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A performance prediction model for bibliographic search using multiple regression technique.

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A PERFORMANCE PREDICTION MODEL FOR BIBLIOGRAPHIC SEARCH USING MULTIPLE REGRESSION TECHNIQUE

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Summary

Bibliographic searching is the establishment of the correct name of the author, title, publisher and date of publication of a book, by means of various tools i. e. Library of Congress Catalogue (LC), Library of Congress Proofslips (PS), Cumulative Book Index (CBI), Publishers Trade List Annual (PTLA), etc.

At the University of Windsor, this task is carried out by the Bibliographic Searching Department of the Technical Services Division of the Library. This is done to avoid duplication and is essential in central cataloguing process.

As a first step, to set up a methodology for predicting the time of searching and other clerical activities in the Bibliographic Searching Department, the least time sequences of searching of various tools were sought. For least time of searching, it was found that the sequences of tools were:

for monographs

1st Publishers Trade List Annual
2nd Library of Congress Proofslips
3rd Library of Congress Catalogue
4th Cumulative Book Index

for serials

1st New Serial Titles

2nd Union List of Serials

3rd Library of Congress Catalogue

4th Library of Congress Proofslips

After the establishment of least time sequences, a model was formulated to predict the time for bibliographic searching and other clerical activities in the above department by taking the data of sixty days and using the multiple regression technique. The model could be expressed as:

$$T = 47.778 + .07955X_1 + .114922X_2 + .00315X_4$$ where

T = Number of hours required

X_1 = Number of requisitions of books searched

X_2 = Number of search-on-arrival books searched

X_4 = Number of proofslips filed

The model was tested statistically for its reliability and its validity was checked by testing against monthly statistical reports and was found to be satisfactory.

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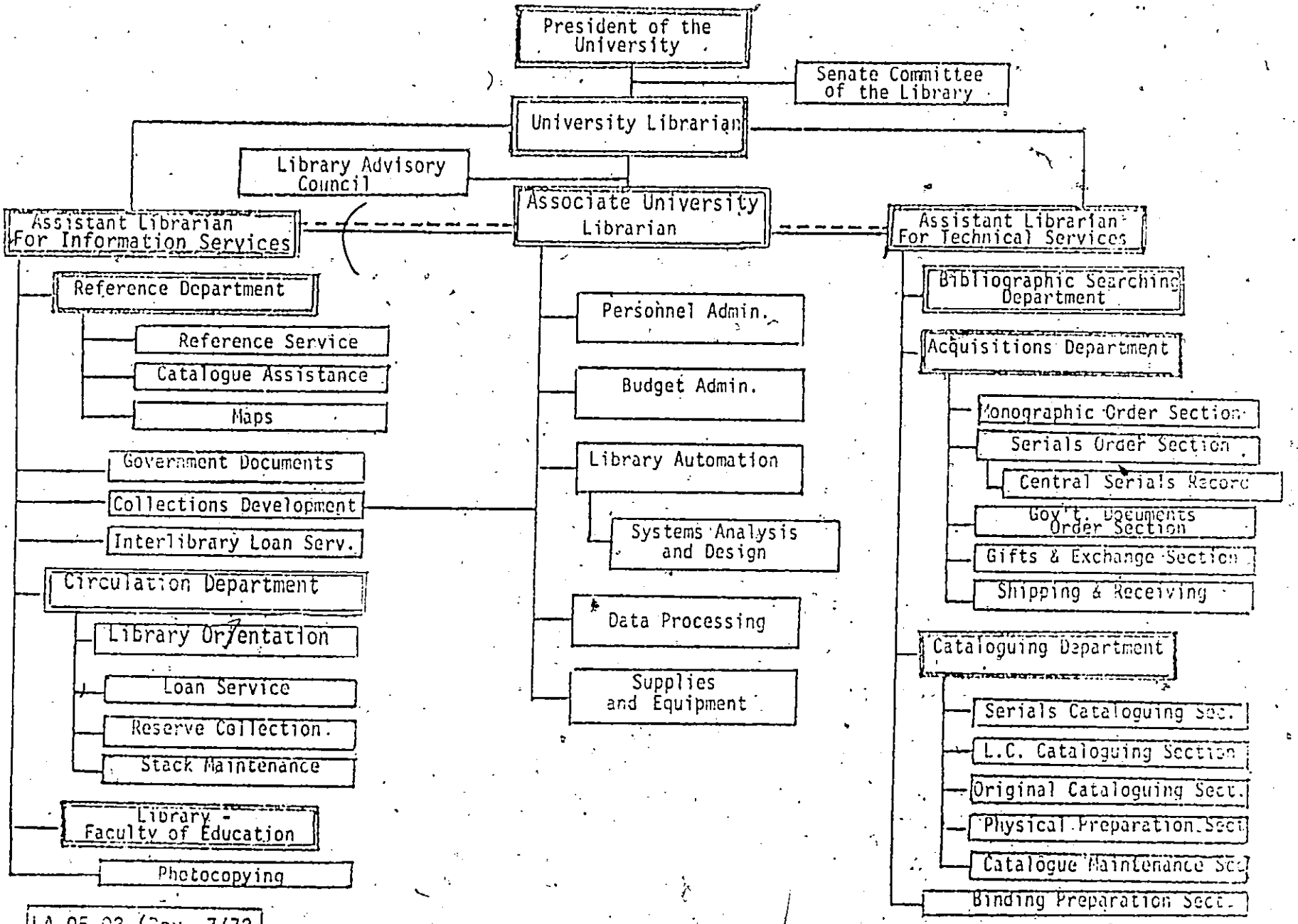
UNIVERSITY OF WINDSOR LIBRARY
ADMINSTRATIVE ORGANIZATION



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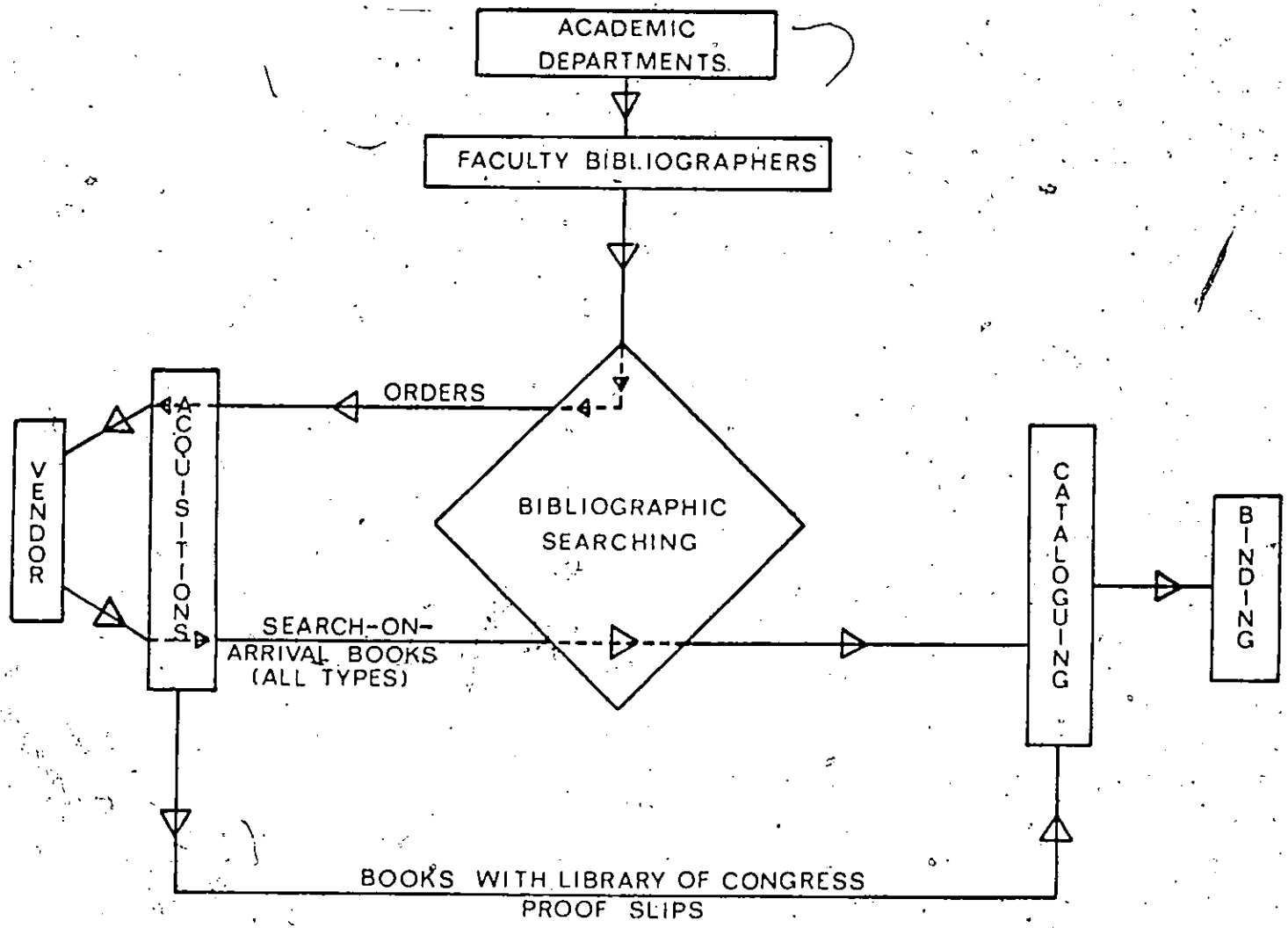

FIG.2 BLOCK DIAGRAM-BIBLIOGRAPHIC SEARCHING

CHAPTER I

INTRODUCTION

Libraries, like other organizations, are concerned with operating requirements that include scheduling, planning work assignments, cost estimation, forecasting, budgeting, manpower control, and performance evaluation. Many of these requirements may have been performed inadequately because of the inability to estimate manpower requirements for a given volume of work.

The management of the Library of the University of Windsor desired to explore the possibility of developing a methodology which could be used in studying and establishing manpower requirements, setting production standards and thus being able to evaluate and control the performance of various departments of the Library.

Technical Services are an essential to any library and are responsible for the acquisitioning, bibliographic searching, and cataloguing of books. The technical Services Division of the University Library (Fig. 1) is comprised of three main departments- Acquisitions, Bibliographic searching, and Cataloguing. In order to make the books available to the reader in a short span of time, the three departments have to work together as one systematic unit. The Bibliographic Searching Department acts as the intermediary department between Acquisitions and Cataloguing (Fig. 2). All requisitions for the books re-

ceived from academic departments through faculty bibliographers are searched by this department for their bibliographic information which means the establishment of the author's correct name, title, publisher, date of publication, edition, series statement, main entry heading, contributor's name etc. through various bibliographic tools i.e. Library of Congress Catalogue, Library of Congress proofslips, Cumulative Book Index, New Serial Titles, Union List of Serials, before they are handed over to the Acquisition Department for ordering. When the books are received from the vendor, they are sent direct from Acquisition Department to Cataloguing Department.

All requisitions of books whose complete bibliographic information can not be found, are marked 'search-on-arrival' and are handed over for ordering. When the books with requisitions marked 'search-on-arrival' are received from the vendor, they are researched by the Bibliographic Searching Department before sending them over to Cataloguing Department.

For purposes of this study, the Bibliographic Searching Department was selected. In a report of the Bibliographic Searching Department of Oct. 5, 1970, it was found that there existed a backlog of 16,925 books to be searched, catalogued and eventually made available to the readers. In order to find out the reason for the backlog, a

further probe was made into the working and previous statistical reports of the departments. In a study conducted by the Technical Services Division in 1968, it was found that a cataloguer catalogued an average of 185.5 books in a month. Assuming this study as reliable, the number of books that could be catalogued in the year 1969-70, was 84,588 books with 38 cataloguers. The total searches done by the Bibliographic Searching Department in the same period was 50,077 with 14 searchers.

Assuming a steady-state condition, there was a discrepancy between the searching department's output and the cataloguing department's output. One of the remedies was to use semi-professional cataloguers from the Cataloguing Department for the searching but that was not the optimal solution. This, of course, was done by the Technical Services Division on an interim basis. Another remedy was to employ a few more searchers. The third and permanent remedy was to find an efficient method of searching and also a model to predict the output of the Bibliographic Searching Department using various techniques available to an industrial engineer.

The normal day-to-day work in the Bibliographic Searching Department consists of the following details:

a) to determine if the requisitioned book is already available in the library.

b) to determine whether the book is in print or

out of print.

c) to find the correct bibliographic information of the book

d) to stamp 'search-on-arrival' on the requisition if no bibliographic information is found

e) assign a vendor

f) research the 'search-on-arrival' books when received from vendor.

The other functions included filing of Library of Congress proofslips and taking photographs of the Library of Congress entries which are used as a substitute when Library of Congress proofslips are not available.

Most of the functions performed by the staff of the Bibliographic Searching Department consist of long cycles, have random demand patterns, and involve clerical as well as manual operations. The conventional techniques available for study work can not adequately measure such activities. For estimating time required for similar conditions, regression technique has been used successfully in some instances.

Before developing a prediction model, studies were made to determine the searching sequence so that the expected time of searching was minimized. For this conditional probabilities indicating success of various searching tools along with the time for various searching sequences were calculated. The relationship between the time needed to process a requisition and other variables was studied. A linear regression model for predicting the productivity of

the Bibliographic Searching Department was developed. The validation of the model was carried out using the day-to-day functioning of the Bibliographic Searching Department.

The object of this thesis is to determine the least time searching sequences for Bibliographic Searching and to explore the possibilities of using the Regression technique for predicting, evaluating and controlling the performance of the Bibliographic Searching Department.

CHAPTER II

LITERATURE SURVEY

2.1 Introduction

The literature pertaining to this study is very scanty. The available literature can be summarized under the following headings:

a) Sequencing as Applied to Search Operations.

b) Regression Technique as Applied to Work Measurement.

2.2 Sequencing as Applied to Search Operations

The operation of bibliographic searching can be viewed as an inspection operation in which the searcher uses various available tools to check the correctness of the requisition. The operation is completed as soon as the entries made or the requisition forms are checked out completely. Some work related to sequencing of the inspection task has been done in the past.

a. Denby's Sequencing Technique

Denby (2) used a method by which he found out the expected maintenance time of examining the components in a particular sequence. According to him the expected time required to determine the defective components, if the components are examined in the sequence i, j, k is the time to examine i times the probability that i caused the failure, plus the time required to examine j added

to the wasted time of examining i times, the probability that j caused the failure, plus the time required to examine k added to the wasted times of examining i and j times the probability that k caused the failure. Calculating the expected time of the sequences, one chooses the sequence which gives the minimum expected time.

Expressed Mathematically:

$$E(T \mid i,j,k) = T_i * P(i \mid F) + (T_i + T_j) * P(j \mid F) + (T_i + T_j + T_k) * P(k \mid F) - \ldots\ldots$$

It can be extended to any number of components.

According to Denby (2), when a system or assembly fails, the cause of failure is not immediately obvious, too often the trouble is sought in a most haphazard manner even by the most experienced repairman. His attempt was to develop the most efficient method of trouble-shooting.

b. Mitten's Least Cost Sequence

This is a special case of sequencing. Mitten (7) solved it as follows:

1) For each test, he computed the ratio C/R, where C is the cost of the test and R the probability of rejection in that test.
2) Run the test with smallest value for the above ratio first, the one with the second smallest ratio second, ..., and the test with the largest ratio last.

This gave the optimal sequence.

c. Least Cost Techniques

Lazorick and Minder (5) tried to find a least cost searching sequence with the help of Mitten's (7) solution to least cost testing sequence problem. They took a random sample of twenty-five English language requisitions and asked the searchers to check each of five sources namely, LC, CBI, BIP, PTLA and PS to see if the items could be identified with adequate bibliographic details. The percentage of time adequate information was found was recorded for each bibliographic tool. Another searcher was given five random samples of ten order forms and was asked to search the samples in the five bibliographic sources while being timed separately for each source. The optimum sequence in this case was determined by taking the time consumed to the percent of success and ordering the tests such that the ratios will be in increasing sequence. Their resultant sequence was BIP, PTLA, PS, CBI and LC.

Fristoe (3), a librarian by profession, tried to find a sequence involving least number of searches in bibliographic tools. He started his project with 100 requisitions of Current American imprints (all in English) and going through six bibliographic tools namely PS, NUC, BPR, PW, PWA and CBI to see if the adequate information is available. After initial search he found that whatever information he found in NUC was also found in PS, PW and BPR. So he

eliminated those tools except PS and was left over with PS, PWA and CBI. He then conducted searches through these three tools in their six possible combinations. He found that the sequence PS, PWA and CBI was the one which required least number of searches.

2.3 Regression Techinique as Applied to Work Measurement.

a. Least Squares and Regression

Least squares, Regression, Multiple Regression are all the methods of forecasting or predicting the value of some process variable from known or related variables. The industrial engineer of a manufacturing plant would like to relate yield of product to a number of variables. He will then use the prediction equation to find the settings of the variable that would provide the maximum yield of that product. The simplest form of prediction equation is $Y = a + bx$ where Y is dependent variable, x is independent and a, b are empirically derived constants. This is based on method of least square. The value of independent variable and dependent variable when plotted on a graph is in a scattered shape. The straight line that best fits those point and which minimizes the sum of the squares of distance between the point and the straight line is a good predictor. This prediction equation is also known as regression line.

