS	LCC NOTATIONS	LCS# CODES
ACCOUNTANTS	HG3701.J5	1
ACCOUNTANTS, PROFESSIONAL ETHICS FOR	HF5616.J5	1
ACCOUNTANTS, PROFESSIONAL ETHICS FOR	HF5628.P47	1
ACCOUNTANTS, PROFESSIONAL ETHICS FOR	HF5627	1
ACCOUNTANTS, PROFESSIONAL ETHICS FOR--ADDRESSES, ESSAYS, LECTURES	HF5628.J7	1
ACCOUNTANTS--AUSTRALIA	KFN3208.125	1
ACCOUNTANTS--LEGAL STATUS, LAWS, ETC --NEBRASKA	KE2620.3	1
ACCOUNTANTS--LEGAL STATUS, LAWS, ETC --UNITED STATES	HF5616.J5.J5	1
ACCOUNTANTS--LEGAL STATUS, LAWS, ETC --UNITED STATES--HISTORY	HF5616.J3.43	1
ACCOUNTANTS--MONTANA--DIRECTORIES	KF6369.21	1
ACCOUNTANTS--UNITED STATES	HF5616.J5	1
ACCOUNTANTS--UNITED STATES--BIOGRAPHY	HF5616.J5	1
ACCOUNTANTS--UNITED STATES--HANDBOOKS, MANUALS, ETC.	HF5616.J5	1
ACCOUNTANTS--UNITED STATES--HISTORY	HF5616.J5	1
ACCOUNTING	HF5635	1
ACCOUNTING	HF5635	1
ACCOUNTING	HF5635	1
ACCOUNTING	HF5635	1
ACCOUNTING	HF5635	1
ACCOUNTING	HF5635	1
ACCOUNTING	HF5635	1
ACCOUNTING	HF5635	1
ACCOUNTING	HF5635	1
ACCOUNTING	HF5635	1
ACCOUNTING	HF5635	1
ACCOUNTING	HF5635	1
ACCOUNTING	HF5635	1
ACCOUNTING	HF5635	1
ACCOUNTING	HF5635	1
ACCOUNTING	HF5635	1
ACCOUNTING	HF5535	1

LIBRARY OF CONGRESS SUBJECT HEADINGS	LCC NOTATIONS	LCSH CODES
ACCOUNTING	HF5635	21
ACCOUNTING	HF5635	21
ACCOUNTING	HF5635	21
ACCOUNTING	HF5635	21
ACCOUNTING	HF5635	21
ACCOUNTING	HF5635	21
ACCOUNTING	HF5635	21
ACCOUNTING	HF5635	21
ACCOUNTING	HF5635	31
ACCOUNTING	HF5635	31
ACCOUNTING	HF5635.A57	31
ACCOUNTING	HF5635.A57	31
ACCOUNTING	HF5635.A57	31
ACCOUNTING	HF5635.A42	31
ACCOUNTING	HF5635.A42	31
ACCOUNTING	HF5681.A32	31
ACCOUNTING	HF5681.A32	31
ACCOUNTING	HF5681.A32	31
ACCOUNTING	HF5681.A57.2756	31
ACCOUNTING AND PRICE FLUCTUATIONS	HF5681.P8	32
ACCOUNTING--ADDRESSES, ESSAYS, LECTURES	HF5629.A1-.A2	31
ACCOUNTING--CANADA--HANDBOOKS, MANUALS, ETC.	HF5616.C3	32
ACCOUNTING--CASE STUDIES	HF5635	31
ACCOUNTING--CONGRESSES	HF5603	31
ACCOUNTING--DATA PROCESSING	HF5679	31
ACCOUNTING--DATA PROCESSING	HF5679	31
ACCOUNTING--DATA PROCESSING	HF5679	31
ACCOUNTING--DATA PROCESSING	HF5679	31
ACCOUNTING--EFFECT OF INFLATION ON	HF5681.P8	31
ACCOUNTING--EFFECT OF INFLATION ON	HF5681.P8	31
ACCOUNTING--EFFECT OF INFLATION ON	HF5681.P8	31
ACCOUNTING--EFFECT OF INFLATION ON--ADDRESSES, ESSAYS, LECTURES	HF5657	31
ACCOUNTING--ENGLAND--HISTORY	HF5616.G7	31
ACCOUNTING--EXAMINATIONS, QUESTIONS, ETC.	HF5661	31
ACCOUNTING--EXAMINATIONS, QUESTIONS, ETC.	HF5661	31
ACCOUNTING--EXAMINATIONS, QUESTIONS, ETC.	HF5661	31
ACCOUNTING--EXAMINATIONS, QUESTIONS, ETC.	HF5661	31
ACCOUNTING--EXAMINATIONS, QUESTIONS, ETC.	HF5661	31
ACCOUNTING--FORMS	HF5635	31
ACCOUNTING--GREAT BRITAIN--HISTORY--ADDRESSES, ESSAYS, LECTURES	HF5581.32	32
ACCOUNTING--INDEXES	HF5635.A57	31
ACCOUNTING--LAW AND LEGISLATION--EUROPEAN ECONOMIC COMMUNITY COUNTRIES	Z7164.C81	32
ACCOUNTING--LAW AND LEGISLATION--GREAT BRITAIN--HISTORY	HG3231.G7	31
ACCOUNTING--LAW AND LEGISLATION--UNITED STATES--CONGRESSES	HG3215.J5	31
ACCOUNTING--LAW--GERMANY, WEST	HF5616.J5	31
ACCOUNTING--MATHEMATICAL MODELS	HF5635	31
ACCOUNTING--NEW ZEALAND--EFFECT OF INFLATION ON	HF5635.V4	31

A SAMPLE OF SUBJECT CATALOG SIMULATION

SDSORT (LIST NO. 2)

LIBRARY OF CONGRESS SUBJECT HEADINGS	DDC NOTATIONS	LCSH CODES
ACCOUNTANTS, PROFESSIONAL ETHICS FOR	332.7427	
ACCOUNTANTS, PROFESSIONAL ETHICS FOR	174.9657	
ACCOUNTANTS, PROFESSIONAL ETHICS FOR	174.9657	
ACCOUNTANTS, PROFESSIONAL ETHICS FOR	658.15	
ACCOUNTANTS, PROFESSIONAL ETHICS FOR—ADDRESSES, ESSAYS, LECTURES	174.9657	
ACCOUNTANTS—AUSTRALIA	657.0233	
ACCOUNTANTS—LEGAL STATUS, LAWS, ETC.—NEBRASKA	346.73042	
ACCOUNTANTS—LEGAL STATUS, LAWS, ETC.—UNITED STATES	346.73042	
ACCOUNTANTS—LEGAL STATUS, LAWS, ETC.—UNITED STATES—HISTORY	657.025795	
ACCOUNTANTS—MONTANA—DIRECTORIES	658.15	
ACCOUNTANTS—UNITED STATES—BIOGRAPHY	657.7352575	
ACCOUNTANTS—UNITED STATES—HANDBOOKS, MANUALS, ETC.	343.73042	
ACCOUNTANTS—UNITED STATES—HISTORY	343.730175155702	
ACCOUNTING		
ACCOUNTING		
ACCOUNTING		
ACCOUNTING		
ACCOUNTING		
ACCOUNTING		
ACCOUNTING		
ACCOUNTING	657	
ACCOUNTING	657	
ACCOUNTING	657	
ACCOUNTING	657	
ACCOUNTING	657	
ACCOUNTING	657	
ACCOUNTING	657	
ACCOUNTING	657	
ACCOUNTING	657	
ACCOUNTING	657	
ACCOUNTING	657	
ACCOUNTING	657	
ACCOUNTING	657.0245	
ACCOUNTING	657.0245	
ACCOUNTING	657.0245	
ACCOUNTING	657.0245	

LIBRARY OF CONGRESS SUBJECT HEADINGS	DDC NOTATIONS	LCSH CODES
ACCOUNTING	657.044	
ACCOUNTING	657.044	
ACCOUNTING	657.045	
ACCOUNTING	657.045	
ACCOUNTING	657.045	
ACCOUNTING	657.3	
ACCOUNTING	657.33	
ACCOUNTING	657.48	
ACCOUNTING	657.48	
ACCOUNTING	657.48	
ACCOUNTING	657.9042	
ACCOUNTING	657.9042	
ACCOUNTING	657.96	
ACCOUNTING	657.48	
ACCOUNTING AND PRICE FLUCTUATIONS	658.1511	
ACCOUNTING--ADDRESSES, ESSAYS, LECTURES	658.15114	
ACCOUNTING--CANADA--HANDBOOKS, MANUALS, ETC.	657.48	
ACCOUNTING--CASE STUDIES	657.30771	
ACCOUNTING--CONGRESSES	657.3075	
ACCOUNTING--DATA PROCESSING	657.0285	
ACCOUNTING--DATA PROCESSING	657.0285	
ACCOUNTING--DATA PROCESSING	657.0285	
ACCOUNTING--DATA PROCESSING	657.0285	
ACCOUNTING--EFFECT OF INFLATION ON	657.48	
ACCOUNTING--EFFECT OF INFLATION ON	657.48	
ACCOUNTING--EFFECT OF INFLATION ON	657.48	
ACCOUNTING--EFFECT OF INFLATION ON	657.48	
ACCOUNTING--EFFECT OF INFLATION ON--ADDRESSES, ESSAYS, LECTURES	657.48	
ACCOUNTING--ENGLAND--HISTORY	657.0941	
ACCOUNTING--EXAMINATIONS, QUESTIONS, ETC.	657.076	
ACCOUNTING--EXAMINATIONS, QUESTIONS, ETC.	657.076	
ACCOUNTING--EXAMINATIONS, QUESTIONS, ETC.	657.076	
ACCOUNTING--EXAMINATIONS, QUESTIONS, ETC.	657.076	
ACCOUNTING--EXAMINATIONS, QUESTIONS, ETC.	657.076	
ACCOUNTING--FORMS	657.075	
ACCOUNTING--GREAT BRITAIN--HISTORY--ADDRESSES, ESSAYS, LECTURES	657.3	
ACCOUNTING--INDEXES	174.9657	
ACCOUNTING--LAW AND LEGISLATION--EUROPEAN ECONOMIC COMMUNITY COUNTRIES	016.657	
ACCOUNTING--LAW AND LEGISLATION--GREAT BRITAIN--HISTORY	657.3	
ACCOUNTING--LAW AND LEGISLATION--UNITED STATES--CONGRESSES	657.0943	
ACCOUNTING--LAW--GERMANY, WEST	657.0943	
ACCOUNTING--MATHEMATICAL MODELS	657.3093	
ACCOUNTING--NEW ZEALAND--EFFECT OF INFLATION ON	657.49	

APPENDIX D

A SAMPLE OF LSSORI LIST NO. 3D, CC SHELF LIST CATALOG SIMULATION

LC NOTATIONS	LIBRARY OF CONGRESS SUBJECT HEADINGS	LCSH CODES
AC1	POPULAR CULTURE--ADDRESSES, ESSAYS, LECTURES	21
AC5	HUGO, HAROLD--ADDRESSES, ESSAYS, LECTURES	21
AC70	ARCHITECTURE--ADDRESSES, ESSAYS, LECTURES	22
AC70	ARCHITECTURE, MODERN--17TH-18TH CENTURIES--SPAIN--MADRID (PROVINCE)	22
AC8	CHURCH ARCHITECTURE--SPAIN--MADRID (PROVINCE)	22
AC8	MYTHOLOGY, HINDU--COLLECTED WORKS	21
AC8	SOCIOLOGY--COLLECTED WORKS	22
AE5	SOCIOLOGY--UNITED STATES	21
AE5	VEDAS--CRITICISM, INTERPRETATION, ETC.--COLLECTED WORKS	11
AE5	ENCYCLOPEDIAS AND DICTIONARIES	11
AE5	ENCYCLOPEDIAS AND DICTIONARIES	11
AE5	ENCYCLOPEDIAS AND DICTIONARIES	31
AG105	DRUGS--THERAPY--HISTORY	32
AG105	MEDICINE, PRIMITIVE	11
AG105	RECIPES	11
AG1850	CURIOSITIES AND WONDERS	11
AG243	CURIOSITIES AND WONDERS	11
AG243	CURIOSITIES AND WONDERS	31
AG243	CURIOSITIES AND WONDERS	22
AG243	CURIOSITIES AND WONDERS	22
AG243	CURIOSITIES AND WONDERS	22
AG243	CURIOSITIES AND WONDERS	21
AG243	CURIOSITIES AND WONDERS	21
AG243	CURIOSITIES AND WONDERS--JUVENILE LITERATURE	31
AG243	CURIOSITIES AND WONDERS--JUVENILE LITERATURE	22
AG243	CURIOSITIES AND WONDERS--JUVENILE LITERATURE	22
AG243	CURIOSITIES AND WONDERS--JUVENILE LITERATURE	21
AG243	CURIOSITIES AND WONDERS--JUVENILE LITERATURE	21
AG243	CURIOSITIES AND WONDERS--JUVENILE LITERATURE	21
AG243	PROBABILITIES--POPULAR WORKS	22

LC NOTATIONS	LIBRARY OF CONGRESS SUBJECT HEADINGS	LCSH CODES
AG243	SEVEN (THE NUMBER)--JUVENILE LITERATURE	42
AG243	ENCYCLOPEDIAS AND DICTIONARIES, FRENCH	11
AG25	ENCYCLOPEDIAS AND DICTIONARIES, FRENCH	21
AG25	FRENCH LANGUAGE--DICTIONARIES	22
AG25	ENCYCLOPEDIAS AND DICTIONARIES, GERMAN	11
AG27	CHILDREN'S ENCYCLOPEDIAS AND DICTIONARIES	11
AG5	ENCYCLOPEDIAS AND DICTIONARIES	11
AG513	CLIPPING BUREAUS	66
AG6	AMUSEMENTS	65
AG6	AMUSEMENTS--JUVENILE LITERATURE	42
AG6	BIRDS--JUVENILE LITERATURE	42
AG6	BIRDS--JUVENILE LITERATURE	43
AG6	BOATS AND BOATING	42
AG6	BOATS AND BOATING--JUVENILE LITERATURE	43
AG6	CIVILIZATION, ANCIENT	11
AG6	CIVILIZATION, ANCIENT--JUVENILE LITERATURE	42
AG6	EARTH	13
AG6	EARTH--JUVENILE LITERATURE	42
AG6	ENCYCLOPEDIAS AND DICTIONARIES	11
AG6	ETHNOLOGY	11
AG6	ETHNOLOGY--JUVENILE LITERATURE	42
AG6	GEOGRAPHY	22
AG6	LET'S DISCOVER--INDEXES	22
AG6	LET'S DISCOVER--INDEXES--JUVENILE LITERATURE	22
AG6	MACHINERY	11
AG6	MACHINERY--JUVENILE LITERATURE	42
AG6	MAMMALS	11
AG6	MAMMALS--JUVENILE LITERATURE	42
AG6	MAN, PREHISTORIC	43
AG6	MAN, PREHISTORIC--JUVENILE LITERATURE	42
AG6	MANNERS AND CUSTOMS	11
AG6	MANNERS AND CUSTOMS--JUVENILE LITERATURE	42
AG6	OCCUPATIONS	22
AG6	OCCUPATIONS--JUVENILE LITERATURE	21
AG6	OCEAN	22
AG6	OCEAN--JUVENILE LITERATURE	21
AG6	OUTER SPACE	22
AG6	OUTER SPACE--JUVENILE LITERATURE	43
AG6	PHYSICAL GEOGRAPHY--JUVENILE LITERATURE	62
AG6	RECREATION	65
AG6	RECREATION--JUVENILE LITERATURE	41
AG6	SHIPS	13
AG6	SHIPS--JUVENILE LITERATURE	54
AG6	SPORTS	