A prediction equation based upon a number of variables is known as multiple regression line or curve. The meth-

odology to find the prediction equation is known as multiple regression technique. The prediction equation can be linear, curvilinear, exponential or geometric depending on the nature of the data. The strength of the relationship between several variables independent of their scales of measurement is known as correlation. The measure is known as coefficient of multiple correlation.

The multiple predictor is like this:

$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + \ldots$

where Y, X_1, X_2, X_3 are variables,

a is the intercept and b_1, b_2, b_3 are regression coefficients.

b. Multiple Regression Techniques for the Measurement of Indirect Work.

According to Industrial Engineering Handbook (6), all the operations of a service nature are usually referred as indirect. Indirect work includes clerical, material handling, maintenance and sanitation work etc.

Regression Analysis technique for the indirect work measurement is fairly new. Richardson (8), Barta (1), Krick (4), Shell and Shupe (9) have used the technique of multiple regression technique for estimating production standards for specific instances. Richardson (8) used it to predict production standard for a machine room in a sales office. His model was:

$T = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6$

where T = Time in minutes

a is the intercept and b_1, b_2, b_3, b_4, b_5, b_6 are regression coefficients. X_1 was the number of orders processed, X_2 the number of immediate orders processed, X_3 the number of priority orders processed, X_4 the number of registers processed, X_5 the number of back orders processed, X_6 the number of change orders processed.

Barta (1) used it for predicting the time in unloading a truck carrying drums and cardboard boxes. His model was:-

Standard minutes per truck = a + b_1 (weight)

+ b_2 (cardboard boxes) + b_3 (drums)

where a is the intercept and b_1, b_2, b_3 are regression coefficients.

Krick (4) used the method to find out the time to clean the office.

His model was:-

Time to clean office = $a + b_1v_1 + b_2v_2 + b_3v_3$

$+ b_4v_4 + b_5v_5 + b_6v_6$

where a is the intercept and b_1, b_2, b_3, b_4, b_5, b_6 are all regression coefficients.

v_1 = Square feet of bare floor, wood or tile

v_2 = Square feet of rug

v_3 = Number of moveable objects

v_4 = Number of stationary objects, floor accessible

v_5 = Number of stationary objects, floor inaccessible

v_6 = Square feet of area to be dusted.

Shell and Shupe (9) used multiple linear regression technique to find the work time (T_w) required for collecting solid waste in the city of Cincinnati, Ohio. The result is the equation computing the work time in minutes for each sub-district:

$T_w = a + bT + cL - dH - eF + gS - fTR$

where a is the intercept and b,c,d,e,f,g are regression coefficients.

T_w = Work time in minutes

T = Average number of tons

L = Average number of loads times the distance to the nearest incinerator

H = Number of helpers

F = Number of families

S = Number of stops

TR = Number of trucks

2.4 Review

Lazorick and Minder (5) treated BIP as a bibliographic searching tool in their sequence. BIP is an essential tool and every requisition of book should always be searched in it first, to determine whether the book is in print or not therefore it should not be included in the sequence. Their sample was small and contained only English language requisitions.

Fristoe (3) based his sequence on the 'minimum number of searches' and utilized current American Imprints requisitions only. As he was dealing with current books, he missed out an important Bibliographic Searching tool i.e. Library of Congress Catalogue assuming that all of the requisitioned books could be found in Library of Congress Proofslips.

There is no evidence available that regression technique has been used for predicting the output of library operations previously.

CHAPTER III

PROCEDURE

3.1 Introduction

The study was conducted by first finding the conditional probabilities of Bibliographic tools given success (i.e. CBI, LC, LC Proof Slips, NST, PLTS and ULS) for monographs and serials separately. Then requisitions for monographs and serials were timed for the bibliographic search by changing the sequence of the Bibliographic tools. These two elements of study are needed to calculate the least expected time of search.

Once the least time sequences for monographs and serials were established, the output data of the Bibliographic Searching Department was collected for a sixty day period and using this data, regression coefficients for prediction model were computed. Later on, the model was tested statistically for its reliability and validity.

3.2 Finding the Conditional Probability of Successful Search

Five hundred requisitions of monographs and one hundred requisitions of serials over a period of a year (Oct. '70 - '71) to cover as many departments and languages as possible were randomly selected. The staff of the Bibliographic Searching Department was asked to go through CBI, BNB, FB, PS, LC, CAN, PTLA for monographs NST, ULS, PS, LS, and ULR for serials and try to find adequate bibliographic information in each one of them. The data collected and the

calculation of conditional probabilities are attached in Appendix A. This study showed that in case of monographs, LC, PS, CBI, and PTLA were significant Bibliographic tools and in case of serials, LC, PS, NST and ULS.

3.3 Finding the Least Time Sequence

75 random sample requisitions of monographs and 25 of serial were selected over a period from Oct. '71 to Jan. '72. The staff of Bibliographic Searching Department was asked to go through 24 possible sequences of LC, PS, CBI, and PTLA for monographs and LS, PS, NST and ULS for serials and record the time on the proforma attached as sample in Appendix B. The summary of data of 25 requisitions for monographs and 10 requisitions for serials out of 100 requisitions originally selected for this study, is also attached in Appendix B. The reason for selecting 35 requisitions was to have only those requisitions, which were found in all the Bibliographic tools.

The expected time was calculated by using Denby's (2) method using conditional probabilities calculated in section 3.2:

$$E(T \mid i,j,k) = T_i * P(i \mid s) + (T_i + T_j) * P(j \mid s) + (T_i + T_j + T_k) * P(k \mid s) + (T_i + T_j + T_k + T_e) * P(e \mid s)$$

where T_m = Time of search in the m^{th} tool were

$m = 1, 2, 3, 4.$

$P(m \mid s)$ = Conditional Probability of Search in the m^{th} tool

given success (s) where m = 1, 2, 3, 4.

and i, j, k, e are 1, 2, 3, 4.

This relationship could be extended to any number of tools. A computer program was run having the above equation to find the least time sequences for monographs and serials as attached in Appendix C.

3.4. Data Collection and Regression Model

Once the least time sequence were established, the staff of the Bibliographic Searching Department was asked to record the daily output in the proforma attached as a sample in Appendix D. The summary data for a period of 60 days from Jan. 17, '72 - Feb. 28 '72 and from May 23 '72 - July 4, '72 is also attached in the same appendix. The total time in a day (T) was calculated as number of searchers into seven working hours each day and was treated as dependent variable. Miscellaneous jobs performed like preparing monthly statistics etc. were assumed to be indirectly related to other works. The other independent variables were the number of requisitions processed X_1, the number of Search-on-Arrival Books X_2, the number of photographs taken for LC entry X_3, and the number of proof slips filed X_4.

The relationship was established by the help of computer as:

$$T = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4$$

where a is the intercept and b_1, b_2, b_3, b_4 are regression coefficients.

The validity of the model was checked by day to day work in the Bibliographic Searching Department as explained in Chapter IV.

CHAPTER IV

RESULTS AND ANALYSIS

4.1 The Least Time Sequence for Monographs and Serials

The time study data for twenty five monographs and ten serials in twenty four possible sequences of four respective bibliographic tools has been attached in appendix B.

The conditional probabilities of the bibliographic tools as calculated in Appendix A, and the time study in Appendix B, were used to calculate the least time sequences, in the following equation with the help of computer:

$$E(T \mid i,j,k) = T_i * P(i \mid s) + (T_i + T_j) * P(j \mid s) + (T_i + T_j + T_k) * P(k \mid s) + (T_i + T_j + T_k + T_e) * P(e \mid s)$$

where T_m = Time of searching m^{th} tool and

$m = 1, 2, 3, 4.$

$P(m \mid s)$ = conditional probability of m^{th} tool given success (s) where m = 1, 2, 3, 4.

and i, j, k, e are 1, 2, 3, 4.

The computer program and the print-out are attached in Appendix C. The results are summarized as follows:

Monographs Sequence:

1st PTLA	Publishers Trade List Annual
2nd PS	Library of Congress Proof Slips
3rd LC	Library of Congress Catalogue

4th CBI — Comulative Book Index

Serials Sequence:

1st NST — New Serial Titles

2nd ULS — Union List of Serials

3rd LC — Library of Congress Catalogue

4th PS — Library of Congress Proof Slips

4.2 Prediction Model-Result-I

The data summary of all the clerical and manual work in Bibliographic Searching Department for sixty days has been attached in Appendix D. Treating time (T) as a dependent variable and the number of requisitions of books searched (X_1), the number of Search-on-Arrival books searched (X_2), the number of photographs taken (X_3) and the number of proof slips filed (X_4) as independent variables, a computer program was run using multiple linear regression technique to compute the intercept, the regression coefficients and the statistical details i.e. t-values, multiple correlation, F-value and standard error of estimate.

The model was:

$$T = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 \qquad (1)$$

where T = Time of search in hours

a = Intercept

X_1 = {Variable No. 2 in the computer program / No. of requisitions of books searched

b_1 = regression coefficient for variable No. 2

X_2 = {Variable No. 3 in the computer program / No. of Search-on-Arrival books searched

b_2 = regression coefficient for variable No. 3

X_3 = {Variable No. 4 in the computer program / No. of LC Photographs taken

b_3 = regression coefficient for variable No. 4

X_4 = {Variable No. 5 in the computer program / No. of Proof slips filed

b_4 = regression coefficient for variable No. 5

The results obtained by the computer run (see details in Appendix E) are as follows:

a)

	Variable No.	Correlation*	Regression Coefficient	Computed T-Value
X_1	2	.140	b_1 = .0818	4.00
X_2	3	.408	b_2 = .1144	5.34
X_3	4	.001	b_3 = .0139	.75
X_4	5	.386	b_4 = .0032	3.90

Intercept: a = 46.842

Substituting the values of the intercept, the regression coefficients b_1, b_2, b_3, and b_4 in the regression equation (1), the model would be:

$$T = 46.842 + .0818X_1 + .1144X_2 + .0139X_3 + .0032X_4$$

b) Multiple Correlation: .671

c) Standard Error of Estimate: 7.9

* The correlation values are significat at a 90 percent level of confidence.

d) Analysis of Variance

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Squares	F-Value
Attributable to Regression	4	2936	733.8	11.8
Deviation from Regression	55	3433	62.4	
Total	59	6369		

4.3 Analysis-Result-I

The statistical details of the model are analyzed as follows:

Correlation

All the independent variables have positive correlation. There is no significant postive correlation in case of third independent variable (LC Photographs taken)

t-values

Keeping 90 percent confidence, it is observed that the value of t for 59 degrees of freedom is 1.68 from the tables. Looking at the computed t-values it is found that all are significant except X_3 (No. of Lc Photographs taken) which is 0.754.

Multiple Correlation

The coefficient is .67 which is considered to be adequate.

Standard Error of Estimate

With 95 percent confidence interval the errors of prediction should be within $\pm$ 1.96Se where Se is the Standard Error of Estimate.

$\pm$ 1.96Se = 1.95 * 7.9 = $\pm$ 15.484

From the residual tables—I in Appendix E, it is observed that only one observation lies outside the interval. So the prediction is fairly good.

F-test

With numerator n as 4 and denominator m as 55, from the F-distribution table, it is found that F-ratio is 2.55 under 95 percent confidence. The computer result shows that it is 11.8. This means that a significant relationship exists between dependent variable and independent variables.

Final Remarks:

As X_3 (LC Photographs taken) was not significant (as proved by t-values), it was dropped from the next computer run.

4.4 Predication Model-Result-II

As number of photographs taken (X_3) was statistically insignificant so this variable was dropped. The model after exclusion of X_3 was:

$$T = a + b_1X_1 + b_2X_2 + b_4X_4 \qquad (2)$$

where T = Time in hours

a = Intercept

X_1 = {Variable No. 2 in the computer program / No. of requisition of books searched

b_1 = regression coefficient for variable No. 2

X_2 = {Variable No. 3 in the computer program / No. of search-on-arrival books searched

b_2 = regression coefficient for variable No. 3

X_4 = {Variable No. 4 in the computer program / No. of proof slips filed

b_4 = regression coefficient for variable No. 4

The program was run again for another set of results as follows:

a)

	Variable No.	Correlation*	Regression Coefficient	Computed T-Value
X_1	2	.14	b_1 = .07955	3.95
X_2	3	.41	b_2 = .11492	5.39
X_4	4	.39	b_4 = .00315	3.84

Intercept: a = 47.778

Substituting the values of intercept, the regression coefficient b_1, b_2, and b_4 in regression equation (2), the model would be:

$$T = 47.778 + .0796X_1 + .115X_2 + 003X_4$$

b) Multiple correlation: .675

c) Standard Error of Estimate: 7.87

* The correlation values are significant at a 90 percent level of confidence.

d) Analysis of Variance

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Squares	F-Value
Attributable to Regression	3	2900	966	15.6
Deviation from Regression	56	3468	61.9	
Total	59	6368		

4.5 Analysis-Result-II

The statistical details of the model are analyzed as follows:

Correlation:

All the independent variables have significant positive correlation.

t-values:

From the tables for 90 percent confidence and 59 degrees of freedom the value of t is 1.68. All t-values shown in the computer results presented in section 4.4 are highly significant when compared with the table value.

Multiple Correlation:

It is 0.675, which shows an improvement over the Result-I. It means the model has a better prediction value.

Standard Errors of Estimate:

The errors of prediction should lie within $\pm$ 1.96Se where Se is the Standard Error of Estimate.

$\pm$ 1.96Se = $\pm$ 1.96 * 7.87 = $\pm$ 15.47

From the table of residuals - II in Appendix E it is seen that only one residual observation lies outside + 15.47 and - 15.47.

So the prediction is considered to be reasonably adequate.

F-Test:

The F-value from the result is 15.6 and from the table with n as 3 and m as 55 it is 2.78, so it means significant relation exists between dependent and independent variables under 95 percent level of confidence.

4.6 Validity of Prediction Model From Day to Day Work.

The model is:

$T = 47.778 + .0796X_1 + .115X_2 + .003X_4$

where

T = Number of hours

X_1 = Number of requisition of books searched

X_2 = Number of Search-on-Arrival books searched

X_4 = Number of Proof Slips filed

Substituting the value of X_1, X_2 and X_4 from the monthly statistical reports of Bibliographic Searching Department for the month of March, December, 1972 and January, February, 1973 in the equation above we get:

MARCH , 1972

$X_1 = 2829$

$X_2 = 1641$

$X_4 = 25684$

Number of working days = 25

$$T = 47.77 + \frac{.079 * 2829}{25} + \frac{.115 * 1641}{25} + \frac{.003 * 25684 * 8}{25}$$

$$= 88.97$$

Number of working hours per day = 7

Predicted number of Searchers = $\frac{88.97}{7} = 13$

Actual number of Searchers = 15

DECEMBER, 1972

$X_1 = 1287$

$X_2 = 721$

$X_4 = 8896$

Number of working days = 17

$$T = 47.77 + \frac{.0796 * 1287}{17} + \frac{.115 * 721}{17} + \frac{.003 * 8896 * 8}{17}$$

$$= 71.24$$

Number of working hours per day = 7

Predicted number of Searchers = $\frac{71.24}{7} = 10$

Actual number of Searchers = 12

JANUARY, 1973

$X_1 = 2271$

$X_2 = 1053$

$X_4 = 24601$

Number of working days = 22

$$T = 47.77 + \frac{.0796 * 2271}{22} + \frac{.115 * 1053}{22} + \frac{.003 * 24601 * 8}{22}$$

$$= 88.29$$

Number of working hours per day = 7

Predicted number of Searchers = $\frac{88.29}{7}$ = 13

Actual number of Searchers = 13

FEBRUARY, 1973

X_1 = 2179

X_2 = 1290

X_4 = 11702

Number of working days = 19

$$T = 47.77 + \frac{.0796 * 2179}{19} + \frac{.115 * 1290}{19} + \frac{.003 * 11702 * 8}{19}$$

$$= 79.51$$

Number of working hours per day = 7

Predicted number of Searchers = $\frac{79.51}{7}$ = 12

Actual number of Searchers = 12

Summary

Month	Year	Predicted No. of Searchers	Actual No. of Searchers
March	1972	13	15
December	1972	10	12
January	1973	13	13
February	1973	12	12