A SAMPLE OF SDSORT (LIST NO. 4) DDC SHELF LIST CATALOG SIMULATION

DDC NOTATIONS	LIBRARY OF CONGRESS SUBJECT HEADINGS	LCSH CODES
051	COMMUNICATION--HISTORY	
301	LEARNING AND SCHOLARSHIP--UNITED STATES	
001.12	SCIENCE AND THE HUMANITIES	
001.C12	BIOLOGY--CLASSIFICATION	
001.C12	BIOLOGY--CLASSIFICATION	
001·012	NATURAL HISTORY--CLASSIFICATION--JUVENILE LITERATURE	
001·012	NATURAL HISTORY--CLASSIFICATION--JUVENILE LITERATURE	
001·1	INTELLECTUAL LIFE--ADDRESSES, ESSAYS, LECTURES	
001·12	LEARNING AND SCHOLARSHIP--ADDRESSES, ESSAYS, LECTURES	
001·12	LEARNING AND SCHOLARSHIP--FRANCE--CONGRESSES	
001·12	LEARNING AND SCHOLARSHIP--TEXAS	
001·12	REFORMATION	
001·2 23324	TEXAS--UNIVERSITY AT AUSTIN --HUMANITIES RESEARCH CENTER	
001·2 203324	AUTHORS, ENGLISH--20TH CENTURY--BIOGRAPHY	
001·2 203924	GERMANY--BIOGRAPHY	
001·2 203924	JAMES, MONTAGUE RHODES, 1862-1936	
001·2 203924	KIRCHER, ATHANASIUS, 1602-1680	
001·2 203924	SCHOLARS--ENGLAND--BIOGRAPHY	
001·2 203324	BOOKS--MISCELLANEA	
001·3	HUMANITIES	
001·3	HUMANITIES	
001·3	HUMANITIES	
001·3	HUMANITIES	
001·3	HUMANITIES--CONGRESSES	
001·3	LITERATURE--MISCELLANEA	
001·3	HUMANITIES--MISCELLANEA	
001·3	SCIENCE--CONGRESSES	
001·3	UNITED STATES--INTELLECTUAL LIFE	
001·3	UNITED STATES--INTELLECTUAL LIFE	
001·3 382573	HUMANITIES--RESEARCH--UNITED STATES--CONGRESSES	
001·3 382573	HUMANITIES--RESEARCH--UNITED STATES--DIRECTORIES	
001·3 382854	HUMANITIES--DATA PROCESSING	
001·30712241	EDUCATION--CURRICULUM--GREAT BRITAIN	
001·30712481	HUMANITIES--CURRICULUM PROJECT	
001·303843	HUMANITIES--RESEARCH--NORWAY	
001·303843	GERMANY--CIVILIZATION--CONGRESSES	
001·309843	HUMANITIES--CIVILIZATION	
001·309843	PHILOSOPHY--CONGRESSES	
001·309435	RENAISSANCE--CONGRESSES	
001·3094435	AMERICAN LITERATURE--20TH CENTURY--HISTORY AND CRITICISM	
001·3094435	AMERICAN LITERATURE--20TH CENTURY--HISTORY AND CRITICISM	

DDC NOTATIONS	LIBRARY OF CONGRESS SUBJECT HEADINGS	LCSH CODES
001.3094436	AMERICAN LITERATURE--20TH CENTURY--HISTORY AND CRITICISM	
001.3094435	AMERICANS IN PARIS	
001.3094436	AMERICANS IN PARIS	
001.3094436	AMERICANS IN PARIS	
001.3094435	PARIS--INTELLECTUAL LIFE	
001.3094436	PARIS--INTELLECTUAL LIFE	
001.3094436	PARIS--INTELLECTUAL LIFE	
001.3094436	ARTS--UNITED STATES--CONGRESSES	
001.309973	HUMANITIES--UNITED STATES--CONGRESSES	
001.30973	UNITED STATES--INTELLECTUAL LIFE--CONGRESSES	
001.3973	BIBLIOGRAPHY--CONGRESSES	
001.4	EVALUATION	
001.4	EVALUATION--METHODOLOGY	
001.4	INFORMATION SERVICES--UNITED STATES	
001.4	REPORT WRITING--CONGRESSES	
001.4	RESEARCH--HANDBOOKS, MANUALS, ETC.	
001.4025753	MANUALS, ETC.; MOVING-PICTURES--INFORMATION SERVICES--WASHINGTON, D.C.--DIRECTORIES	
001.4025753	TELEVISION BROADCASTING--INFORMATION SERVICES--WASHINGTON, D.C.--DIRECTORIES	
001.4094428	RESEARCH--FRANCE--NORD (DEPT.)	
001.4094428	UNIVERSITIES AND COLLEGES--FRANCE--NORD (DEPT.)	
001.4097917	ARIZONA--UNIVERSITY	
001.4097917	RESEARCH--ARIZONA	
001.42	DIGITAL COMPUTER SIMULATION	
001.42	FORECASTING--ADDRESSES, ESSAYS, LECTURES	
001.42	INFORMATION SERVICES--USER EDUCATION	
001.42	OPERATIONS RESEARCH--ADDRESSES, ESSAYS, LECTURES	
001.42	QUEUING THEORY--ADDRESSES, ESSAYS, LECTURES	
001.42	RESEARCH--METHODOLOGY	
001.42	RESEARCH--METHODOLOGY	
001.42	STATISTICAL COMMUNICATION THEORY--ADDRESSES, ESSAYS, LECTURES	
001.422	CARTOGRAPHY--DATA PROCESSING--STUDY AND TEACHING--ADDRESSES, ESSAYS, LECTURES	
001.422	INCOME FORECASTING--UNITED STATES	
001.4222	MATHEMATICAL FORECASTING--UNITED STATES	
001.4222	MATHEMATICAL STATISTICS--CONGRESSES	
001.4222	POPULATION FORECASTING--UNITED STATES	
001.4222	SAMPLING (STATISTICS)--ADDRESSES, ESSAYS, LECTURES	
001.4222	STATISTICS	
001.4222	UNITED STATES--CENSUS, 19TH, 1970	
001.4222	UNITED STATES--CENSUS--MATHEMATICAL MODELS	
001.4222	BIRTH INTERVALS--INDONESIA--CASE STUDIES	
001.4222	BIRTH INTERVALS--INDONESIA--NJAGLIK	
001.4222	CENSUS	
001.4222	CENSUS--TERMINOLOGY	

TABLE 41
Probability and Correlation between LCSH and LCC
in All Classes of the Library of Congress
Classification

LCSH Groups	LCSH Orders	LCSH Frequency	LCC Frequency	p	r	Significance of r
ALL	ALL	61766	27188	0.44	0.0085	.113
ALL	1	21754	16373	0.75	0.44	.001
ALL	2	10259	4649	0.45	0.71	.001
ALL	3	19259	1603	0.47	0.89	.001
ALL	4	924	515	0.56	0.74	.001
1	ALL	6142	5010	0.82	0.74	.001
2	ALL	11400	6939	0.61	0.82	.001
3	ALL	7476	4036	0.54	0.91	.001
4	ALL	4070	2587	0.64	0.82	.001
1	1	6142	5010	0.82	0.74	.001
2	1	4844	4089	0.84	0.74	.001
2	2	4469	2391	0.54	0.83	.001
3	1	1933	1669	0.86	0.93	.001
3	2	1570	1017	0.65	0.79	.001
3	3	1770	956	0.54	0.95	.001
4	1	772	701	0.91	0.81	.001
4	2	656	509	0.78	0.78	.001
4	3	616	476	0.77	0.91	.001
4	4	679	471	0.69	0.98	.001

TABLE 42
Probability and Correlation between LCSH and LCC
in Class: A (General Works)

LCSH Groups	LCSH Orders	LCSH Frequency	LCC Frequency	p	r	Significance of r
ALL	ALL	537	145	0.27	0.034	.312
ALL	1	127	53	0.42	0.93	.001
ALL	2	70	23	0.38	0.55	.001
ALL	3	23	5	0.27	0.67	.001
ALL	4	7	3	0.43	0.60	.001
1	ALL	29	20	0.69	0.98	.001
2	ALL	69	31	0.45	0.26	.001
3	ALL	49	12	0.25	0.25	.001
4	ALL	41	13	0.32	0.59	.001
1	1	29	20	0.69	0.98	.001
2	1	21	17	0.61	0.88	.001
2	2	32	16	0.50	0.83	.001
3	1	8	2	0.25	0.73	.001
3	2	7	2	0.29	0.45	.001
3	3	8	2	0.25	1.00	.001
4	1	7	3	0.83	0.99	.001
4	2	5	3	0.60	0.09	.001
4	3	3	3	1.00	*	.001
4	4	5	3	0.60	0.99	.001

* Uncomputable

TABLE 43
Probability and Correlation between LCSH and LCC
in Class: B (Philosophy, Psychology, Religion)

LCSH Groups	LCSH Orders	LCSH Frequency	LCC Frequency	p	r	Significance of r
ALL	ALL	5709	2150	0.38	0.014	.277
ALL	1	2006	1481	0.74	0.61	.001
ALL	2	926	323	0.35	0.68	.001
ALL	3	323	107	0.33	0.85	.001
ALL	4	71	34	0.48	0.51	.001
1	ALL	625	516	0.83	0.70	.001
2	ALL	981	577	0.59	0.68	.001
3	ALL	624 ·	282	0.45	0.95	.001
4	ALL	351	160	0.46	0.86	.001
1	1	625	516	0.83	0.70	.001
2	1	434	389	0.90	0.72	.001
2	2	373	167	0.45	0.81	.001
3	1	164	131	0.80	0.97	.001
3	2	126	73	0.58	0.64	.001
3	3	159	68	0.43	0.93	.001
4	1	69	59	0.85	0.65	.001
4	2	55	32	0.58	0.77	.001
4	3	46	26	0.57	0.93	.001
4	4	54	30	0.55	0.85	.001

TABLE 44
Probability and Correlation between LCSH and LCC
in Class: C (Auxiliary Sciences of History)

LCSH Groups	LCSH Orders	LCSH Frequency	LCC Frequency	p	r	Significance of r
ALL	ALL	699	226	0.32	0.72	.001
ALL	1	214	137	0.64	0.64	.001
ALL	2	167	61	0.37	0.65	.001
ALL	3	28	16	0.57	0.81	.001
ALL	4	11	4	0.36	0.72	.001
1	ALL	66	52	0.79	0.44	.001
2	ALL	149	72	0.48	0.84	.001
3	ALL	80	38	0.47	0.94	.001
4	ALL	29	18	0.62	0.67	.001
1	1	66	52	0.79	0.44	.001
2	1	45	33	0.73	0.99	.001
2	2	91	39	0.43	0.99	.001
3	1	15	13	0.87	0.99	.001
3	2	15	6	0.40	0.99	.001
3	3	20	14	0.70	0.99	.001
4	1	4	4	1.00	0.99	.001
4	2	4	4	1.00	0.99	.001
4	3	4	4	1.00	0.99	.001
4	4	9	4	0.44	0.99	.001

TABLE 45
Probability and Correlation between LCSH and LCC
in Class: D (Hisory: General and Old World)

LCSH Groups	LCSH Orders	LCSH Frequency	LCC Frequency	p	r	Significance of r
ALL	ALL	4168	1721	0.39	0.0003	.495
ALL	1	1349	986	0.73	0.33	.001
ALL	2	645	254	0.39	0.70	.001
ALL	3	260	103	0.40	0.88	.001
ALL	4	93	47	0.51	0.69	.001
1	ALL	319	258	0.81	0.64	.001
2	ALL	574	300	0.52	0.73	.001
3	ALL	519	247	0.48	0.87	.001
4	ALL	291	172	0.59	0.74	.001
1	1	319	258	0.81	0.64	.001
2	1	236	181	0.77	0.33	.001
2	2	199	99	0.50	0.80	.001
3	1	126	105	0.83	0.92	.001
3	2	107	61	0.57	0.60	.001
3	3	138	64	0.46	0.91	.001
4	1	47	43	0.91	0.91	.001
4	2	40	34	0.85	0.74	.001
4	3	43	37	0.86	0.85	.001
4	4	67	43	0.64	0.99	.001

TABLE 46
Probability and Correlation between LCSH and LCC
in Class: E (History: America)

LCSH Groups	LCSH Orders	LCSH Frequency	LCC Frequency	p	r	Significance of r
ALL	ALL	1775	661	0.37	0.004	.465
ALL	1	367	285	0.78	0.59	.001
ALL	2	266	122	0.46	0.68	.001
ALL	3	141	54	0.38	0.85	.001
ALL	4	61	25	0.41	0.77	.001
1	ALL	56	48	0.86	0.56	.001
2	ALL	168	113	0.67	0.85	.001
3	ALL	180	70	0.39	0.97	.001
4	ALL	222	125	0.39	0.93	.001
1	1	56	48	0.86	0.56	.001
2	1	69	57	0.83	0.75	.001
2	2	68	46	0.68	0.85	.001
3	1	29	27	0.93	0.92	.001
3	2	34	19	0.56	0.81	.001
3	3	57	24	0.42	0.99	.001
4	1	38	36	0.95	0.99	.001
4	2	40	28	0.70	0.44	.001
4	3	34	21	0.62	0.95	.001
4	4	43	23	0.53	0.73	.001

TABLE 47
Probability and Correlation between LCSH and LCC
in Class: F (History: United States)

LCSH Groups	LCSH Orders	LCSH Frequency	LCC Frequency	p	r	Significance of r
ALL	ALL	1587	814	0.51	0.005	.445
ALL	1	395	339	0.86	0.41	.001
ALL	2	230	146	0.63	0.79	.001
ALL	3	130	60	0.46	0.95	.001
ALL	4	26	22	0.85	0.75	.001
1	ALL	60	57	0.95	0.84	.001
2	ALL	213	171	0.80	0.98	.001
3	ALL	201	107	0.53	0.99	.001
4	ALL	134	96	0.72	0.89	.001
1	1	60	57	0.95	0.84	.001
2	1	84	76	0.90	0.75	.001
2	2	82	66	0.80	0.85	.001
3	1	41	35	0.85	0.99	.001
3	2	35	26	0.74	0.75	.001
3	3	58	29	0.50	0.99	.001
4	1	25	24	0.96	0.71	.001
4	2	25	22	0.88	0.93	.001
4	3	28	22	0.79	0.95	.001
4	4	20	20	1.00	0.99	.001

TABLE 48
Probability and Correlation between LCSH and LCC
in Class: G (Geography, Anthropology, Recreation)

LCSH Groups	LCSH Orders	LCSH Frequency	LCC Frequency	p	r	Significance of r
ALL	ALL	2302	1053	0.46	0.0134	.344
ALL	1	806	644	0.80	0.46	.001
ALL	2	425	204	0.48	0.79	.001
ALL	3	140	69	0.49	0.90	.001
ALL	4	29	20	0.69	0.81	.001
1	ALL	275	231	0.84	0.75	.001
2	ALL	467	295	0.63	0.83	.001
3	ALL	294	168	0.57	0.88	.001
4	ALL	125	72	0.58	0.84	.001
1	1	275	231	0.84	0.75	.001
2	1	189	161	0.85	0.83	.001
2	2	217	120	0.55	0.79	.001
3	1	62	58	0.94	0.95	.001
3	2	75	59	0.79	0.80	.001
3	3	85	48	0.56	0.98	.001
4	1	20	20	1.00	0.99	.001
4	2	18	16	0.89	0.84	.001
4	3	22	16	0.73	0.56	.001
4	4	20	18	0.90	1.00	.001

TABLE 49
Probability and Correlation between LCSH and LCC
in Class: H (Social Sciences)