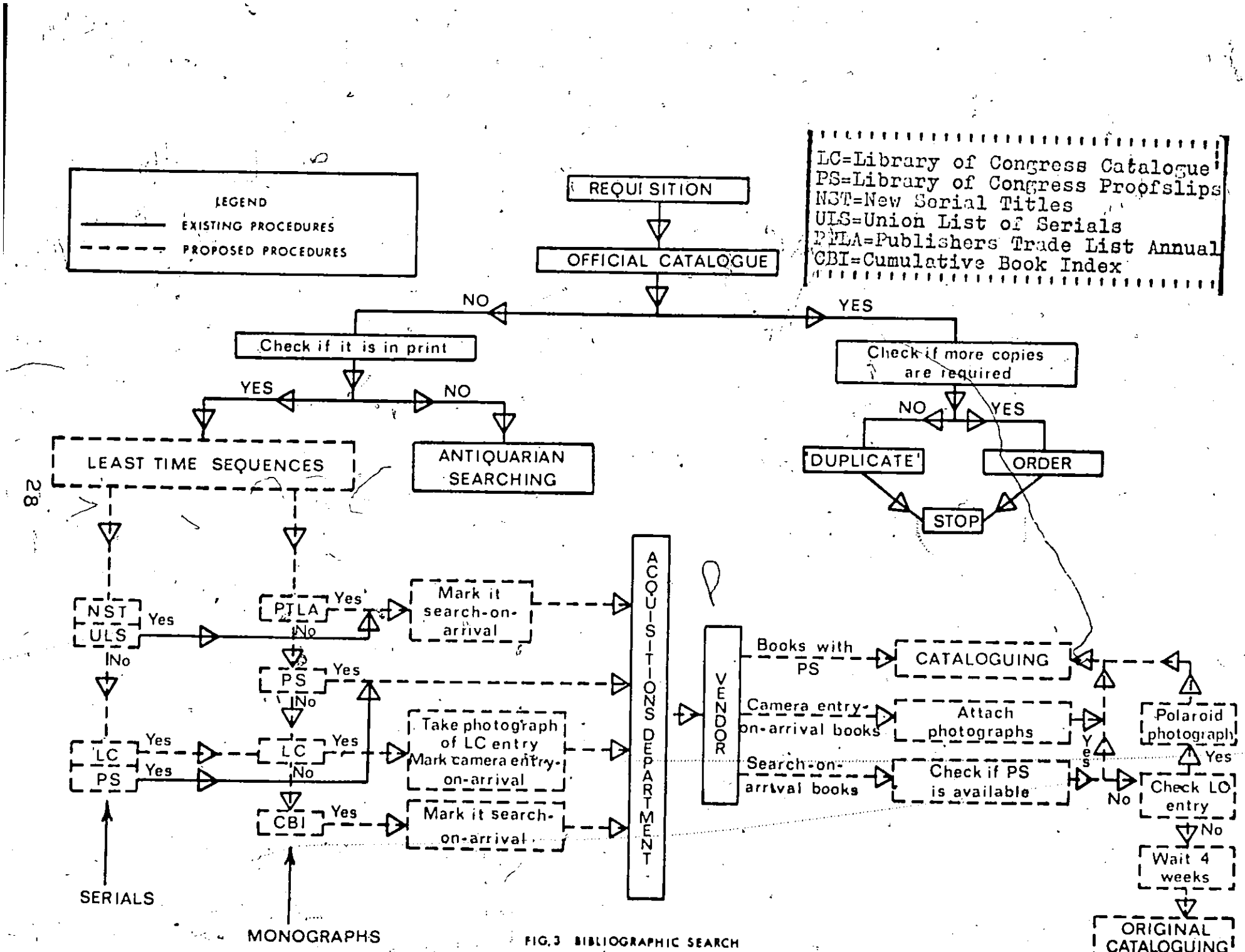

FIG. 3 BIBLIOGRAPHIC SEARCH

CHAPTER V

CONCLUSION AND SUGGESTION FOR FURTHER RESEARCH

5.1 Conclusion

Previous reserchers have derived least time sequences of bibliographic searching but they only included English Language monographs and American Imprints. Lazorick and Minder (5) based their least time sequence on Mitten's (7) technique of least cost sequence and Fristoe (3) based his least time sequence on a purely non-mathematical approach of 'minimum number of searches' to get adequate bibliographic information.

The present work in deriving least time sequences in bibliographic searching included as much diversification as it could by including languages like Spanish, French, etc. and scientific, non-scientific books. It also developed a least time sequence in bibliographic searching of Serials. Denby's (2) technique was used to arrive at both the sequences. The bibliographic searching tools in order of sequence are Publisher Trade List Annual, Library of Congress Proof slips, Library of Congress Catalogue, Cumulative Book Index for monographs and New Serial Titles Union List of Serials, Library of Congress Catalogue, Library of Congress Proof slips for serials. The existing procedures of bibliographic searching and the proposed procedures with the least time sequences are shown as in Fig. (3).

After establishing the leasttime sequences, a prediction model was formulated with the help of the computer, that could estimate all the clerical and manual work in the Bibliographic Searching Department, using multiple linear regression technique. The model formulated is as follows:

$$T = 47.778 + .07955X_1 + .11492X_2 + .00315X_4$$

where

T = Time in hours

X_1 = Number of requisition of books searched

X_2 = Number of search-on-arrival books searched

X_4 = Number of Proofslips filed

This model has been tested for its reliability by statistical means and validity by day-to-day work of the Bibliographic Searching Department and has proved to be satisfactory. Hence it is concluded that this model may be used for exercising control over the output and manpower requirement.

5.2 Suggestions for Further Research:

The multiple regression model for prediction of work in Bibliographic Searching Department has been tested for its statistical significance and reliability of prediction. The same type of approach can be applied to various other departments of libriary i.e. cataloguing, binding, circulation, etc.

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APPENDIX A

FINDING THE CONDITIONAL PROBABILITIES OF SUCCESSFUL SEARCH IN BIBLIOGRAPHIC TOOLS

GENERAL INFORMATION

The requisitions of monographs and serials from various academic departments of the University of Windsor were searched through their respective bibliographic tools to find out the overall probability of success and the probability of success of the individual tools. Then the conditional probability of the individual tool given success was calculated.

	MONOGRAPHS						
DEPARTMENT	CBI	BNB	FB	PS	LC	CAN	PTLA
1. General	-	-	-	-	-	-	-
2. General	-	-	-	-	-	-	x
3. General	-	-	-	-	-	-	x
4. General	x	-	-	-	x	-	-
5. Economics	-	-	-	-	x	-	x
6. Economics	-	-	-	-	x	-	-
7. Economics	x	-	-	-	-	-	-
8. Economics	-	-	-	-	-	-	-
9. Economics	-	-	-	-	-	-	x
10. Economics	-	-	-	-	-	-	x
11. Economics	-	-	-	-	-	-	x
12. Hispanic Studies	-	-	-	-	-	-	x
13. Hispanic Studies	-	-	x	-	-	-	-
14. French	-	-	-	-	-	-	-
15. French	-	-	-	-	x	-	x

	CBI	BNB	FB	PS	LC	CAN	PTLA
16. French	-	-	-	-	-	-	-
17. French	-	-	-	-	-	-	-
18. Psychology	x	-	-	-	x	-	x
19. Psychology	-	-	-	x	x	x	-
20. General	-	-	-	x	x	-	x
21. French	-	-	-	x	x	-	-
22. Communication Arts	-	-	-	-	-	-	-
23. Classics	x	-	-	x	x	-	-
24. History	x	-	-	x	x	-	-
25. Economics	x	-	-	x	x	x	x
26. French	-	-	-	-	-	-	-
27. French	-	-	-	x	x	-	x
28. French	-	-	-	x	x	-	x
29. French	-	-	-	x	x	-	x
30. French	-	-	-	x	x	-	x
31. Geology	x	-	-	x	x	-	x

	CBI	BNB	FB	PS	LC	CAN	PTLA
32. Geology	x	-	-	x	x	-	x
33. History	-	-	-	-	-	-	-
34. Business Administration	x	-	-	-	x	-	x
35. Physical Education	x	-	-	-	x	-	-
36. Geology	x	-	-	-	x	-	x
37. Hispanic & Italian Studies	x	-	-	-	x	-	x
38. Physical Education	-	x	-	-	x	-	-
39. Geology	x	-	-	-	x	-	-
40. Hispanic & Italian Studies	-	-	-	-	x	-	x
41. Hispanic & Italian Studies	-	-	-	-	x	-	x
42. Geology	x	-	-	-	x	-	x
43. Theology	x	x	-	x	x	-	x
44. Theology	x	-	-	x	x	-	x
45. Anthropology	-	-		x	x	-	-
46. Sociology	-	-	-	x	x	-	x

	CBI	BNB	FB	PS	LC	CAN	PTLA
47. Sociology	-	-	-	x	x	-	x
48. Anthropology	-	-	x	x	x	-	x
49. Antrhopology	-	-	x	x	x	-	x
50. Anthropology	-	x	x	x	x	x	x
51. Psychology	-	-	x	-	x	-	x
52. Theology	-	-	-	x	x	-	x
53. Theology	x	-	x	x	-	-	x
54. Political Science	-	-	x	x	x	-	-
55. Political Science	x	-	-	x	x	-	x
56. Political Science	x	-	-	x	x	-	x
57. English	x	x	-	x	x	-	-
58. English	-	x	-	x	x	-	-
59. English	x	x	-	x	x	-	-
60. Psychology	-	-	-	-	x	-	-
61. Psychology	-	-	-	-	x	-	-

	CBI	BNB	FB	PS	LC	CAN	PTLA
62. Psychology	-	-	-	x	x	-	x
63. Psychology	-	-	x	x	x	-	-
64. Psychology	-	x	x	x	x	-	-
65. History	x	-	-	x	x	-	x
66. History	x	x	x	x	x	-	-
67. History	x	x	-	-	x	-	x
68. History	x	-	-	-	-	-	x
69. History	x	-	-	-	x	-	x
70. History	x	-	-	-	x	-	x
71. History	x	x	-	-	x	-	x
72. History	x	-	-	-	x	-	x
73. History	x	x	-	-	x	-	x
74. History	x	-	-	-	x	-	x
75. History	x	x	-	-	x	-	x
76. History	x	x	x	-	x	-	x
77. History	x	x	-	-	x	-	-
78. History	x	x	-	-	x	-	x

	CBI	BNB	FB	PS	LC	CAN	PTLA
79. History	x	-	-	-	x	-	x
80. History	x	x	-	-	x	-	x
81. History	x	x	-	-	x	-	-
82. History	x	-	-	-	x	-	x
83. History	x	x	-	-	x	-	-
84. History	x	-	-	-	x	-	x
85. History	x	x	-	-	x	-	-
86. History	x	-	x	-	x	-	-
87. History	x	x	-	-	x	-	-
88. History	x	x	-	-	x	-	x
89. History	x	-	-	-	x	-	x
90. History	x	-	-	-	x	-	x
91. Government Document	-	-	-	-	-	-	-
92. History	x	-	-	-	x	-	x
93. History	x	x	-	-	x	-	-
94. Hispanic Studies	x	-	-	x	x	-	x

	CBI	BNB	FB	PS	LC	CAN	PTLA
95. Hispanic Studies	x	-	-	-	-	-	x
96. Hispanic Studies	-	-	-	-	-	-	x
97. Hispanic Studies	-	-	-	-	x	-	x
98. French	-	-	-	x	x	x	x
99. French	-	-	-	-	-	-	-
100. French	-	-	-	-	x	x	-
101. Geography	-	x	-	-	x	-	x
102. Geography	x	-	-	-	x	-	-
103. Anthropology	x	-	-	-	x	-	x
104. Anthropology	-	-	-	x	x	-	-
105. Anthropology	x	-	-	-	x	-	x
106. Anthropology	x	-	-	-	x	-	x
107. Anthropology	x	-	-	-	x	-	x
108. Anthropology	x	-	-	-	x	-	-
109. Anthropology	-	-	-	-	-	-	-
110, Psychology	x	-	-	-	x	-	-

	CBI	BNB	FB	PS	LC	CAN	PTLA
111. Psychology	x	-	-	x	x	-	-
112. Psychology	-	-	-	x	-	-	x
113. Psychology	-	-	-	x	x	-	-
114. Psychology	-	-	-	-	-	-	x
115. Hispanic Studies	x	x	-	-	x	-	x
116. Hispanic Studies	x	x	-	x	x	-	-
117. Hispanic Studies	x	-	-	-	x	-	x
118. Anthropology	x	-	-	-	-	-	x
119. Anthropology	x	x	-	x	x	-	x
120. Anthropology	x	x	-	-	x	-	-
121. English	-	x	x	-	-	-	-
122. English	-	-	x	x	x	-	x
123. English	-	-	x	x	-	-	x
124. Classics	-	x	-	x	x	-	-
125. Classics	x	-	-	-	x	-	-
126. Classics	x	x	x	x	x	-	x

	CBI	BNB	FB	PS	LC	CAN	PTLA
127. Classics	-	x	-	x	x	-	x
128. Classics	-	-	-	x	x	-	-
129. Classics	-	-	-	x	x	-	-
130. Classics	-	-	-	-	x	-	-
131. Classics	-	-	-	x	x	-	x
132. Classics	x	x	-	x	x	-	x
133. Classics	-	x	-	-	-	-	-
134. Philosophy	x	-	-	-	x	-	x
135. Philosophy	x	-	-	-	x	-	x
136. Philosophy	x	-	-	-	x	-	x
137. Philosophy	x	-	-	-	x	-	x
138. Business Administration	-	-	x	x	x	-	x
139. Business Administration	x	-	-	x	x	-	x
140. Business Administration	x	-	-	-	-	-	x
141. Business Administration	-	-	-	-	x	-	-

	CBI	BNB	FB	PS	LC	CAN	PTLA
142. History	x	-	-	-	x	-	x
143. History	-	-	-	-	-	-	x
144. Economics	-	x	x	-	-	x	x
145. Economics	-	-	-	-	-	-	x
146. Economics	-	-	-	-	-	-	x
147. Economics	-	-	x	x	x	-	x
148. English	-	-	-	-	-	-	-
149. English	-	-	-	-	-	-	x
150. English	-	-	-	-	-	-	-
151. English	-	-	x	x	-	-	x
152. English	-	-	-	-	-	-	x
153. English	-	-	-	-	-	-	x
154. Economics	x	-	-	-	x	-	x
155. Economics	x	x	-	-	x	-	x
156. Economics	x	-	-	-	x	-	x
157. Economics	x	x	-	-	x	-	x
158. Economics	x	x	-	-	x	-	x

	CBI	BNB	FB	PS	LC	CAN	PTLA
159. Economics	x	x	-	-	x	-	x
160. Economics	x	-	-	-	x	-	x
161. Economics	-	-	-	-	-	-	x
162. Economics	-	-	-	x	x	-	x
163. Economics	-	-	-	-	x	-	x
164. Economics	-	-	-	-	-	-	-
165. Economics	-	-	-	x	x	-	x
166. Economics	x	x	-	x	x	-	x
167. Economics	x	x	-	x	x	-	x
168. Economics	-	-	-	-	-	-	x
169. Economics	x	x	-	x	x	-	x
170. Economics	-	-	-	-	-	-	-
171. Economics	x	-	-	-	x	-	x
172. Economics	-	-	-	-	-	-	x
173. Hispanic & Italian Studies	x	-	-	-	x	x	x
174. Home Economics	-	-	-	-	x	x	-

	CBI	BNB	FB	PS	LC	CAN	PTLA
175. Home Economics	-	-	-	x	x	-	-
176. Economics	-	-	x	x	x	-	x
177. Economics	x	-	-	-	x	-	-
178. Economics	-	-	-	-	x	-	-
179. Economics	x	-	-	-	x	-	-
180. Nursing	x	-	-	-	x	-	x
181. Nursing	x	-	-	-	x	-	x
182. Nursing	x	-	-	x	x	-	-
183. Nursing	-	-	x	x	x	-	-
184. English	-	-	-	x	x	x	x
185. English	-	-	-	-	-	x	x
186. English	-	-	-	-	-	-	-
187. English	-	-	-	-	-	-	-
188. English	-	-	-	-	x	x	-
189. English	-	-	-	-	-	x	-
190. English	-	-	-	-	x	-	-
191. English	x	-	-	x	x	x	-

	CBI	BNB	FB	PS	LC	CAN	PTLA
192. English	x	-	-	x	x	x	-
193. English	-	z	-	x	x	-	x
194. English	x	x	-	x	x	x	x
195. English	x	x	-	x	x	x	x
196. English	x	x	-	x	x	x	-
197. English	-	-	x	x	-	-	-
198. Economics	x	-	x	x	x	-	-
199. Economics	-	-	x	-	x	-	-
200. Economics	-	-	-	-	-	-	-
201. Economics	-	-	x	-	-	-	-
202. French	-	-	-	-	x	x	x
203. French	-	-	-	x	-	-	x
204. French	-	-	-	-	x	-	-
205. French	-	-	-	-	x	x	x
206. French	-	-	-	-	x	-	-
207. French	-	-	x	-	x	-	-
208. French	-	-	-	-	-	-	x

	CBI	BNB	FB	PS	LC	CAN	PTLA
209. French	-	-	-	x	x	-	-
210. French	-	-	-	x	x	-	-
211. French	-	-	-	x	x	-	-
212. Hispanic & Italian Studies	-	-	-	-	x	-	x
213. Hispanic & Italian Studies	-	-	-	-	x	-	-
214. Hispanic & Italian Studies	-	-	-	-	x	-	-
215. Hispanic & Italian Studies	-	-	-	-	x	-	-
216. Hispanic & Italian Studies	-	-	-	-	x	-	-
217. Economics	x	-	-	-	x	x	-
218. Geography	x	-	-	-	x	-	-
219. Geography	-	-	-	-	x	-	-
220. Geography	x	-	-	-	-	-	-
221. Geography	-	-	-	-	x	-	-
222. Geography	-	-	-	-	x	-	-
223. Geography	-	-	-	-	-	-	-

	CBI	BNB	FB	PS	LC	CAN	PTLA
224. Geography	x	-	-	-	x	-	x
225. Geography	x	-	-	-	x	-	-
226. Geography	x	-	-	-	x	-	x
227. Geography	x	x	-	x	x	-	x
228. Geography	-	-	-	-	x	x	-
229. Geography	x	-	-	-	x	-	x
230. Geography	-	-	-	x	-	-	-
231. Geography	-	-	-	-	x	x	x
232. Business Administration	-	-	-	x	x	-	x
233. Business Administration	x	-	-	x	x	-	x
234. Business Administration	-	-	-	x	x	-	x
235. Business Administration	-	-	-	x	x	-	-
236. Business Administration	-	-	x	x	x	-	x
237. Sociology	-	x	-	x	-	-	-
238. Sociology	-	-	-	x	x	-	-

	CBI	BNB	FB	PS.	LC	CAN	PTLA
239. Sociology	-	-	-	x	x	-	-
240. Theology	x	-	-	-	x	-	x
241. Theology	-	-	x	-	-	-	-
242. Theology	-	x	x	-	-	-	-
243. Political Science	-	-	-	x	x	-	x
244. Political Science	-	-	-	x	-	-	-
245. Psychology	-	-	-	-	-	-	x
246. Psychology	-	-	-	x	x	-	x
247. Psychology	-	-	-	x	x	-	x
248. Geology	-	-	-	x	x	-	x
249. Geology	x	-	-	-	x	-	-
250. Geology	x	-	-	x	x	-	x
251. Geology	-	x	-	-	x	-	-
252. Geology	-	x	-	-	-	-	-
253. Geology	x	-	-	x	x	-	x
254. Geology	x	-	-	x	-	-	x

	CBI	BNB	FB	PS	LC	CAN	PTLA
255. Geology	x	-	-	-	x	-	-
256. Geology	x	-	-	-	x	-	-
257. Geology	x	x	-	x	x	-	x
258. Geology	-	-	-	x	x	-	-
259. Geology	x	x	-	x	x	-	x
260. Geology	-	-	x	-	x	-	-
261. Geology	x	x	-	-	x	-	-
262. Geology	-	-	-	-	x	-	x
263. Social Work	-	-	-	-	x	-	-
264. Social Work	x	-	-	-	x	-	x
265. Social Work	x	-	-	-	x	-	x
266. Social Work	x	-	-	-	x	-	x
267. Social Work	-	-	-	-	x	-	x
268. Social Work	-	-	-	-	x	-	x
269. Social Work	x	-	-	x	x	-	-
270. Social Work	x	x	-	x	x	-	x
271. Social Work	x	-	-	x	x	-	x
272. Drama	x	-	-	x	x	-	-

	CBI	BNB	FB	PS	LC	CAN	PTLA
273. Drama	-	-	x	x	x	-	x
274. Drama	x	x	x	x	x	-	x
275. Drama	-	-	-	-	x	-	-
276. Drama	x	-	-	x	x	-	x
277. Drama	-	-	x	x	x	-	x
278. Drama	x	-	x	x	x	-	x
279. Drama	-	-	-	x	x	-	x
280. Drama	x	x	-	x	x	-	-
281. Drama	-	-	x	-	-	-	x
282. Drama	-	-	x	-	-	-	x
283. Psychology	-	-	x	-	-	-	-
284. Psychology	-	-	-	x	x	-	-
285. Psychology	-	-	-	x	x	-	-
286. Psychology	-	-	-	x	x	-	-
287. Psychology	-	-	x	x	-	-	-
288. Psychology	-	x	-	-	x	-	x
289. Sociology	-	-	x	x	x	-	x
290. Sociology	x	-	x	x	x	-	-

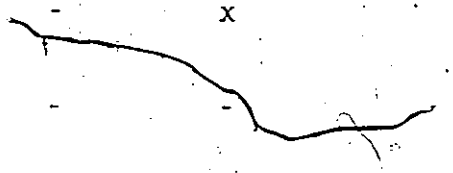
	CBI	BNB	FB	PS	LC	CAN	PTLA
291. Sociology	x	-	-	x	x	-	x
292. Sociology	x	-	x	x	x	-	-
293. Sociology	x	-	-	x	x	-	-
294. Sociology	x	x	x	x	x	-	x
295. Sociology	-	-	-	x	x	-	-
296. Sociology	x	-	-	x	x	-	x
297. Sociology	x	-	x	x	x	-	-
298. Sociology	-	-	-	-	x	-	-
299. Sociology	-	-	-	-	x	-	-
300. Sociology	-	x	-	-	-	-	-
301. Sociology	-	-	x	x	x	-	x
302. Sociology	-	-	-	x	x	-	-
303. Sociology	-	-	-	x	x	-	-
304. Sociology	-	x	-	x	-	-	-
305. Sociology	-	-	x	x	x	-	x
306. Sociology	-	-	x	x	x	-	-
307. Theology	x	-	-	-	x	-	x
308. Theology	x	-	-	-	x	-	x

	CBI	BNB	FB	PS	LC	CAN	PTLA
309. Theology	x	-	x	-	x	-	-
310. Theology	-	-	x	-	x	-	-
311. Theology	-	-	x	x	-	-	-
312. Political Science	x	-	-	-	x	-	x
313. Political Science	x	x	-	x	x	-	-
314. Political Science	x	-	x	x	x	-	x
315. Political Science	x	-	x	x	x	-	x
316. Political Science	x	-	x	x	x	-	x
317. Political Science	x	-	x	x	x	-	-
318. Political Science	-	-	-	x	x	-	x
319. Drama	-		-		x	-	-
320. Drama	-	-	-	-	x	-	-
321. Drama	-	-	-	x	x	-	x
322. Drama	-	-	-	x	x	-	x

	CBI	BNB	FB	PS	LC	CAN	PTLA
323. Drama	-	-	-	x	x	-	-
324. Drama	-	-	x	x	x	-	x
325. Drama	-	-	-	x	x	-	x
326. Drama	-	-	-	x	x	-	x
327. Classics	-	x	x	-	-	-	-
328. Classics	-	x	x	-	-	-	-
329. Classics	-	x	x	-	-	-	-
330. Classics	-	x	-	x	x	-	-
331. Classics	-	-	x	-	-	-	-
332. Classics	-	x	-	-	-	-	x
333. Classics	-	x	x	x	x	-	-
334. Classics	-	-	-	-	-	-	x
335. Classics	-	-	x	-	-	-	x
336. Classics	-	x	-	x	-	-	-
337. Classics	-	x	x	x	-	-	-
338. Theology	x	x	-	-	x	-	-
339. Theology	x	x	-	-	x	-	-
340. Theology	x	-	-	-	x	-	x

	CBI	BNB	FB	PS	LC	CAN	PTLA
341. Theology	-	-	-	-	x	-	x
342. Theology	x	-	-	-	x	-	x
343. Theology	x	-	-	-	x	-	-
344. Theology	x	x	-	-	x	-	x
345. Theology	x	x	-	-	x	-	-
346. Theology	x	-	x	-	x	-	-
347. Theology	x	-	-	x	x	-	x
348. Theology	x	x	-	x	x	-	-
349. Theology	-	-	-	x	-	-	-
350. Theology	-	-	-	-	x	-	-
351. Theology	-	-	-	-	x	-	-
352. Theology	-	-	-	-	x	-	-
353. Computer Science	x	-	-	x	x	-	x
354. Computer Science	-	-	x	x	x	-	-
355. Mechanical Engineering	-	-	x	-	-	-	-
356. Biology	-	-	x	x	x	-	x

	CBI	BNB	FB	PS	LC	CAN	PTLA
357. Philosophy	x	x	-	-	x	-	x
358. Philosophy	x	x	-	-	x	-	x
359. Philosophy	x	-	-	-	-	-	-
360. Philosophy	-	x	-	x	x	-	-
361. Physical Education	-	-	-	-	x	-	-
362. Physical Education	-	-	-	-	x	-	x
363. Physical Education	-	-	-	-	-	-	-
364. Physical Education	-	-	-	-	x	-	-
365. Physical Education	-	-	-	-	x	-	-
366. Physical Education	-	-	-	-	x	-	-
367. Physical Education	x	-	-	-	x	-	-
368. Physical Education	-	-	-	x	x	-	x
369. Communication Arts	-	x	x	x	x	-	-



	CBI	BNB	FB	PS	LC	CAN	PTLA
370. Communication Arts	-	-	-	x	x	-	x
371. Communication Arts	-	-	-	x	x	-	-
372. Communication Arts	-	x	-	-	x	-	-
373. Communication Arts	-	x	x	-	-	-	-
374. Communication Arts.	-	-	-	-	-	-	x
375. Communication Arts	-	-	-	-	-	-	-
376. Philosophy	-	-	-	-	x	-	-
377. Philosophy	-	-	-	x	x	-	-
378. Philosophy	-	-	-	x	x	-	-
379. Philosophy	-	-	-	-	-	-	x
380. Philosophy	-	-	x	-	x	-	
381. Philosophy	-	x	x	-	x	-	-
382. Philosophy	-	-	-	x	x	-	-
383. Philosophy	-	-	-	x	x	-	x

	CBI	BNB	FB	PS	LC	CAN	PTLA
384. Philosophy	-	-	-	x	x	-	x
385. Philosophy	-	-	-	x	x	-	x
386. Philosophy	-	-	-	-	-	-	x
387. Philosophy	-	-	-	x	x	-	x
388. Philosophy	x	-	-	-	x	-	-
389. History	-	-	x	x	-	-	x
390. History	-	-	-	x	-	-	-
391. History	-	-	-	x	x	-	x
392. History	-	-	-	-	-	-	-
393. History	-	-	-	-	x	x	-
394. Geography	-	-	-	x	x	-	-
395. Geography	x	-	-	-	x	-	x
396. Geography	-	-	-	-	x	-	-
397. Geography	-	-	-	-	x	-	-
398. Geography	-	-	-	-	x	-	-
399. Geography	-	-	-	-	-	-	-
400. Hispanic Studies	x	-	-	-	x	-	-

	CBI	BNB	FB	PS	LC	CAN	PTLA
401. Sociology	-	-	-	-	-	-	-
402. Sociology	-	-	-	-	-	-	-
403. Sociology	-	-	-	-	-	-	-
404. Sociology	-	-	-	-	-	-	-
405. Sociology	-	-	-	-	-	-	-
406. Sociology	-	-	-	-	-	-	-
407. Theology	-	-	-	-	-	-	-
408. Theology	-	-	-	-	-	-	-
409. Theology	-	-	-	-	-	-	-
410. Theology	-	-	-	-	-	-	-
411. Theology	-	-	-	-	-	-	-
412. Political Science	-	-	-	-	-	-	-
413. Political Science	-	-	-	-	-	-	-
414. Political Science	-	-	-	-	-	-	-
415. Political Science	-	-	-	-	-	-	-

	CBI	BNB	FB	PS	LC	CAN	PTLA
416. Political Science	-	-	-	-	-	-	-
417. Political Science	-	-	-	-	-	-	-
418. Political Science	-	-	-	-	-	-	-
419. Drama	-	-	-	-	-	-	-
420. Drama	-	-	-	-	-	-	-
421. Drama	-	-	-	-	-	-	-
422. Drama	-	-	-	-	-	-	-
423. Drama	-	-	-	-	-	-	-
424. Drama	-	-	-	-	-	-	-
425. Drama	-	-	-	-	-	-	-
426. Drama	-	-	-	-	-	-	-
427. Classics	-	-	-	-	-	-	-
428. Classics	-	-	-	-	-	-	-
429. Classics	-	-	-	-	-	-	-
430. Classics	-	-	-	-	-	-	-
431. Classics	-	-	-	-	-	-	-

	CBI	BNB	FB	PS	LC	CAN	PTLA
432. Classics	-	-	-	-	-	-	-
433. Classics	-	-	-	-	-	-	-
434. Classics	-	-	-	-	-	-	-
435. Classics	-	-	-	-	-	-	-
436. Classics	-	-	-	-	-	-	-
437. Classics	-	-	-	-	-	-	-
438. Theology	-	-	-	-	-	-	-
439. Theology	-	-	-	-	-	-	-
440. Theology	-	-	-	-	-	-	-
441. Theology	-	-	-	-	-	-	-
442. Theology	-	-	-	-	-	-	-
443. Theology	-	-	-	-	-	-	-
444. Theology	-	-	-	-	-	-	-
445. Theology	-	-	-	-	-	-	-
446. Theology	-	-	-	-	-	-	-
447. Theology	-	-	-	-	-	-	-
448. Theology	-	-	-	-	-	-	-
449. Theology	-	-	-	-	-	-	-

	CBI	BNB	FB	PS	LC	CAN	PTLA
450. Theology	-	-	-	-	-	-	-
451. Theology	-	-	-	-	-	-	-
452. Theology	-	-	-	-	-	-	-
453. Computer Science	-	-	-	-	-	-	-
454. Computer Science	-	-	-	-	-	-	-
455. Mechanical Engineering	-	-	-	-	-	-	-
456. Biology	-	-	-	-	-	-	-
457. Philosophy	-	-	-	-	-	-	-
458. Philosophy	-	-	-	-	-	-	-
459. Philosophy	-	-	-	-	-	-	-
460. Philosophy	-	-	-	-	-	-	-
461. Physical Education	-	-	-	-	-	-	-
462. Physical Education	-	-	-	-	-	-	-
463. Physical Education	-	-	-	-	-	-	-

	CBI	BNB	FB	PS	LC	CAN	PTLA
464. Physical Education	-	-	-	-	-	-	-
465. Physical Education	-	-	-	-	-	-	-
466. Physical Education	-	-	-	-	-	-	-
467. Physical Education	-	-	-	-	-	-	-
468. Physical Education	-	-	-	-	-	-	-
469. Communication Arts	-	-	-	-	-	-	-
470. Communication Arts	-	-	-	-	-	-	-
471. Communication Arts	-	-	-	-	-	-	-
472. Communication Arts	-	-	-	-	-	-	-
473. Communication Arts	-	-	-	-	-	-	-
474. Communication Arts	-	-	-	-	-	-	-
475. Communication Arts	-	-	-	-	-	-	-

	CBI	BNB	FB	PS	LC	CAN	PTLA
476. Philosophy	-	-	-	-	-	-	-
477. Philosophy	-	-	-	-	-	-	-
478. Philosophy	-	-	-	-	-	-	-
479. Philosophy	-	-	-	-	-	-	-
480. Philosophy	-	-	-	-	-	-	-
481. Philosophy	-	-	-	-	-	-	-
482. Philosophy	-	-	-	-	-	-	-
483. Philosophy	-	-	-	-	-	-	-
484. Philosophy	-	-	-	-	-	-	-
485. Philosophy	-	-	-	-	-	-	-
486. Philosophy	-	-	-	-	-	-	-
487. Philosophy	-	-	-	-	-	-	-
488. Philosophy	-	-	-	-	-	-	-
489. History	-	-	-	-	-	-	-
490. History	-	-	-	-	-	-	-
491. History	-	-	-	-	-	-	-
492. History	-	-	-	-	-	-	-

	CBI	BNB	FB	PS	LC	CAN	PTLA
493. History	–	–	–	–	–	–	–
494. Geography	–	–	–	–	–	–	–
495. Geography	–	–	–	–	–	–	–
496. Geography	–	–	–	–	–	–	–
497. Geography	–	–	–	–	–	–	–
498. Geography	–	–	–	–	–	–	–
499. Geography	–	–	–	–	–	–	–
500. Hispanic Studies	–	–	–	–	–	–	–
	161			161	307		203

The conditional Probabilities of Bibliographic Searching tools for Monographs are as follows:

Tool 1 = T1 = LC

Tool 2 = T2 = PS

Tool 3 = T3 = CBI

Tool 4 = T4 = PTLA

$P(\text{Success}) = \frac{832}{2000}$

$P(\text{Tool 1 . Success}) = \frac{307}{2000}$

$P(\text{Tool 2 . Success}) = \frac{161}{2000}$

$P(\text{Tool 3 . Success}) = \frac{161}{2000}$

$P(\text{Tool 4 . Success}) = \frac{203}{2000}$

$$CBI = P(T3 \mid S) = \frac{P(\text{Tool 3 . Success})}{P(\text{Success})} = \frac{161}{2000} * \frac{2000}{832}$$

$$= \frac{161}{832} = .1935$$

Similarly

$PS = P(T2 \mid S) = \frac{161}{832} = .1935$

$LC = P(T1 \mid S) = \frac{307}{832} = .369$

$PTLA = P(T4 \mid S) = \frac{203}{832} = .244$

SERIALS

DEPARTMENT	NST	ULS	PS	LC	ULR
1. Anthropology	-	x	-	x	-
2. General	-	x	-	x	-
3. General	-	-	-	-	-
4. General	x	-	-	x	x
5. Political Science	x	-	-	-	-
6. Economics	x	-	-	-	x
7. Sociology	-	-	-	-	-
8. Social Work	-	-	-	-	-
9. Anthropology	x	-	-	-	x
10. General	-	-	-	-	-
11. Psychology	-	x	-	x	-
12. Political Science	x	-	-	-	-
13. Theology	-	-	-	-	-
14. Anthropology	x	-	-	-	-
15. Geography	-	-	-	-	-