LCSH Groups	LCSH Orders	LCSH Frequency	LCC Frequency	p	r	Significance of r
ALL	ALL	11279	4353	0.39	0.0032	.424
ALL	1	3816	2832	0.74	0.49	.001
ALL	2	1845	750	0.41	0.64	.001
ALL	3	635	264	0.42	0.85	.001
ALL	4	162	79	0.49	0.74	.001
1	ALL	881	728	0.83	0.76	.001
2	ALL	2178	1249	0.57	0.82	.001
3	ALL	1676	836	0.50	0.94	.001
4	ALL	733	389	0.53	0.80	.001
1	1	881	728	0.83	0.76	.001
2	1	934	777	0.83	0.79	.001
2	2	755	384	0.51	0.75	.001
3	1	435	383	0.88	0.94	.001
3	2	286	177	0.62	0.82	.001
3	3	352	176	0.50	0.98	.001
4	1	135	125	0.93	0.74	.001
4	2	110	86	0.78	0.84	.001
4	3	106	75	0.71	0.98	.001
4	4	127	78	0.61	0.89	.001

TABLE 50
Probability and Correlation between LCSH and LCC
in Class: J (Political Science)

LCSH Groups	LCSH Orders	LCSH Frequency	LCC Frequency	p	r	Significance of r
ALL	ALL	1853	730	0.39	0.318	.001
ALL	1	746	484	0.65	0.46	.001
ALL	2	324	111	0.34	0.79	.001
ALL	3	100	36	0.36	0.86	.001
ALL	4	18	12	0.66	0.66	.001
1	ALL	208	156	0.75	0.74	.001
2	ALL	362	185	0.51	0.63	.001
3	ALL	226	112	0.50	0.94	.001
4	ALL	101	62	0.61	0.77	.001
1	1	208	156	0.75	0.74	.001
2	1	146	122	0.84	0.78	.001
2	2	150	61	0.41	0.82	.001
3	1	54	44	0.81	0.95	.001
3	2	49	32	0.65	0.81	.001
3	3	64	26	0.41	0.84	.001
4	1	28	24	0.86	0.84	.001
4	2	14	10	0.71	0.75	.001
4	3	17	10	0.59	0.98	.001
4	4	16	12	0.75	0.17	.001

TABLE 51
Probability and Correlation between LCSH and LCC
in Class: K (Law)

LCSH Groups	LCSH Orders	LCSH Frequency	LCC Frequency	p	r	Significance of r
ALL	ALL	2840	1107	0.39	0.0067	.414
ALL	1	1080	614	0.57	0.25	.001
ALL	2	445	217	0.49	0.75	.001
ALL	3	133	70	0.53	0.85	.001
ALL	4	34	23	0.68	0.75	.001
1	ALL	323	218	0.68	0.84	.001
2	ALL	530	259	0.49	0.76	.001
3	ALL	326	170	0.52	0.93	.001
4	ALL	177	110	0.62	0.80	.001
1	1	323	218	0.68	0.84	.001
2	1	222	135	0.61	0.73	.001
2	2	190	97	0.51	0.84	.001
3	1	69	53	0.77	0.85	.001
3	2	61	38	0.62	0.74	.001
3	3	72	42	0.58	0.86	.001
4	1	33	27	0.82	0.82	.001
4	2	28	22	0.79	0.72	.001
4	3	24	22	0.92	0.80	.001
4	4	44	23	0.82	0.82	.001

TABLE 52
Probability and Correlation between LCSH and LCC
in Class: L (Education)

LCSH Groups	LCSH Orders	LCSH Frequency	LCC Frequency	p	r	Significance of r
ALL	ALL	1578	704	0.45	0.0075	.443
ALL	1	678	543	0.80	0.65	.001
ALL	2	284	99	0.35	0.82	.001
ALL	3	68	23	0.34	0.95	.001
ALL	4	10	8	0.80	0.75	.001
1	ALL	222	197	0.89	0.58	.001
2	ALL	379	209	0.55	0.47	.001
3	ALL	150	75	0.47	0.99	.001
4	ALL	90	57	0.63	0.85	.001
1	1	222	197	0.89	0.58	.001
2	1	164	141	0.86	0.79	.001
2	2	154	66	0.43	0.86	.001
3	1	47	47	1.00	0.93	.001
3	2	22	12	0.55	0.87	.001
3	3	33	12	0.36	0.99	.001
4	1	17	17	1.00	0.81	.001
4	2	16	12	0.75	0.69	.001
4	3	17	11	0.65	0.99	.001
4	4	10	8	0.80	0.89	.001

TABLE 53
Probability and Correlation between LCSH and LCC
in Class: M (Music)

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LCSH Groups	LCSH Orders	LCSH Frequency	LCC Frequency	p	r	Significance of r
ALL	ALL	883	409	0.46	0.0012	.491
ALL	1	372	271	0.73	0.33	.001
ALL	2	239	90	0.38	0.76	.001
ALL	3	27	14	0.38	0.89	.001
ALL	4	5	4	0.81	0.72	.001
1	ALL	118	93	0.79	0.98	.001
2	ALL	328	192	0.59	0.98	.001
3	ALL	75	34	0.45	0.90	.001
4	ALL	24	16	0.67	0.75	.001
1	1	118	93	0.79	0.98	.001
2	1	116	99	0.85	0.78	.001
2	2	167	71	0.43	0.97	.001
3	1	22	12	0.66	0.88	.001
3	2	18	8	0.44	0.69	.001
3	3	17	10	0.59	0.99	.001
4	1	4	4	1.00	0.71	.001
4	2	8	4	1.00	0.13	.001
4	3	5	4	0.80	0.79	.001
4	4	5	4	0.80	1.00	.001

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TABLE 54
Probability and Correlation between LCSH and LCC
in Class: N (Fine Arts)

LCSH Groups	LCSH Orders	LCSH Frequency	LCC Frequency	p	r	Significance of r
ALL	ALL	1774	732	0.41	0.0016	.483
ALL	1	579	370	0.64	0.83	.001
ALL	2	416	179	0.43	0.72	.001
ALL	3	97	57	0.59	0.86	.001
ALL	4	16	10	0.63	0.63	.001
1	ALL	153	109	0.71	0.50	.001
2	ALL	386	187	0.48	0.93	.001
3	ALL	269	159	0.59	0.88	.001
4	ALL	84	56	0.67	0.72	.001
1	1	153	109	0.71	0.50	.001
2	1	129	96	0.74	0.76	.001
2	2	189	82	0.43	0.69	.001
3	1	72	58	0.81	0.92	.001
3	2	79	56	0.71	0.59	.001
3	3	67	39	0.58	0.94	.001
4	1	14	12	0.86	0.85	.001
4	2	15	12	0.80	0.15	.001
4	3	12	10	0.83	0.90	.001
4	4	12	8	0.67	0.0087	.409

TABLE 55
Probability and Correlation between LCSH and LCC
in Class: P (Language and Literature)

LCSH Groups	LCSH Orders	LCSH Frequency	LCC Frequency	p	r	Significance of r
ALL	ALL	5494	2271	0.41	0.0273	.129
ALL	1	2320	1482	0.64	0.29	.001
ALL	2	1071	417	0.39	0.66	.001
ALL	3	245	112	0.46	0.87	.001
ALL	4	61	36	0.59	0.66	.001
1	ALL	930	586	0.63	0.77	.001
2	ALL	1204	669	0.56	0.81	.001
3	ALL	527	253	0.48	0.89	.001
4	ALL	325	213	0.66	0.82	.001
1	1	930	586	0.63	0.77	.001
2	1	467	385	0.82	0.61	.001
2	2	591	269	0.46	0.89	.001
3	1	133	96	0.72	0.94	.001
3	2	120	66	0.55	0.71	.001
3	3	129	60	0.47	0.90	.001
4	1	64	50	0.78	0.43	.001
4	2	64	38	0.59	0.84	.001
4	3	47	41	0.87	0.80	.001
4	4	48	34	0.71	0.91	.001

TABLE 56
Probability and Correlation between LCSH and LCC
in Class: Q (Science)