	NST	ULS	PS	LC	ULR
16. Psychology	-	-	-	-	-
17. Philosophy	-	-	x	-	-
18. Theology	-	-	-	-	-
19. Economics	x	-	-	-	x
20. Political Science	x	-	-	-	-
21. Political Science	x	-	-	x	-
22. Theology					
23. English	x	-	-	-	-
24. English	-	-	-	-	-
25. Sociology	x	-	x	x	-
26. French	-	-	-	-	-
27. French	-	-	-	-	-
28. Asian Studies	-	-	-	-	-
29. Anthropology	-	x	-	x	-
30. French	-	-	-	-	-
31. General	-	-	-	-	-
32. Philosophy	-	x	-	-	-

	NST	ULS	PS	LC	ULR
33. Political Science	x	-	x	-	-
34. French	-	-	-	x	-
35. French	-	-	-	x	-
36. French	-	-	-	x	-
37. Theology	x	-	x	x	-
38. Theology	x	-	-	-	-
39. Political Science	-	-	-	-	
40. Anthropology	x	-	-	-	-
41. Political Science	-	-	-	-	-
42. Political Science	-	-	-	-	-
43. Theology	-	-	-	-	-
44. French	-	-	-	-	-
45. Social Work	-	-	-	-	-
46. Psychology	-	-	-	-	-
47. Economics	-	-	-	-	-
48. Communication Arts	x	-	-	x	x
49. Communication Arts	-	x	-	x	-
50. Political Science	x	-	-	-	-

	NST	ULS	PS	LC	ULR
51. Political Science	x	-	-	-	-
52. Physics	-	-	-	-	x
53. Theology	x	-	-	-	-
54. Theology	-	-	-	-	x
55. French	x	-	-	-	-
56. Theology	x	-	-	-	-
57. Political Science	-	-	-	-	-
58. Theology	-	x	-	x	-
59. Theology	-	x	-	x	-
60. Nursing	x	-	x	-	x
61. French	-	-	-	x	-
62. Theology	-	x	-	x	-
63. Philosophy	-	-	-	-	-
64. Theology	-	-	-	x	-
65. Theology	-	x	-	x	-
66. Theology	-	x	-	x	-
67. Theology	x	x	-	x	-

	NST	ULS	PS	LC	ULR
68. French	x	-	x	-	-
69. French	x	-	x	-	-
70. French	x	-	x	-	-
71. French	x	-	x	-	-
72. Philosophy	-	-	-	-	-
73. Theology	x	-	-	-	x
74. Philosophy	-	-	-	-	-
75. Theology	x	-	-	-	-
76. Theology	-	-	-	x	-
77. Psychology	-	x	-	x	-
78. Psychology	x	-	-	x	-
79. French	x	-	-	x	-
80. French	x	-	-	-	-
81. Sociology	x	-	x	x	-
82. German & Slavic	-	-	-	x	-
83. French	x	-	-	-	-
84. French	x	-	-	x	-

	NST	ULS	PS	LC	ULR
85. Hispanic Studies	-	x	-	x	-
86. French	x	-	-	-	-
87. French	x	-	-	-	-
88. Geography	x	-	-	-	-
89. Geography	x	-	x	x	-
90. Geography	x	-	-	x	-
91. Geography	-	x	-	x	-
92. Geography	x	-	-	-	x
93. Geography	x	-	-	-	-
94. Geography	x	-	-	-	-
95. Geography	-	x	-	x	-
96. Geography	x	-	x	x	-
97. Asian Studies	-	x	x	x	-
98. Geography	x	-	-	-	-
99. Geography	x	-	x	x	-
100. Geography	-	x	-	x	-
	46	18	14	37	

The Conditional Probabilities of Bibliographic Searching tools for Serials are as follows:

Tool 1 = T1 = LC

Tool 2 = T2 = PS

Tool 3 = T3 = NST

Tool 4 = T4 = ULS

$P(\text{Success}) = \frac{115}{400}$

$P(\text{Tool 1} \cdot S) = \frac{37}{400}$

$P(\text{Tool 2} \cdot S) = \frac{14}{400}$

$P(\text{Tool 3} \cdot S) = \frac{46}{400}$

$P(\text{Tool 4} \cdot S) = \frac{18}{400}$

$$NST = P(T3 \mid S) = \frac{P(\text{Tool 3} \cdot \text{Success})}{P(\text{Success})} = \frac{46}{400} * \frac{400}{115}$$

$$= \frac{46}{115} = .4$$

Similarly

$LC = P(T1 \mid S) = \frac{37}{115} = .322$

$ULS = P(T4 \mid S) = \frac{18}{115} = .156$

$PS = P(T2 \mid S) = \frac{14}{115} = .122$

APPENDIX B

SAMPLE PROFORMA AND TIME STUDY DATA FOR SEARCHING OF MONOGRAPHS AND SERIALS IN THEIR RESPECTIVE BIBLIOGRAPHIC TOOLS WITH DIFFERENT SEQUENCES

MONOGRAPHS/SERIALS

REQUISITION INFORMATION

DEPARTMENT:

LANGUAGE:

SEARCHERS INFORMATION

EXPERIENCE:

TOOL	TIME	TOOL	TIME	TOOL	TIME	TOOL	TIME
LC		LC		LS		LC	
PS		PS		CBI/NST		CBI/NST	
CBI/NST		PTLA/ULS		PS		PTLA/ULS	
PTLA/ULS		CBI/NST		PTLA/ULS		PS	

TOOL	TIME	TOOL	TIME	TOOL	TIME	TOOL	TIME
LC		LC		PS		PS	
PTLA/ULS		TLA/ULS		CBI/NST		CBI/NST	
CBI/NST		PS		PTLA/ULS		LC	
PS		CBI/NST		LC		PTLA/ULS	

TOOL	TIME	TOOL	TIME	TOOL	TIME	TOOL	TIME
PS		PS		PS		PS	
LC		LC		PTLA/ULS		PTLA/ULS	
CBI/NST		PTLA/ULS		LC		CBI/NST	
PTLA/ULS		CBI/NST		CBI/NST		LC	

TOOL	TIME	TOOL	TIME	TOOL	TIME	TOOL	TIME
CBI /NST		CBI /NST		CBI /NST		CBI /NST	
LC		PTLA /ULS		PTLA /ULS		LC	
PTLA /ULS		LC		PS		PS	
PS		PS		LC		PTLA /ULS	

TOOL	TIME	TOOL	TIME	TOOL	TIME	TOOL	TIME
CBI /NST		CBI /NST		PTLA /ULS		PTLA /ULS	
PS		PS		LC		PS	
LC		PTLA /ULS		PS		CPF /NST	
PTLA /ULS		LC		CBI /NST		LC	

TOOL	TIME	TOOL	TIME	TOOL	TIME	TOOL	TIME
PTLA /ULS		PTLA /ULS		PTLA /ULS		PTLA /ULS	
CBI /NST		PS		CBI /NST		LC	
PS		LC		LC		CBI /NST	
LC		CBI /NST		PS		PS	

MONOGRAPHS

LEGEND

LC	1	Library of Congress Catalogue
PS	2	Library of Congress Proof Slips
CBI	3	Cumulative Book Index
PTLA	4	Publishers Trade List Annual

MONOGRAPHS REQUISITIONS

TIME STUDY SUMMARY (Mins.)

SEQUENCES		1	2	3	4	5	6	7	8	9	10
(1)	1	1.2	2.35	5.5	.7	1.9	3.85	.5	.7	.3	.3
	2	2.1	.5	1.8	.5	1.4	.84	.3	.5	.6	.1
	3	.6	1.9	4.5	.5	.7	.67	.9	.6	.3	.3
	4	.4	.53	.2	.7	.6	.17	.5	.8	.2	.5
(2)	1	1.2	2.35	5.5	.7	1.9	3.85	.5	.7	.3	.3
	2	2.1	.5	1.8	.5	1.4	.84	.3	.5	.6	.1
	4	.4	.53	.2	.7	.6	.17	.5	.8	.2	.5
	3	.6	1.9	4.5	.5	.7	.67	.9	.6	.3	.3
(3)	1	1.2	2.35	5.5	.7	1.9	3.85	.5	.7	.3	.3
	3	.6	1.9	4.5	.5	.7	.67	.9	.6	.3	.3
	2	2.1	.5	1.8	.5	1.4	.84	.3	.5	.6	.1
	4	.4	.53	.2	.7	.6	.17	.5	.8	.2	.5
(4)	1	1.2	2.35	5.5	.7	1.9	3.85	.5	.7	.3	.3
	3	.6	1.9	4.5	.5	.7	.67	.9	.6	.3	.3
	4	.4	.53	.2	.7	.6	.17	.5	.8	.2	.5
	2	2.1	.5	1.8	.5	1.4	.84	.3	.5	.6	.1
(5)	1	1.2	2.35	5.5	.7	1.9	3.85	.5	.7	.3	.3
	4	.4	.53	.2	.7	.6	.17	.5	.8	.2	.5
	3	.6	1.9	4.5	.5	.7	.67	.9	.6	.3	.3
	2	2.1	.5	1.8	.5	1.4	.84	.3	.5	.6	.1
(6)	1	1.2	2.35	5.5	.7	1.9	3.85	.5	.7	.3	.3
	4	.4	.53	.2	.7	.6	.17	.5	.8	.2	.5
	2	2.1	.5	1.8	.5	1.4	.84	.3	.5	.6	.1
	3	.6	1.9	4.5	.5	.7	.67	.9	.6	.3	.3
(7)	2	2.1	.5	1.8	.5	1.4	.84	.3	.5	.6	.1
	3	.6	1.9	4.5	.5	.7	.67	.9	.6	.3	.3
	4	.4	.53	.2	.7	.6	.17	.5	.8	.2	.5
	1	1.2	2.35	5.5	.7	1.9	3.85	.5	.7	.3	.3
(8)	2	2.1	.5	1.8	.5	1.4	.84	.3	.5	.6	.1
	3	.6	1.9	4.5	.5	.7	.67	.9	.6	.3	.3
	1	1.2	.53	5.5	.7	1.9	3.85	.5	.7	.3	.3
	4	.4	2.35	.2	.7	.6	.17	.5	.8	.2	.5
(9)	2	2.1	.5	1.8	.5	1.4	.84	.3	.5	.6	.1
	1	1.2	2.35	5.5	.7	1.9	3.85	.5	.7	.3	.3
	3	.6	1.9	4.5	.5	.7	.67	.9	.6	.3	.3
	4	.4	.53	.2	.7	.6	.17	.5	.8	.2	.5

MONOGRAPHS REQUISITIONS

TIME STUDY SUMMARY (Mins.)

SEQUENCES		11	12	13	14	15	16	17	18	19	20
(1)	1	5.95	.6	4.1	1.6	1.3	.6	.7	1.8	1.3	1.8
	2	3.20	.1	.1	1.4	1.4	1.1	.7	.5	.5	.5
	3	.50	.8	4.0	1.2	1.0	.4	.5	.5	.9	1.8
	4	.80	.2	.8	1.2	.5	1.0	.5	.5	.9	.2
(2)	1	5.95	.6	4.1	1.6	1.3	.6	.7	1.8	1.3	1.8
	2	3.20	.1	.1	1.4	1.4	1.1	.7	.5	.5	.5
	4	.80	.2	.8	1.2	.5	1.0	.5	.5	.9	.2
	3	.50	.8	4.0	1.2	1.0	.4	.5	.5	.9	1.8
(3)	1	5.95	.6	4.1	1.6	1.3	.6	.7	1.8	1.3	1.8
	3	.5	.8	4.0	1.2	1.0	.4	.5	.5	.9	1.8
	2	3.20	.1	.1	1.4	1.4	1.1	.7	.5	.5	.5
	4	.80	.2	.8	1.2	.5	1.0	.5	.5	.9	.2
(4)	1	5.95	.6	4.1	1.6	1.3	.6	.7	1.8	1.3	1.8
	3	.50	.8	4.0	1.2	1.0	.4	.5	.5	.9	1.8
	4	.80	.2	.8	1.2	.5	1.0	.5	.5	.9	.2
	2	3.20	.1	.1	1.4	1.4	1.1	.7	.6	.5	.5
(5)	1	5.95	.6	4.1	1.6	1.3	.6	.7	1.8	1.3	1.8
	4	.80	.2	.8	1.2	.5	1.0	.5	.5	.9	.2
	3	.50	.8	4.0	1.2	1.0	.4	.5	.5	.9	1.8
	2	3.20	.1	.1	1.4	1.4	1.1	.7	.6	.5	.5
(6)	1	5.95	.6	4.1	1.6	1.3	.6	.7	1.8	1.3	1.8
	4	.80	.2	.8	1.2	.5	1.0	.5	.5	.9	.2
	2	3.20	.1	4.1	1.4	1.4	1.1	.7	.5	.5	.5
	3	.50	.8	4.0	1.2	1.0	.4	.5	.5	.9	1.8
(7)	2	3.20	.1	0.1	1.4	1.4	1.1	.7	.5	.5	.5
	3	.50	.8	4.0	1.2	1.0	.4	.5	.5	.9	1.8
	4	.80	.2	.8	1.2	.5	1.0	.5	.5	.9	.2
	1	5.95	.6	4.1	1.6	1.3	.6	.7	1.8	1.3	1.8
(8)	2	3.20	.1	.1	1.4	1.4	1.1	.7	.5	.5	.5
	3	.50	.8	4.0	1.2	1.0	.4	.5	.5	.9	1.8
	1	5.95	.6	4.1	1.6	1.3	.6	.7	1.8	1.3	1.8
	4	.80	.2	.8	1.2	.5	1.0	.5	.5	.9	.2
(9)	2	3.20	.1	.1	1.4	1.4	1.1	.7	.5	.5	.5
	1	5.95	.6	4.1	1.6	1.3	.6	.7	1.8	1.3	1.8
	3	.50	.8	4.0	1.2	1.0	.4	.5	.5	.9	1.8
	4	.80	.2	.8	1.2	.5	1.0	.5	.5	.9	.2

...OGRAPHS REQUISITIONS

...E STUDY SUMMARY (Mins.)

SUBJECTS		21	22	23	24	25
(1)	1	2.4	4.7	5.0	.2	.3
	2	.	2.5	1.3	.3	.4
	3	1.4	7.6	5.7	.2	.1
	4	.5	1.8	1.3	.1	.1
(2)	1	2.4	4.7	5.0	.2	.3
	2	.	2.5	1.3	.3	.4
	4	.5	1.8	1.3	.1	.1
	3	1.4	7.6	5.7	.2	.1
(3)	1	2.4	4.7	5.0	.2	.3
	3	1.4	7.6	5.7	.2	.1
	2	.	2.5	1.3	.3	.4
	4	.5	1.8	1.3	.1	.1
(4)	1	2.4	4.7	5.0	.2	.3
	3	1.4	7.6	5.7	.2	.1
	4	.5	1.8	1.3	.1	.1
	2	.9	2.5	1.3	.3	.4
(5)	1	2.4	4.7	5.0	.2	.3
	4	.5	1.8	1.3	.1	.6
	3	1.4	7.6	5.7	.2	.1
	2	.9	2.5	1.3	.3	.4
(6)	1	2.4	4.7	5.0	.2	.3
	4	.5	1.8	1.3	.1	.6
	2	.	2.5	1.3	.3	.4
	3	1.4	7.6	5.7	.2	.1
(7)	2	.	2.5	1.3	.3	.4
	3	1.4	7.6	5.7	.2	.1
	4	.5	1.8	1.3	.1	.6
	1	2.4	4.7	5.0	.2	.3
(8)	2	.	2.5	1.3	.3	.4
	3	1.4	7.6	5.7	.2	.1
	1	2.4	4.7	5.0	.2	.3
	4	.5	1.8	1.3	.1	.6
(9)	2	.	2.5	1.3	.3	.4
	1	2.4	4.7	5.0	.2	.3
	3	1.4	7.6	5.7	.2	.1
	4	.5	1.8	1.3	.1	.6