LCSH Groups	LCSH Orders	LCSH Frequency	LCC Frequency	p	r	Significance of r
ALL	ALL	6515	2907	0.44	0.0059	.392
ALL	1	2080	1645	0.79	0.59	.001
ALL	2	1078	482	0.45	0.75	.001
ALL	3	405	190	0.47	0.84	.001
ALL	4	100	52	0.52	0.78	.001
1	ALL	613	541	0.88	0.71	.001
2	ALL	1072	681	0.64	0.80	.001
3	ALL	897	454	0.51	0.88	.001
4	ALL	446	307	0.69	0.90	.001
1	1	613	541	0.88	0.71	.001
2	1	445	405	0.89	0.75	.001
2	2	406	243	0.60	0.84	.001
3	1	205	177	0.86	0.96	.001
3	2	194	118	0.61	0.87	.001
3	3	194	109	0.56	0.93	.001
4	1	78	70	0.90	0.87	.001
4	2	74	58	0.78	0.67	.001
4	3	75	60	0.80	0.91	.001
4	4	70	52	0.74	0.82	.001

TABLE 57
Probability and Correlation between LCSH and LCC
in Class: R (Medicine)

LCSH Groups	LCSH Orders	LCSH Frequency	LCC Frequency	p	r	Significance of r
ALL	ALL	6545	3573	0.55	0.0112	.298
ALL	1	1782	1502	0.84	0.35	.001
ALL	2	934	549	0.59	0.75	.001
ALL	3	448	249	0.56	0.87	.001
ALL	4	168	96	0.57	0.83	.001
1	ALL	219	210	0.96	0.76	.001
2	ALL	833	655	0.79	0.87	.001
3	ALL	740	556	0.75	0.98	.001
4	ALL	646	516	0.80	0.96	.001
1	1	219	210	0.96	0.76	.001
2	1	379	343	0.91	0.99	.001
2	2	256	183	0.71	0.99	.001
3	1	243	225	0.93	0.99	.001
3	2	169	137	0.82	0.99	.001
3	3	167	118	0.71	0.99	.001
4	1	133	129	0.97	0.99	.001
4	2	98	85	0.87	0.99	.001
4	3	82	68	0.83	0.99	.001
4	4	96	75	0.78	0.99	.001

TABLE 58
Probability and Correlation between LCSH and LCC
in Class: S (Agriculture)

LCSH Groups	LCSH Orders	LCSH Frequency	LCC Frequency	p	r	Significance of r
ALL	ALL	939	518	0.55	0.0015	.448
ALL	1	293	239	0.82	0.40	.001
ALL	2	163	102	0.63	0.78	.001
ALL	3	56	24	0.43	0.92	.001
ALL	4	8	6	0.75	0.85	.001
1	ALL	68	63	0.93	0.42	.001
2	ALL	194	138	0.71	0.93	.001
3	ALL	91	65	0.71	0.99	.001
4	ALL	60	44	0.73	0.87	.001
1	1	68	63	0.93	0.42	.001
2	1	86	73	0.85	0.84	.001
2	2	84	59	0.70	0.85	.001
3	1	22	22	1.00	0.95	.001
3	2	24	18	0.75	0.91	.001
3	3	19	12	0.63	0.99	.001
4	1	11	11	1.00	0.99	.001
4	2	10	8	0.80	0.0973	.024
4	3	14	12	0.86	0.91	.001
4	4	8	6	0.75	0.99	.001

TABLE 59
Probability and Correlation between LCSH and LCC
in Class: T (Technology)

LCSH Groups	LCSH Orders	LCSH Frequency	LCC Frequency	p	r	Significance of r
ALL	ALL	4190	2497	0.60	0.0146	.285
ALL	1	2109	1833	0.87	0.66	.001
ALL	2	663	404	0.61	0.79	.001
ALL	3	160	115	0.72	0.96	.001
ALL	4	34	20	0.59	0.85	.001
1	ALL	797	746	0.94	0.79	.001
2	ALL	1103	727	0.66	0.91	.001
3	ALL	478	334	0.70	0.98	.001
4	ALL	126	97	0.77	0.87	.001
1	1	797	746	0.94	0.79	.001
2	1	512	456	0.89	0.89	.001
2	2	410	254	0.62	0.91	.001
3	1	147	140	0.95	0.98	.001
3	2	108	87	0.81	0.83	.001
3	3	117	85	0.73	0.99	.001
4	1	26	26	1.00	0.79	.001
4	2	21	21	1.00	0.84	.001
4	3	18	16	0.89	0.99	.001
4	4	24	16	0.67	1.00	.001

TABLE 60
Probability and Correlation between LCSH and LCC
in Class: U (Military Science)

LCSH Groups	LCSH Orders	LCSH Frequency	LCC Frequency	p	r	Significance of r
ALL	ALL	362	173	0.48	0.0147	.431
ALL	1	120	91	0.76	0.82	.001
ALL	2	51	27	0.53	0.68	.001
ALL	3	18	10	0.56	0.90	.001
ALL	4	11	6	0.55	0.75	.001
1	ALL	31	29	0.94	0.70	.001
2	ALL	52	35	0.58	0.86	.001
3	ALL	42	17	0.41	0.99	.001
4	ALL	52	32	0.62	0.63	.001
1	1	31	29	0.94	0.70	.001
2	1	18	13	0.72	0.61	.001
2	2	15	8	0.53	0.71	.001
3	1	5	5	1.00	0.99	.001
3	2	6	2	0.29	0.70	.001
3	3	6	2	0.50	*	.001
4	1	9	7	0.78	0.99	.001
4	2	7	6	0.86	0.71	.001
4	3	8	6	0.75	*	.001
4	4	11	6	0.55	1.00	.001

* Uncomputable

TABLE 61
Probability and Correlation between LCSH and LCC
in Class: V (Naval Science)

LCSH Groups	LCSH Orders	LCSH Frequency	LCC Frequency	p	r	Significance of r
ALL	ALL	151	66	0.44	0.66	.001
ALL	1	64	44	0.69	0.80 ·	.001
ALL	2	27	11	0.41	0.20	.001
ALL	3	9	3	0.33	0.57	.001
ALL	4	0	0	0.00	0.00	.000
1	ALL	12	10	0.83	0.99	.001
2	ALL	27	17	0.63	0.29	.397
3	ALL	14	8	0.57	1.00	.001
4	ALL	0	0	0.00	0.00	.000
1	1	12	10	0.83	0.99	.001
2	1	11	11	1.00	0.15	.001
2	2	8	6	0.75	0.82	.001
3	1	4	4	1.00	1.00	.001
3	2	4	2	0.50	1.00	.001
3	3	4	2	0.50	*	.001
4	1	0	0	0.00	*	.001
4	2	0	0	0.00	*	.001
4	3	0	0	0.00	*	.001
4	4	0 ·	0	0.00	*	.001

* Uncomputable

TABLE 62
Probability and Correlation between LCSH and LCC
in Class: Z (Bibliography)

LCSH Groups	LCSH Orders	LCSH Frequency	LCC Frequency	p	r	Significance of r
ALL	ALL	1048	599	0.57	0.0043	.465
ALL	1	418	343	0.82	0.28	.001
ALL	2	178	111	0.62	0.75	.001
ALL	3	56	34	0.61	0.96	.001
ALL	4	12	10	0.83	0.78	.001
1	ALL	128	112	0.88	0.81	.001
2	ALL	241	188	0.78	0.99	.001
3	ALL	131	80	0.61	0.99	.001
4	ALL	58	52	0.90	0.92	.001
1	1	128	112	0.88	0.81	.001
2	1	114	101	0.89	0.83	.001
2	2	87	65	0.75	0.92	.001
3	1	33	30	0.91	0.99	.001
3	2	32	22	0.54	0.90	.001
3	3	37	20	0.54	0.99	.001
4	1	10	10	1.00	0.50	.001
4	2	10	10	1.00	0.71	.001
4	3	13	12	0.92	0.98	.001
4	4	12	10	0.83	1.00	.001