NOMOGRAPHS REQUISITIONS

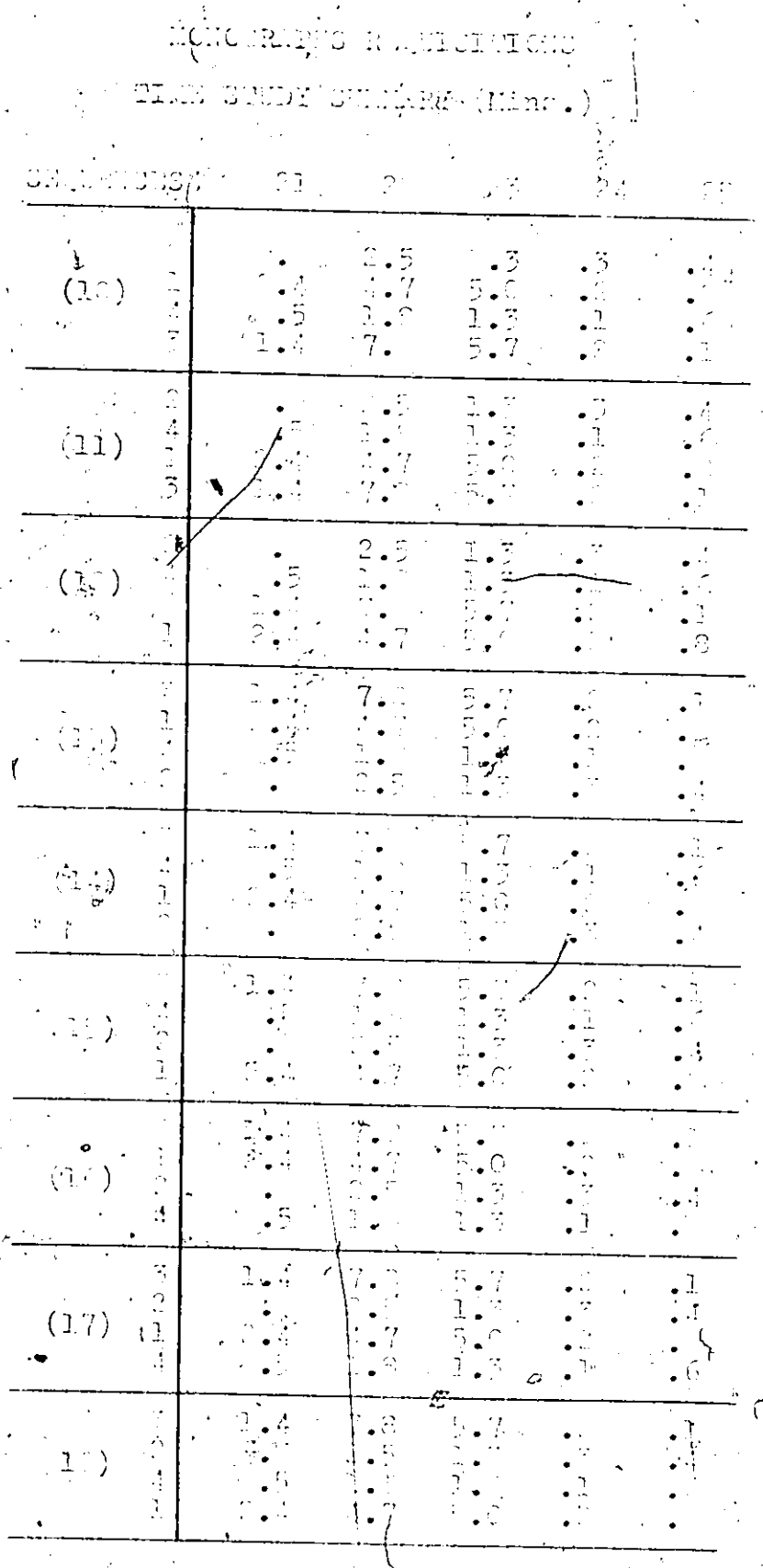
TIME STUDY SUMMARY (Hours.)

SEL. VALUES		1	2	3	4	5	6	7	8	9	10
(10)	2	2.1	.5	1.8	.5	1.4	.84	.9	.5	.6	.1
	1	1.2	2.35	5.5	.7	1.9	3.85	.5	.7	.5	.5
	4	.4	.55	.2	.7	.6	.17	.5		.5	.5
	3	.6	1.9	4.5	.5	.7	.7	.9	.6	.5	.5
(11)	2	2.1	.5	1.8	.5	1.4	.84	.9	.5	.6	.1
	4	.4	.55	.2	.7	.6	.17	.5		.5	.5
	1	1.2	2.35	5.5	.7	1.9	3.85	.5	.7	.5	.5
	3	.6	1.9	4.5	.5	.7	.67	.9	.6	.5	.5
(12)	2	2.1	.5	1.8	.5	1.4	.84	.9	.5	.6	.1
	4	.4	.55	.2	.7	.6	.17	.5		.5	.5
	3	.6	1.9	4.5	.5	.7	.67	.9	.6	.5	.5
	1	1.2	2.35	5.5	.7	1.9	3.85	.5	.7	.5	.5
(13)	3	.6	1.9	4.5	.5	.7	.67	.9	.6	.5	.5
	1	1.2	2.35	5.5	.7	1.9	3.85	.5	.7	.5	.5
	4	.4	.55	.2	.7	.6	.17	.5		.5	.5
	2	2.1	.5	1.8	.5	1.4	.84	.9	.5	.6	.1
(14)	3	.6	1.9	4.5	.5	.7	.67	.9	.6	.5	.5
	4	.4	.55	.2	.7	.6	.17	.5		.5	.5
	1	1.2	2.35	5.5	.7	1.9	3.85	.5	.7	.5	.5
	2	2.1	.5	1.8	.5	1.4	.84	.9	.5	.6	.1
(15)	3	.6	1.9	4.5	.5	.7	.67	.9	.6	.5	.5
	4	.4	.55	.2	.7	.6	.17	.5		.5	.5
	2	2.1	.5	1.8	.5	1.4	.84	.9	.5	.6	.1
	1	1.2	2.35	5.5	.7	1.9	3.85	.5	.7	.5	.5
(16)	3	.6	1.9	4.5	.5	.7	.67	.9	.6	.5	.5
	1	1.2	2.35	5.5	.7	1.9	3.85	.5	.7	.5	.5
	2	2.1	.5	1.8	.5	1.4	.84	.9	.5	.6	.1
	4	.4	.55	.2	.7	.6	.17	.5		.5	.5
(17)	3	.6	1.9	4.5	.5	.7	.67	.9	.6	.5	.5
	2	2.1	.5	1.8	.5	1.4	.84	.9	.5	.6	.1
	1	1.2	2.35	5.5	.7	1.9	3.85	.5	.7	.5	.5
	4	.4	.55	.2	.7	.6	.17	.5	.8	.2	.5
(18)	3	.6	1.9	4.5	.5	.7	.67	.9	.6	.5	.5
	2	2.1	.5	1.8	.5	1.4	.84	.9	.5	.6	.1
	4	.4	.55	.2	.7	.6	.17	.5		.5	.5
	1	1.2	2.35	5.5	.7	1.9	3.85	.5	.7	.5	.5

LONGRANS REQUISITIONS

TIME STUDY SUMMARY (Mins.)

SUBJECTS		11	12	13	14	15	16	17	18	19	20
(10)	2	3.20	.1	.1	1.4	1.4	1.1	.7	.6	.5	.5
	4	5.95	.6	4.1	1.6	1.3	.6	.7	1.8	1.3	1.8
	1	.0	.2	.8	1.2	.5	1.0	.5	.5	.3	.2
	3	.50	.8	4.0	1.2	1.0	.4	.5	.5	.0	1.2
(11)	2	3.20	.1	.1	1.4	1.4	1.1	.7	.6	.5	.5
	4	.00	.2	.8	1.2	.5	1.0	.5	.5	.3	.2
	1	5.15	.6	4.1	1.6	1.3	.6	.7	1.8	1.3	1.8
	3	.50	.8	4.0	1.2	1.0	.4	.5	.5	.0	1.2
(12)	2	3.20	.1	.1	1.4	1.4	1.1	.7	.6	.5	.5
	4	.00	.2	.8	1.2	.5	1.0	.5	.5	.3	.2
	3	.50	.8	4.0	1.2	1.0	.4	.5	.5	.0	1.2
	1	5.95	.6	4.1	1.6	1.3	.6	.7	1.8	1.3	1.8
(13)	3	.50	.8	4.0	1.2	1.0	.4	.5	.5	.0	1.2
	1	5.95	.6	4.1	1.6	1.3	.6	.7	1.8	1.3	1.8
	4	.80	.2	.2	1.2	.5	1.0	.5	.5	.3	.2
	2	3.20	.1	.1	1.4	1.4	1.1	.7	.6	.5	.5
(14)	3	.50	.8	4.0	1.2	1.0	.4	.5	.5	.0	1.2
	4	.00	.2	.8	1.2	.5	1.0	.5	.5	.3	.2
	1	5.95	.6	4.1	1.6	1.3	.6	.7	1.8	1.3	1.8
	2	3.20	.1	.1	1.4	1.4	1.1	.7	.6	.5	.5
(15)	3	.50	.8	4.0	1.2	1.0	.4	.5	.5	.0	1.2
	4	.00	.2	.8	1.2	.5	1.0	.5	.5	.3	.2
	2	3.20	.1	.1	1.4	1.4	1.1	.7	.6	.5	.5
	1	5.95	.6	4.1	1.6	1.3	.6	.7	1.8	1.3	1.8
(16)	3	.50	.8	4.0	1.2	1.0	.4	.5	.5	.0	1.2
	1	5.95	.6	4.1	1.6	1.3	.6	.7	1.8	1.3	1.8
	2	3.20	.1	.1	1.4	1.4	1.1	.7	.6	.5	.5
	4	.00	.2	.8	1.2	.5	1.0	.5	.5	.3	.2
(17)	3	.50	.8	4.0	1.2	1.0	.4	.5	.5	.0	1.2
	2	3.20	.1	.1	1.4	1.4	1.1	.7	.6	.5	.5
	1	5.95	.6	4.1	1.6	1.3	.6	.7	1.8	1.3	1.8
	4	.00	.2	.8	1.2	.5	1.0	.5	.5	.3	.2
(18)	3	.50	.8	4.0	1.2	1.0	.4	.5	.5	.0	1.2
	4	.00	.2	.8	1.2	.5	1.0	.5	.5	.3	.2
	2	3.20	.1	.1	1.4	1.4	1.1	.7	.6	.5	.5
	1	5.95	.6	4.1	1.6	1.3	.6	.7	1.8	1.3	1.8



MONOGRAPHS REQUISITIONS

TIME STUDY SUMMARY (Mins.)

SEQUENCES		1	2	3	4	5	6	7	8	9	10
(19)	4	.4	.54	.2	.7	.6	.17	.5	.8	.2	.5
	1	1.2	2.35	5.5	.7	1.9	3.85	.5	.7	.3	.3
	2	2.1	.5	1.8	.5	1.4	.84	.3	.5	.6	.1
	3	.6	1.9	4.5	.5	.7	.67	.9	.6	.3	.3
(20)	4	.4	.53	.2	.7	.6	.17	.5	.8	.2	.5
	2	2.1	.5	1.8	.5	1.4	.84	.3	.5	.6	.1
	3	.6	1.9	4.5	.5	.7	.67	.9	.6	.3	.3
	1	1.2	2.35	5.5	.7	1.9	3.85	.5	.7	.3	.3
(21)	4	.4	.53	.2	.7	.6	.17	.5	.8	.2	.5
	3	.6	1.9	4.5	.5	.7	.67	.9	.6	.3	.3
	2	2.1	.5	1.8	.5	1.4	.84	.3	.5	.6	.1
	1	1.2	2.35	5.5	.7	1.9	3.85	.5	.7	.3	.3
(22)	4	.4	.53	.2	.7	.6	.17	.5	.8	.2	.5
	2	2.1	.5	1.8	.5	1.4	.84	.3	.5	.6	.1
	1	1.2	2.35	5.5	.7	1.9	3.85	.5	.7	.3	.3
	3	.6	1.9	4.5	.5	.7	.67	.9	.6	.3	.3
(23)	4	.4	.53	.2	.7	.6	.17	.5	.8	.2	.5
	3	.6	1.9	4.5	.5	.7	.67	.9	.6	.3	.3
	1	1.2	2.35	5.5	.7	1.9	3.85	.5	.7	.3	.3
	2	2.1	.5	1.8	.5	1.4	.84	.3	.5	.6	.1
(24)	4	.4	.53	.2	.7	.6	.17	.5	.8	.2	.5
	1	1.2	2.35	5.5	.7	1.9	3.85	.5	.7	.3	.3
	3	.6	1.9	4.5	.5	.7	.67	.9	.6	.3	.3
	2	2.1	.5	1.8	.5	1.4	.84	.3	.5	.6	.1

MONOGRAPHS REQUISITIONS

TIME STUDY SUMMARY (Mins.)

SEQUENCES		11	12	13	14	15	16	17	18	19	20
(19)	4	.80	.2	.8	1.2	.5	1.0	.5	.5	.3	.2
	1	5.95	.6	4.1	1.6	1.3	.6	.7	1.8	1.3	1.8
	2	3.20	.1	.1	1.4	1.4	1.1	.7	.6	.5	.5
	3	.50	.8	4.0	1.2	1.0	.4	.5	.5	.9	1.8
(20)	4	.80	.2	.8	1.2	.5	1.0	.5	.5	.3	.2
	2	3.20	.1	.1	1.4	1.4	1.1	.7	.6	.5	.5
	3	.50	.8	4.0	1.2	1.0	.4	.5	.5	.9	1.8
	1	5.95	.6	4.1	1.6	1.3	.6	.7	1.8	1.3	1.8
(21)	4	.80	.2	.8	1.2	.5	1.0	.5	.5	.3	.2
	3	.50	.8	4.0	1.2	1.0	.4	.5	.5	.9	1.8
	2	3.20	.1	.1	1.4	1.4	1.1	.7	.6	.5	.5
	1	5.95	.6	4.1	1.6	1.3	.6	.7	1.8	1.3	1.8
(22)	4	.80	.2	.8	1.2	.5	1.0	.5	.5	.3	.2
	2	3.20	.1	.1	1.4	1.4	1.1	.7	.6	.5	.5
	1	5.95	.6	4.1	1.6	1.3	.6	.7	1.8	1.3	1.8
	3	.50	.8	4.0	1.2	1.0	.4	.5	.5	.9	1.8
(23)	4	.80	.2	.8	1.2	.5	1.0	.5	.5	.3	.2
	3	.50	.8	4.0	1.2	1.0	.4	.5	.5	.9	1.8
	1	5.95	.6	4.1	1.6	1.3	.6	.7	1.8	1.3	1.8
	2	3.20	.1	.1	1.4	1.4	1.1	.7	.6	.5	.5
(24)	4	.80	.2	.8	1.2	.5	1.0	.5	.5	.3	.2
	1	5.95	.6	4.1	1.6	1.3	.6	.7	1.8	1.3	1.8
	3	0.50	.8	4.0	1.2	1.0	.4	.5	.5	.9	1.8
	2	3.20	.1	0.1	1.4	1.4	1.1	.7	.6	.5	.5

MONOGRAPHS REQUISITIONS

TIME STUDY SUMMARY (Mins.)

SEQUENCES		21	22	23	24	25
(19)	4	.5	1.8	1.3	.1	.6
	1	2.4	4.7	5.0	.2	.8
	2	.9	2.5	1.3	.3	.4
	3	1.4	7.8	5.7	.2	.1
(20)	4	.5	1.8	1.3	.1	.6
	2	.9	2.5	1.3	.3	.4
	3	1.4	7.8	5.7	.2	.1
	1	2.4	4.7	5.0	.2	.8
(21)	4	.5	1.8	1.3	.1	.6
	3	1.4	7.8	5.7	.2	.1
	2	.9	2.5	1.3	.3	.4
	1	2.4	4.7	5.0	.2	.8
(22)	4	.5	1.8	1.3	.1	.6
	2	.9	2.5	1.3	.3	.4
	1	2.4	4.7	5.0	.2	.8
	3	1.4	7.8	5.7	.2	.1
(23)	4	.5	1.8	1.3	.1	.6
	3	1.4	7.8	5.7	.2	.1
	1	2.4	4.7	5.0	.2	.8
	2	.9	2.5	1.3	.3	.4
(24)	4	.5	1.8	1.3	.1	.6
	1	2.4	4.7	5.0	.2	.8
	3	1.4	7.8	5.7	.2	.1
	2	.9	2.5	1.3	.3	.4

SERIALS

LEGEND

LC	1	Library of Congress Catalogue
PS	2	Library of Congress Proof Slips
NST	3	New Serial Titles
ULS	4	Union List of Serials

SERIALS REQUISITIONS

TIME STUDY SUMMARY

SEQUENCES		1	2	3	4	5	6	7	8	9	10
(1)	1	.5	.7	1.0	1.2	.7	1.4	.7	1.8	1.7	2.0
	2	.7	.7	.6	.6	.4	.4	.5	.6	1.1	.9
	3	.6	.6	.3	.6	.3	.7	.7	2.0	1.3	.3
	4	.5	.5	.3	.2	.3	.2	.3	.2	.4	.2
(2)	1	.5	.7	1.0	1.2	.7	1.4	.7	1.8	1.7	2.0
	2	.7	.7	.6	.6	.4	.4	.5	.6	1.1	.9
	4	.5	.5	.3	.2	.3	.2	.3	.2	.4	.2
	3	.6	.6	.3	.6	.3	.7	.7	2.0	1.3	.3
(3)	1	.5	.7	1.0	1.2	.7	1.4	.7	1.8	1.7	2.0
	3	.6	.6	.3	.6	.3	.7	.7	2.0	1.3	.3
	2	.7	.7	.6	.6	.4	.4	.5	.6	1.1	.9
	4	.5	.5	.3	.2	.3	.2	.3	.2	.4	.2
(4)	1	.5	.7	1.0	1.2	.7	1.4	.7	1.8	1.7	2.0
	3	.6	.6	.3	.6	.3	.7	.7	2.0	1.3	.3
	4	.5	.5	.3	.2	.3	.2	.3	.2	.4	.2
	2	.7	.7	.6	.6	.4	.4	.5	.6	1.1	.9
(5)	1	.5	.7	1.0	1.2	.7	1.4	.7	1.8	1.7	2.0
	4	.5	.5	.3	.2	.3	.2	.3	.2	.4	.2
	3	.6	.6	.3	.6	.3	.7	.7	2.0	1.3	.3
	2	.7	.7	.6	.6	.4	.4	.5	.6	1.1	.9
(6)	1	.5	.7	1.0	1.2	.7	1.4	.7	1.8	1.7	2.0
	4	.5	.5	.3	.2	.3	.2	.3	.2	.4	.2
	2	.7	.7	.6	.6	.4	.4	.5	.6	1.1	.9
	3	.6	.6	.3	.6	.3	.7	.7	2.0	1.3	.3
(7)	2	.7	.7	.6	.6	.4	.4	.5	.6	1.1	.9
	3	.6	.6	.3	.6	.3	.7	.7	2.0	1.3	.3
	4	.5	.5	.3	.2	.3	.2	.3	.2	.4	.2
	1	.5	.7	1.0	1.2	.7	1.4	.7	1.8	1.7	2.0
(8)	2	.7	.7	.6	.6	.4	.4	.5	.6	1.1	.9
	3	.6	.6	.3	.6	.3	.7	.7	2.0	1.3	.3
	1	.5	.7	1.0	1.2	.7	1.4	.7	1.8	1.7	2.0
	4	.5	.5	.3	.2	.3	.2	.3	.2	.4	.2

SERIALS REQUISITIONS

TIME STUDY SUMMARY

SEQUENCES		1	2	3	4	5	6	7	8	9	10
(9)	2	.7	.7	.6	.6	.4	.4	.5	.6	1.1	.9
	1	.5	.7	1.0	1.2	.7	1.4	.7	1.8	1.7	2.0
	3	.6	.6	.3	.6	.3	.7	.7	2.0	1.3	.3
	4	.5	.5	.3	.2	.3	.2	.3	.2	.4	.2
(10)	2	.7	.7	.6	.6	.4	.4	.5	.6	1.1	.9
	1	.5	.7	1.0	1.2	.7	1.4	.7	1.8	1.7	2.0
	4	.5	.5	.3	.2	.3	.2	.3	.2	.4	.2
	3	.6	.6	.3	.6	.3	.7	.7	2.0	1.3	.3
(11)	2	.7	.7	.6	.6	.4	.4	.5	.6	1.1	.9
	4	.5	.5	.3	.2	.3	.2	.3	.2	0.4	.2
	1	.5	.7	1.0	1.2	.7	1.4	.7	1.8	1.7	2.0
	3	.6	.6	.3	.6	.3	.7	.7	2.0	1.3	.3
(12)	2	.7	.7	.6	.6	.4	.4	.5	.6	1.1	.9
	4	.5	.5	.3	.2	.3	.2	.3	.2	.4	.2
	3	.6	.6	.3	.6	.3	.7	.7	2.0	1.3	.3
	1	.5	.7	1.0	1.2	.7	1.4	.7	1.8	1.7	2.0
(13)	3	.6	.6	.3	.6	.3	.7	.7	2.0	1.3	.3
	1	.5	.7	1.0	1.2	.7	1.4	.7	1.8	1.7	2.0
	4	.5	.5	.3	.2	.3	.2	.3	.2	.4	.2
	2	.7	.7	.6	.6	.4	.4	.5	.6	1.1	.9
(14	3	.6	.6	.3	.6	.3	.7	.7	2.0	1.3	.3
	4	.5	.5	.3	.2	.3	.2	.3	.2	.4	.2
	1	.5	.7	1.0	1.2	.7	1.4	.7	1.8	1.7	2.0
	2	.7	.7	.6	.6	.4	.4	.5	.6	1.1	.9
(15)	3	.6	.6	.3	.6	.3	.7	.7	2.0	1.3	.3
	4	.5	.5	.3	.2	.3	.2	.3	.2	.4	.2
	2	.7	.7	.6	.6	.4	.4	.5	.6	1.1	.9
	1	.5	.7	1.0	1.2	.7	1.4	.7	1.8	1.7	2.0
(16)	3	.6	.6	.3	.6	.3	.7	.7	2.0	1.3	.3
	1	.5	.7	1.0	1.2	.7	1.4	.7	1.8	1.7	2.0
	2	.7	.7	.6	.6	.4	.4	.5	.6	1.1	.9
	4	.5	.5	.3	.2	.3	.2	.3	.2	.4	.2

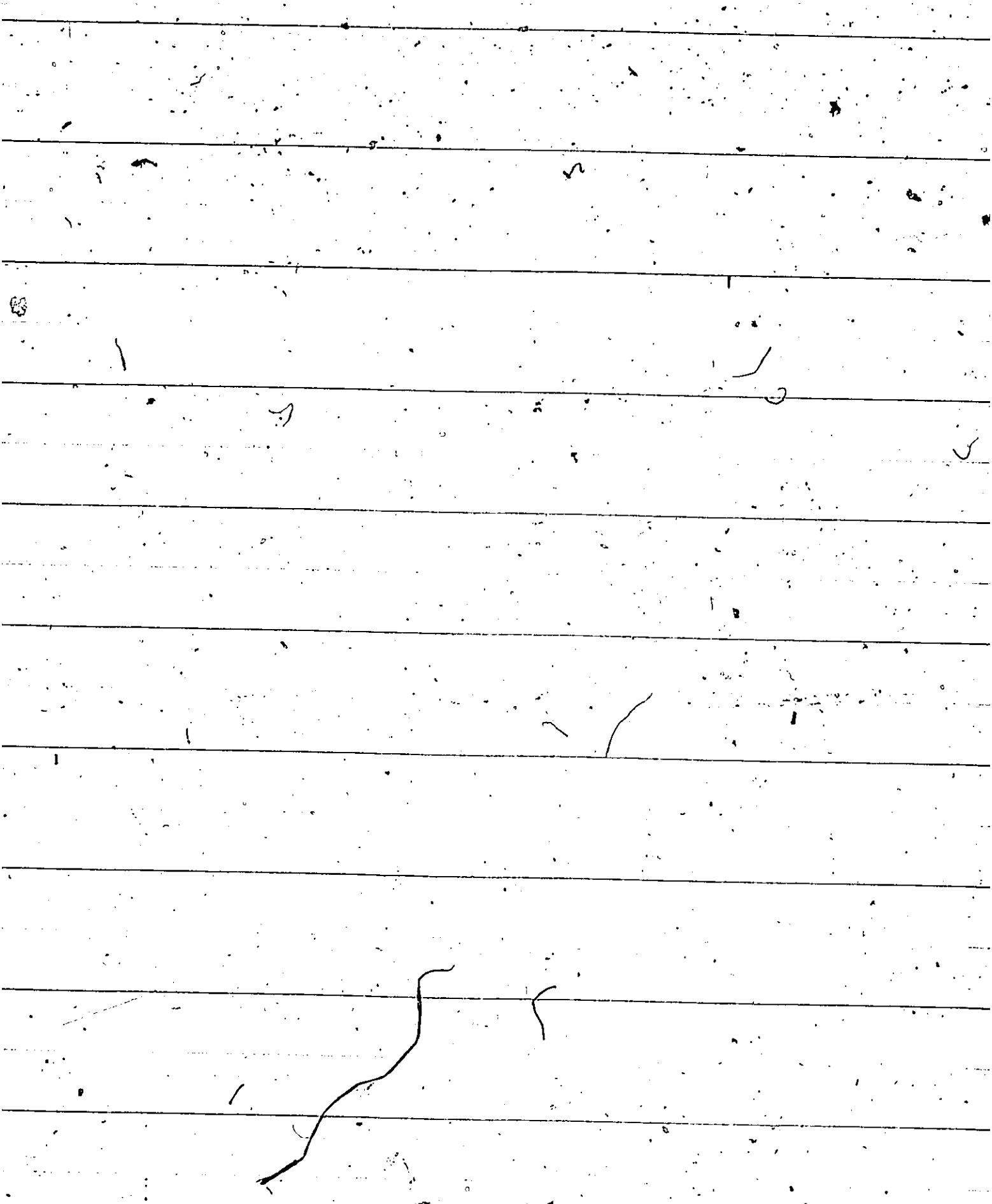
SERIALS REQUISITIONS

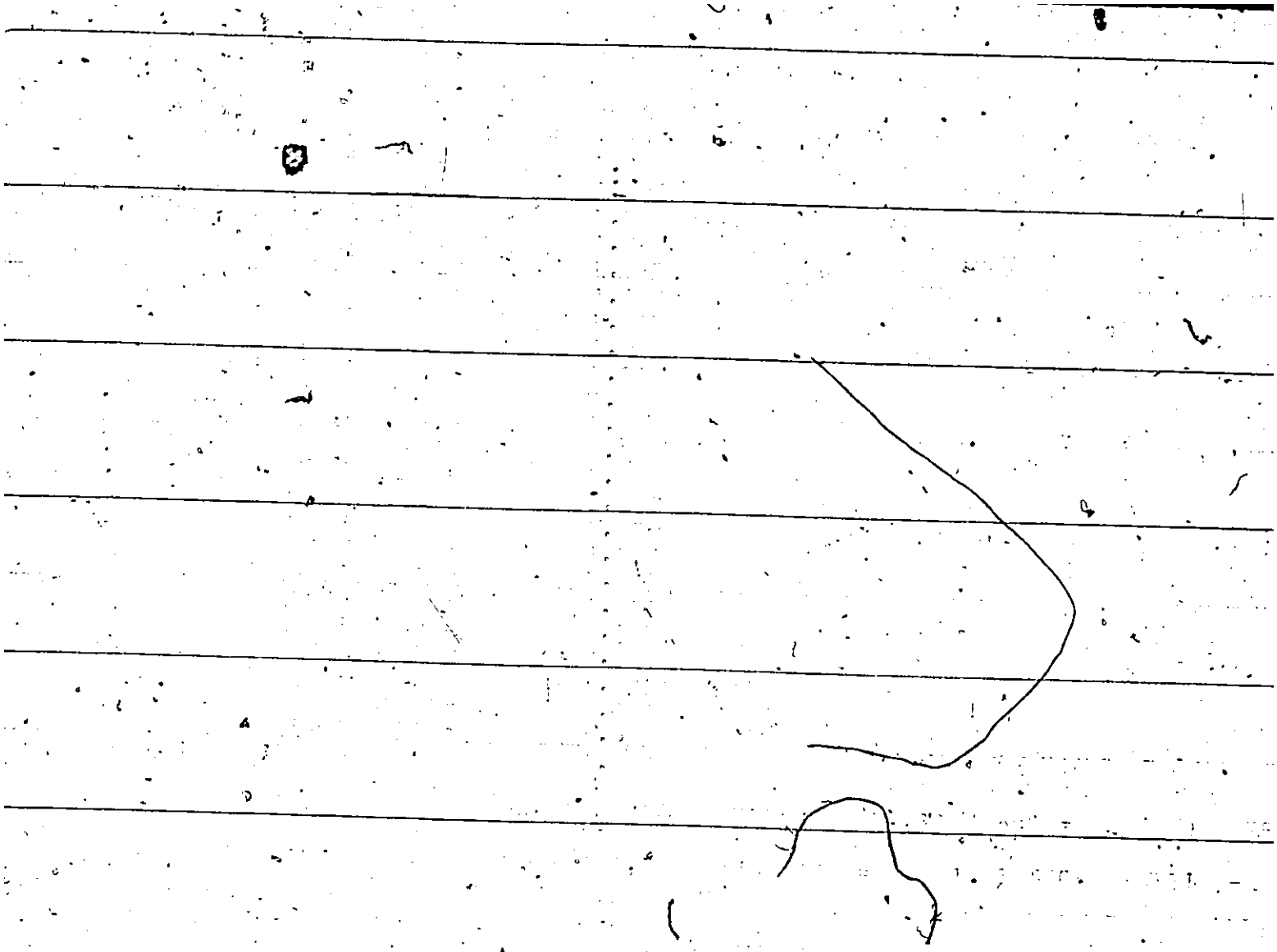
TIME STUDY SUMMARY

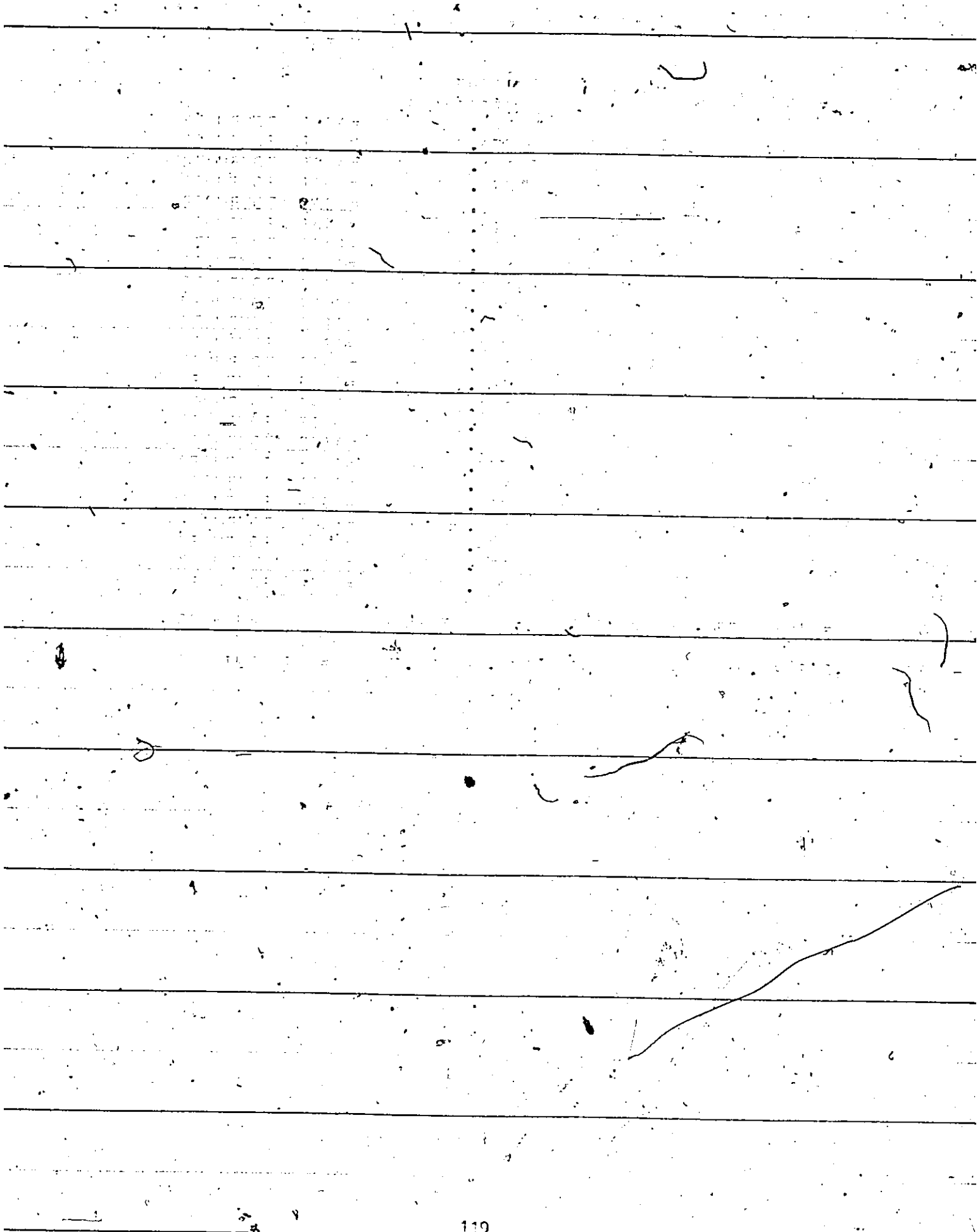
SEQUENCES		1	2	3	4	5	6	7	8	9	10
(17)	3	.6	.6	.3	.6	.3	.7	.7	2.0	1.3	.3
	2	.7	.7	.6	.6	.4	.4	.5	.6	1.1	.9
	1	.5	.7	1.0	1.2	.7	1.4	.7	1.8	1.7	2.0
	4	.5	.5	.3	.2	.3	.2	.3	.2	.4	.2
(18)	3	.6	.6	.3	.6	.3	.7	.7	2.0	1.3	.3
	2	.7	.7	.6	.6	.4	.4	.5	.6	1.1	.9
	4	.5	.5	.3	.2	.3	.2	.3	.2	.4	.2
	1	.5	.7	1.0	1.2	.7	1.4	.7	1.8	1.7	2.0
(19)	4	.5	.5	.3	.2	.3	.2	.3	.2	.4	.2
	1	.5	.7	1.0	1.2	.7	1.4	.7	1.8	1.7	2.0
	2	.7	.7	.6	.6	.4	.4	.5	.6	1.1	.9
	3	.6	.6	.3	.6	.3	.7	.7	2.0	1.3	.3
(20)	4	.5	.5	.3	.2	.3	.2	.3	.2	.4	.2
	2	.7	.7	.6	.6	.4	.4	.5	.6	1.1	.9
	3	.6	.6	.3	.6	.3	.7	.7	2.0	1.3	.3
	1	.5	.7	1.0	1.2	.7	1.4	.7	1.8	1.7	2.0
(21)	4	.5	.5	.3	.2	.3	.2	.3	.2	.4	.2
	3	.6	.6	.3	.6	.3	.7	.7	2.0	1.3	.3
	2	.7	.7	.6	.6	.4	.4	.5	.6	1.1	.9
	1	.5	.7	1.0	1.2	.7	1.4	.7	1.8	1.7	2.0
(22)	4	.5	.5	.3	.2	.3	.2	.3	.2	.4	.2
	2	.7	.7	.6	.6	.4	.4	.5	.6	1.1	.9
	1	.5	.7	1.0	1.2	.7	1.4	.7	1.8	1.7	2.0
	3	.6	.6	.3	.6	.3	.7	.7	2.0	1.3	.3
(23)	4	.5	.5	.3	.2	.3	.2	.3	0.2	.4	.2
	3	.6	.6	.3	.6	.3	.7	.7	2.0	1.3	.3
	1	.5	.7	1.0	1.2	.7	1.4	.7	1.8	1.7	2.0
	2	.7	.7	.6	.6	.4	.4	.5	.6	1.1	.9
(24)	4	.5	.5	.3	.2	.3	.2	.3	.2	.4	.2
	1	.5	.7	1.0	1.2	.7	1.4	.7	1.8	1.7	2.0
	3	.6	.6	.3	.6	.3	.7	.7	2.0	1.3	.3
	2	.7	.7	.6	.6	.4	.4	.5	0.6	1.1	.9