TABLE 63
Probability and Correlation between LCSH and DDC in
Class: All Classes

LCSH Groups	LCSH Orders	LCSH Frequency	DDC Frequency	p	r	Significance of r
ALL	ALL	61744	24535	0.40	0.0097	.084
ALL	1	20652	12649	0.61	0.45	.001
ALL	2	9956	4678	0.47	0.68	.001
ALL	3	3348	1572	0.47	0.81	.001
ALL	4	888	502	0.57	0.73	.001
1	ALL	5841	4530	0.78	0.76	.001
2	ALL	11096	6434	0.58	0.81	.001
3	ALL	7355	3734	0.51	0.88	.001
4	ALL	3978	2441	0.61	0.78	.001
1	1	5841	4530	0.78	0.76	.001
2	1	4383	3159	0.72	0.78	.001
2	2	4337	2502	0.58	0.84	.001
3	1	1687	1242	0.73	0.86	.001
3	2	1557	992	0.74	0.80	.001
3	3	1686	953	0.64	0.87	.001
4	1	677	560	0.83	0.86	.001
4	2	627	488	0.78	0.79	.001
4	3	623	461	0.74	0.93	.001
4	4	658	446	0.68	0.91	.001

TABLE 64
Probability and Correlation between LCSH and DDC in
Class: 000 (Generalities)

LCSH Groups	LCSH Orders	LCSH Frequency	DDC Frequency	p	r	Significance of r
ALL	ALL	3024	1151	0.38	0.0167	.284
ALL	1	1026	641	0.63	0.44	.001
ALL	2	497	239	0.48	0.67	.001
ALL	3	146	62	0.43	0.76	.001
ALL	4	27	13	0.48	0.76	.001
1	ALL	311	257	0.83	0.74	.001
2	ALL	602	348	0.58	0.64	.001
3	ALL	372	192	0.52	0.58	.001
4	ALL	158	71	0.45	0.95	.001
1	1	311	257	0.83	0.64	.001
2	1	252	185	0.73	0.86	.001
2	2	242	146	0.60	0.69	.001
3	1	88	64	0.73	0.86	.001
3	2	85	55	0.65	0.76	.001
3	3	81	47	0.58	0.92	.001
4	1	25	15	0.60	0.91	.001
4	2	21	15	0.71	0.84	.001
4	3	25	13	0.52	0.90	.001
4	4	25	13	0.52	0.70	.001

TABLE 65
Probability and Correlation between LCSH and DDC in
Class: 100 (Philosophy & Related Disciplines)

LCSH Groups	LCSH Orders	LCSH Frequency	DDC Frequency	p	r	Significance of r
ALL	ALL	2834	919	0.32	0.0001	.500
ALL	1	894	534.	0.60	0.44	.001
ALL	2	448	164	0.37	0.63	.001
ALL	3	151	51	0.34	0.86	.001
ALL	4	38	19	0.50	0.79	.001
1	ALL	274	217	0.79	0.53	.001
2	ALL	439	253	0.58	0.67	.001
3	ALL	293	126	0.43	0.95	.001
4	ALL	198	105	0.53	0.84	.001
1	1	274	217	0.79	0.53	.001
2	1	178	140	0.79	0.60	.001
2	2	171	95	0.56	0.83	.001
3	1	66	45	0.68	0.94	.001
3	2	52	28	0.53	0.75	.001
3	3	60	33	0.55	0.77	.001
4	1	30	25	0.83	0.99	.001
4	2	24	18	0.75	0.59	.001
4	3	34	17	0.50	0.90	.001
4	4	28	19	0.68	0.91	.001

TABLE 66
Probability and Correlation between LCSH and DDC in
Class: 200 (Religion)

LCSH Groups	LCSH Orders	LCSH Frequency	DDC Frequency	p	r	Significance of r
ALL	ALL	3199	1270	0.40	0.01	.407
ALL	1	1136	673	0.59	0.50	.001
ALL	2	508	254	0.50	0.66	.001
ALL	3	162	72	0.44	0.86	.001
ALL	4	36	18	0.50	0.74	.001
1	ALL	356	224	0.63	0.71	.001
2	ALL	611	379	0.62	0.72	.001
3	ALL	342	187	0.55	0.90	.001
4	ALL	167	88	0.53	0.86	.001
1	1	356	224	0.63	0.71	.001
2	1	259	194	0.75	0.77	.001
2	2	228	142	0.62	0.76	.001
3	1	84	66	0.79	0.92	.001
3	2	76	52	0.68	0.83	.001
3	3	81	48	0.59	0.82	.001
4	1	28	24	0.86	0.89	.001
4	2	32	26	0.81	0.89	.001
4	3	20	14	0.70	0.96	.001
4	4	28	14	0.50	0.82	.001

TABLE 67
Probability and Correlation between LCSH and DDC in
Class: 300 (Social Sciences)

LCSH Groups	LCSH Orders	LCSH Frequency	DDC Frequency	p	r	Significance of r
ALL	ALL	20762	6521	0.31	0.0031	.397
ALL	1	6363	3508	0.55	0.31	.001
ALL	2	3196	1215	0.38	0.63	.001
ALL	3	1140	427	0.37	0.80	.001
ALL	4	280	152	0.54	0.71	.001
1	ALL	1480	1110	0.75	0.60	.001
2	ALL	3466	1617	0.47	0.80	.001
3	ALL	2645	1116	0.42	0.91	.001
4	ALL	1385	734	0.53	0.77	.001
1	1	1480	1110	0.75	0.60	.001
2	1	1349	871	0.65	0.71	.001
2	2	1254	551	0.44	0.81	.001
3	1	561	384	0.68	0.86	.001
3	2	489	286	0.58	0.72	.001
3	3	555	258	0.46	0.88	.001
4	1	235	191	0.81	0.80	.001
4	2	208	160	0.77	0.77	.001
4	3	203	137	0.67	0.96	.001
4	4	220	139	0.63	0.90	.001

TABLE 68
Probability and Correlation between LCSH and DDC in
Class: 400 (Language)

LCSH Groups	LCSH Orders	LCSH Frequency	DDC Frequency	p	r	Significance of r
ALL	ALL	1109	472	0.43	0.0001	.355
ALL	1	428	274	0.65	0.40	.001
ALL	2	200	98	0.49	0.68	.001
ALL	3	52	21	0.40	0.91	.001
ALL	4	16	15	0.94	0.76	.001
1	ALL	131	106	0.81	0.62	.001
2	ALL	245	153	0.62	0.90	.001
3	ALL	123	55	0.45	0.93	.001
4	ALL	91	68	0.75	0.99	.001
1	1	131	106	0.81	0.62	.001
2	1	101	83	0.82	0.90	.001
2	2	103	64	0.62	0.98	.001
3	1	29	22	0.76	0.93	.001
3	2	20	12	0.60	0.75	.001
3	3	23	8	0.34	0.97	.001
4	1	16	16	1.00	0.99	.001
4	2	17	13	0.76	0.48	.001
4	3	14	12	0.86	0.99	.001
4	4	14	13	0.93	1.00	.001

TABLE 69
Probability and Correlation between LCSH and DDC in
Class: 500 (Pure Sciences)

LCSH Groups	LCSH Orders	LCSH Frequency	DDC Frequency	p	r	Significance of r
ALL	ALL	5234	1898	0.36	0.014	.271
ALL	1	1639	989	0.60	0.59	.001
ALL	2	810	336	0.42	0.62	.001
ALL	3	295	131	0.44	0.82	.001
ALL	4	74	33	0.46	0.67	.001
1	ALL	500	418	0.84	0.77	.001
2	ALL	831	462	0.56	0.73	.001
3	ALL	678	288	0.43	0.79	.001
4	ALL	330	183	0.56	0.82	.001
1	1	500	418	0.84	0.77	.001
2	1	330	236	0.72	0.70	.001
2	2	326	180	0.55	0.76	.001
3	1	128	89	0.70	0.90	.001
3	2	155	73	0.47	0.70	.001
3	3	146	80	0.55	0.81	.001
4	1	49	37	0.75	0.66	.001
4	2	55	33	0.60	0.71	.001
4	3	55	41	0.75	0.76	.001
4	4	47	33	0.70	0.85	.001

TABLE 70
Probability and Correlation between LCSH and DDC in
Class: 600 (Technology: Applied Sciences)

LCSH Groups	LCSH Orders	LCSH Frequency	DDC Frequency	p	r	Significance of r
ALL	ALL	12082	5793	0.48	0.003	.436
ALL	1	4055	2660	0.66	0.46	.001
ALL	2	1864	1004	0.54	0.72	.001
ALL	3	670	370	0.55	0.85	.001
ALL	4	213	126	0.59	0.81	.001
1	ALL	1052	868	0.83	0.76	.001
2	ALL	2188	1424	0.65	0.83	.001
3	ALL	1370	872	0.64	0.95	.001
4	ALL	834	632	0.76	0.88	.001
1	1	1052	868	0.83	0.76	.001
2	1	883	691	0.78	0.87	.001
2	2	783	499	0.64	0.91	.001
3	1	362	296	0.82	0.93	.001
3	2	311	229	0.74	0.85	.001
3	3	317	210	0.66	0.94	.001
4	1	147	128	0.87	0.88	.001
4	2	131	110	0.84	0.84	.001
4	3	119	101	0.85	0.94	.001
4	4	137	105	0.77	0.92	.001

TABLE 71
Probability and Correlation between LCSH and DDC in
Class: 700 (The Arts)

LCSH Groups	LCSH Orders	LCSH Frequency	DDC Frequency	p	r	Significance of r
ALL	ALL	4809	2303	0.48	0.1124	.301
ALL	1	1816	1166	0.64	0.65	.001
ALL	2	1004	563	0.56	0.80	.001
ALL	3	243	138	0.57	0.88	.001
ALL	4	40	26	0.65	0.79	.001
1	ALL	601	472	0.79	0.70	.001
2	ALL	1235	769	0.62	0.43	.001
3	ALL	598	322	0.54	0.91	.001
4	ALL	182	133	0.73	0.86	.001
1	1	601	472	0.79	0.70	.001
2	1	440	321	0.73	0.71	.001
2	2	572	371	0.65	0.74	.001
3	1	146	103	0.71	0.89	.001
3	2	147	96	0.65	0.89	.001
3	3	155	90	0.58	0.76	.001
4	1	33	31	0.94	0.76	.001
4	2	31	28	0.90	0.67	.001
4	3	38	34	0.89	0.99	.001
4	4	25	22	0.88	0.72	.001

TABLE 72
Probability and Correlation between LCSH and DDC in
Class: 800 (Literature--Belles-Lettres)

LCSH Groups	LCSH Orders	LCSH Frequency	DDC Frequency	p	r	Significance of r
ALL	ALL	3552	1620	0.46	0.041	.088
ALL	1	1506	914	0.61	0.65	.001
ALL	2	676	312	0.46	0.76	.001
ALL	3	144	75	0.52	0.84	.001
ALL	4	39	25	0.64	0.82	.001
1	ALL	672	449	0.67	0.75	.001
2	ALL	741	447	0.60	0.89	.001
3	ALL	323	180	0.56	0.89	.001
4	ALL	180	102	0.57	0.84	.001
1	1	672	449	0.67	0.75	.001
2	1	259	202	0.78	0.41	.001
2	2	378	217	0.57	0.59	.001
3	1	69	46	0.67	0.30	.001
3	2	66	43	0.65	0.84	.001
3	3	81	54	0.66	0.91	.001
4	1	31	20	0.65	0.71	.001
4	2	31	20	0.65	0.99	.001
4	3	20	16	0.80	0.87	.001
4	4	32	22	0.69	0.93	.001

TABLE 73
Probability and Correlation between LCSH and DDC in
Class: 900 (General Geography & History)

LCSH Groups	LCSH Orders	LCSH Frequency	DDC Frequency	p	r	Significance of r
ALL	ALL	5998	2931	0.49	0.005	.406
ALL	1	1892	1269	0.67	0.25	.001
ALL	2	896	519	0.58	0.74	.001
ALL	3	397	232	0.58	0.86	.001
ALL	4	137	81	0.59	0.77	.001
1	ALL	475	383	0.81	0.76	.001
2	ALL	842	580	0.69	0.82	.001
3	ALL	696	432	0.62	0.90	.001
4	ALL	492	332	0.67	0.88	.001
1	1	475	383	0.81	0.76	.001
2	1	354	252	0.71	0.79	.001
2	2	333	241	0.72	0.79	.001
3	1	160	127	0.79	0.82	.001
3	2	156	118	0.76	0.92	.001
3	3	207	131	0.63	0.86	.001
4	1	86	75	0.87	0.91	.001
4	2	82	69	0.84	0.80	.001
4	3	95	72	0.76	0.86	.001
4	4	109	72	0.66	0.85	.001

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1981." Library Resources & Technical Services 26
(July-September 1982): 263-76.

VITA OF ABOLGHASEM (SAM) KHOSH-KHUI

EDUCATION

Ph.D., May 1985, Indiana University, Bloomington, Indiana, Major: Information Science, Minor: Philosophy of Education.

MLS, May 1976, Emporia State University, Emporia, Kansas, Major: Library Science.

B.S., June 1970, Shiraz University, Shiraz, Iran, Major: Economics & Business Administration, Minor: National Development.

PROFESSIONAL EXPERIENCE

Southwest Texas State University, San Marcos, TX, Serials Cataloger, 4/85-.

Indiana University, Bloomington, Indiana, Editorial Associate & Computer Consultant, BIHEP (Bibliographic Index of Health Education Periodicals), 11/82-3/85; Reference Assistant, Undergraduate Library, 8/81-3/85.

The University of Iowa, Iowa City, Iowa, Visiting Faculty, School of Library & Information Science, 6/84-8/84.

Shiraz University, Shiraz, Iran, Adjunct Faculty Department of Library Science, 8/77-8/78; Director, College of Arts & Sciences Library, 8/77-8/78; Director, College of Agriculture Library, 5/76-8/77; and Cataloger & Classifier, School of Engineering Library, 6/71-11/74.

COURSES TAUGHT:

Cataloging & Classification; Cataloging of Audiovisual Materials; How to Use Libraries; Library Administration; Research Methods; and Technical Services.

OTHER COURSES WILLING TO TEACH:

Abstracting & Indexing; Computer Applications (Automation, Microcomputer, programming); Information Science; Information Sources & Services; Information Storage & Retrieval Systems; and Systems Analysis.

SPECIAL QUALIFICATIONS

Skilled in BASIC, COBOL, PASCAL, and familiar with some
other programming languages.

Experience in using KRONOS & NOS operating systems on
CDC-6600, CYBER-170, CYBER-172, and DEC-10 mainframes;
VMS & PRIMOS on VAX-11/780 & PRIME/750 superminis.

Experience with a variety of microcomputers (IBM PC, Os-
borne, etc.) and CAI systems such as PLATO.

RESEARCH AND PUBLICATIONS

Khosh-khui, A. "Specificity of LC Subject Headings and
Depth of Subject Analysis in Monographic Records."
(Submitted for publication, December 1984).

Khosh-Khui, A. "Statistical Analysis of the Association
between LC Subject Headings and Class Notations in
Main Classes of DDC and LCC." Ph. D. dissertation, In-
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AWARDS, HONORS AND SCHOLARSHIPS

Shiraz University Graduate Study Scholarship (1974).
Beta Phi Mu, Honorary Membership (1976).
UNESCO/UNISIST Workshop Grant, Ankara, Turkey (1977).
Doctoral Study Grant, Ministry of Higher Education, Iran
(1978).

MEMBERSHIP IN PROFESSIONAL SOCIETIES

American Library Association, 1975-
American Society for Information Science, 1980-
Association for Library and Information Science Education,
1981-
Special Libraries Association, 1981-