APPENDIX C

COMPUTER PROGRAM FOR CALCULATION OF LEAST TIME SEQUENCE OF SEARCHING IN BIBLIOGRAPHIC TOOLS AND ITS OUTPUTS FOR BOTH MONOGRAPHS AND SERIALS



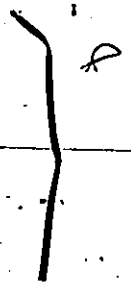


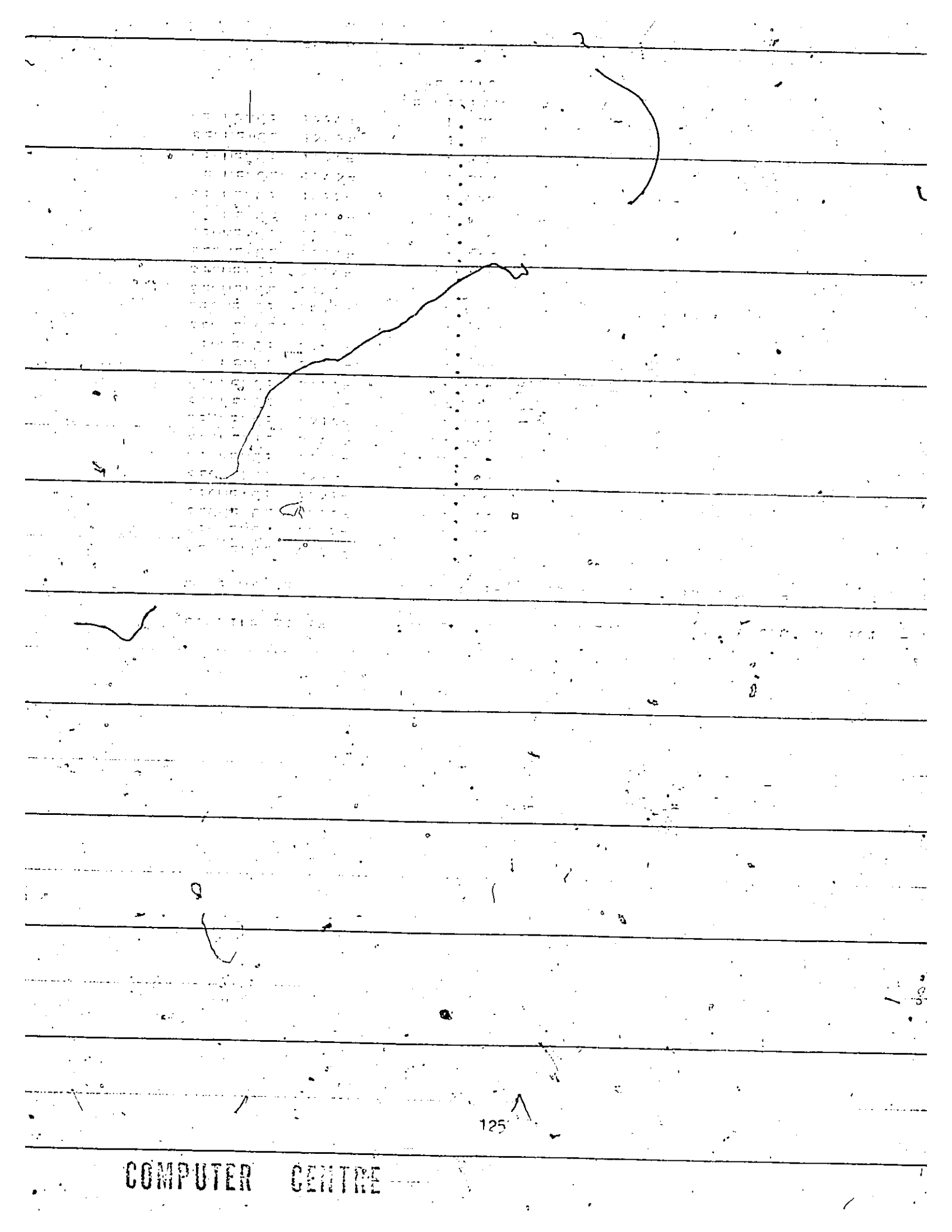


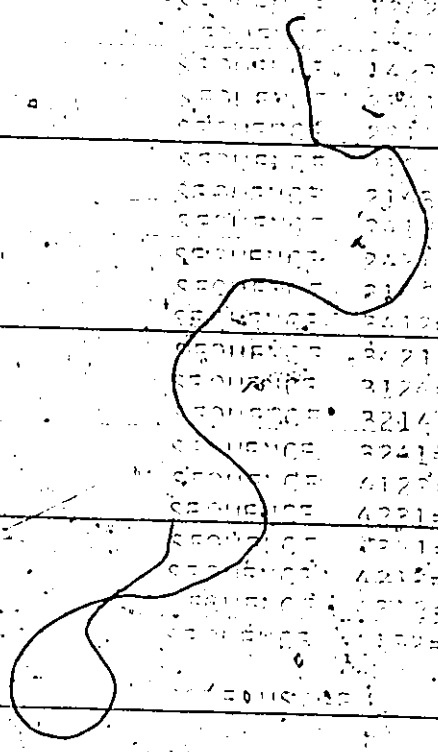
MONOGRAPHS

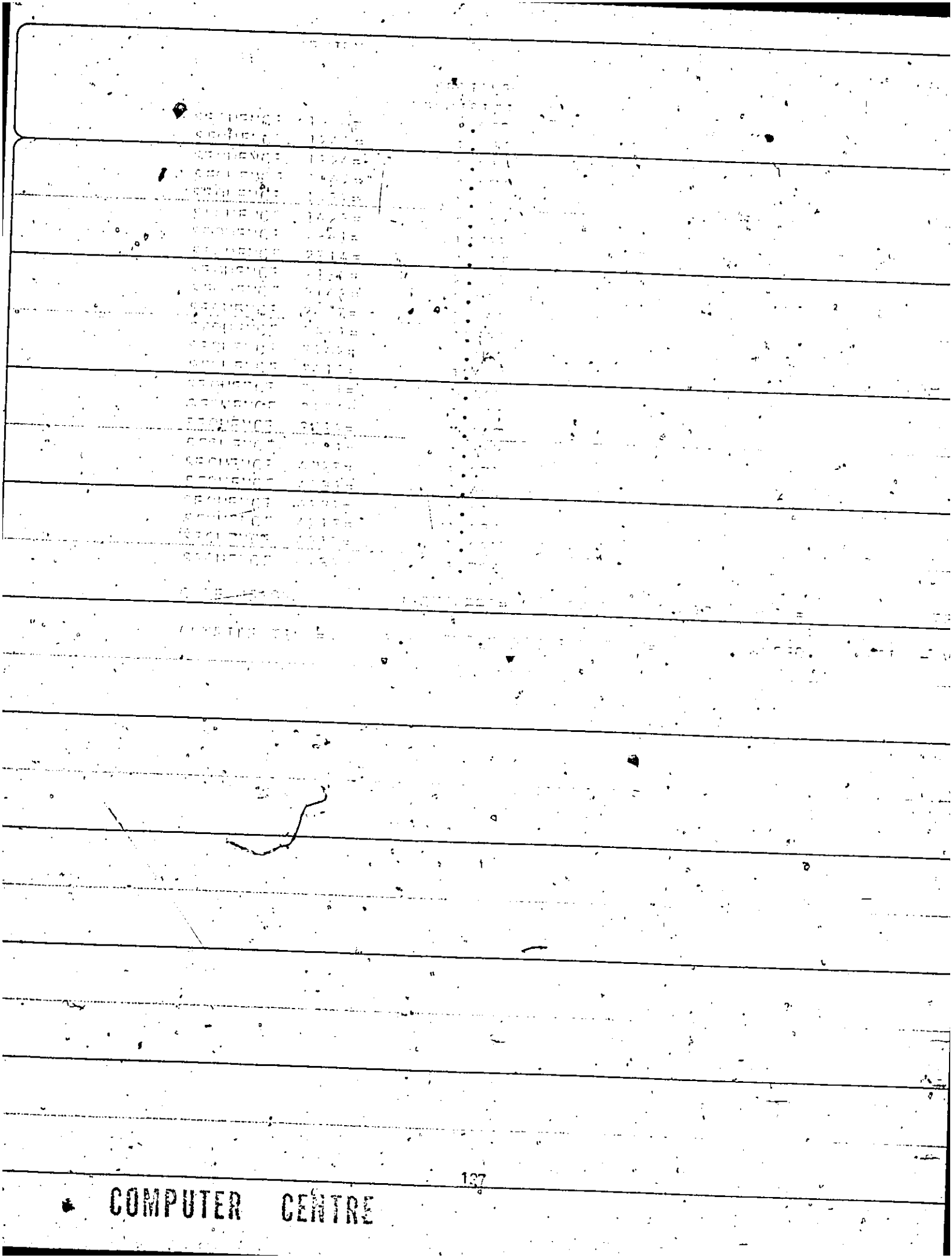
REQUISITION NO.	LEAST TIME SEQUENCE
1	4 3 1 2
2	4 2 1 3
3	4 2 1 3
4	1 2 3 4
5	4 3 1 2
6	4 3 1 2
7	1 2 4 3
8	1 2 3 4
9	1 4 3 2
10	2 1 3 4
11	3 4 1 2
12	2 4 1 3
13	2 4 1 3
14	1 4 3 2
15	4 1 3 2
16	1 3 4 2
17	1 4 3 2
18	4 3 2 1
19	4 2 1 3
20	4 2 1 3
21	4 2 1 3
22	4 1 2 3
23	4 2 1 3
24	4 1 3 2
25	3 2 1 4

By seeing above, it can be inferred that the most preferred least time sequence of searching is 4 2 1 3 or Publishers Trade List Annual, Proofslips, Library of Congress Catalogue and Cumulative Book Index.









COMPUTER CENTRE

L 130

SERIALS

REQUISITION NO.	LEAST TIME SEQUENCE
1	3 1 4 2
2	1 4 3 2
3	3 4 1 2
4	4 3 1 2
5	3 4 1 2
6	4 3 2 1
7	3 2 1 4
8	4 3 2 1
9	3 4 1 2
10	3 4 1 2

By observing above, it can be inferred that the most preferred least time sequence of searching is 3 4 1 2 or New Serial Titles, Union List of Serials, Library of Congress Catalogue and Proofslips.

APPENDIX D

SAMPLE PROFORMA AND DATA SUMMARY OF THE WORK IN BIBLIOGRAPHIC SEARCHING DEPARTMENT FOR 60 WORKING DAYS

(FROM JAN. 17, 1972 TO FEB. 28, 1972)

AND

(FROM MAY 23, 1972 TO JUL. 4, 1972)

STATISTICS

Years of Service:

Date:

Time	No. of Requisitions Searched	No. of Books Search on arrival	No. of Photos taken	No. of P.S. filed
(T)	(X_1)	(X_2)	(X_3)	(X_4)
8:30 - 9:30				
9:30 - 10:30				
10:30 - 12:00				
12:00 - 1:00				
1:00 - 2:00				
2:00 - 3:00				
3:00 - 4:00				

INPUT I (LEVEL 1)

NO. OF OBSERVATIONS - 60

NO. OF VARIABLES - 5

DATE (1972)	DAYS	T	x_1	x_2	x_3	x_4
Jan. 17	1	91.0	272.0	107.0	0.0	2116.0
Jan. 18	2	91.0	125.0	95.0	60.0	2189.0
Jan. 19	3	88.0	184.0	82.0	0.0	1251.0
Jan. 20	4	84.0	154.0	89.0	115.0	2800.0
Jan. 21	5	89.0	210.0	54.0	40.0	1270.0
Jan. 24	6	96.0	204.0	101.0	0.0	5164.0
Jan. 25	7	89.0	121.0	49.0	0.0	4945.0
Jan. 26	8	91.0	164.0	75.0	43.0	3851.0
Jan. 27	9	70.0	165.0	34.0	0.0	2013.0
Jan. 28	10	84.0	196.0	50.0	0.0	4062.0
Jan. 31	11	56.0	151.0	18.0	0.0	2057.0
Feb. 1	12	63.0	138.0	47.0	0.0	1051.0
Feb. 2	13	77.0	183.0	39.0	0.0	3459.0
Feb. 3	14	81.0	147.0	86.0	0.0	1269.0
Feb. 4	15	70.0	119.0	119.0	0.0	1751.0
Feb. 7	16	58.0	171.0	26.0	0.0	1182.0
Feb. 8	17	63.0	96.0	26.0	0.0	700.0
Feb. 9	18	70.0	131.0	32.0	0.0	1488.0
Feb. 10	19	56.0	152.0	14.0	0.0	1445.0
Feb. 11	20	56.0	132.0	40.0	0.0	963.0
Feb. 14	21	63.0	106.0	78.0	152.0	44.0
Feb. 15	22	70.0	177.0	95.0	0.0	307.0
Feb. 16	23	70.0	158.0	125.0	0.0	1138.0

DATE (1972)	DAYS	T	x_1	x_2	x_3	x_4
Feb. 17	24	77.0	142.0	134.0	0.0	2715.0
Feb. 18	25	63.0	146.0	27.0	0.0	2845.0
Feb. 21	26	66.0	125.0	56.0	264.0	920.0
Feb. 22	27	70.0	144.0	49.0	0.0	1971.0
Feb. 23	28	74.0	139.0	64.0	0.0	2626.0
Feb. 24	29	73.0	155.0	55.0	0.0	2276.0
Feb. 28	30	70.0	118.0	50.0	100.0	2363.0
May 23	31	70.0	58.0	119.0	90.0	2348.0
May 24	32	77.0	64.0	118.0	8.0	1970.0
May 25	33	77.0	40.0	130.0	175.0	2716.0
May 26	34	84.0	85.0	126.0	12.0	4727.0
May 29	35	89.0	41.0	125.0	13.0	3155.0
May 30	36	84.0	68.0	70.0	125.0	3299.0
May 31	37	84.0	89.0	89.0	92.0	2102.0
Jun. 1	38	82.0	89.0	190.0	9.0	234.0
Jun. 2	39	83.0	46.0	154.0	4.0	5667.0
Jun. 5	40	63.0	44.0	90.0	3.0	1751.0
Jun. 6	41	75.0	40.0	106.0	4.0	2143.0
Jun. 7	42	77.0	55.0	94.0	80.0	2876.0
Jun. 8	43	68.0	39.0	95.0	60.0	3414.0
Jun. 9	44	77.0	131.0	98.0	7.0	2803.0
Jun. 12	45	80.0	195.0	106.0	6.0	3428.0
Jun. 13	46	73.0	110.0	71.0	20.0	2291.0
Jun. 14	47	70.0	93.0	94.0	7.0	3871.0
Jun. 15	48	70.0	60.0	134.0	9.0	2717.0

DATE (1972)	DAYS	T	x_1	x_2	x_3	x_4
Jun. 16	49	70.0	45.0	199.0	18.0	3663.0
Jun. 19	50	84.0	142.0	148.0	182.0	1182.0
Jun. 20	51	91.0	110.0	300.0	42.0	2869.0
Jun. 21	52	91.0	59.0	157.0	34.0	3421.0
Jun. 22	53	77.0	28.0	171.0	13.0	2496.0
Jun. 23	54	70.0	72.0	91.0	16.0	2926.0
Jun. 26	55	81.0	25.0	166.0	30.0	1502.0
Jun. 27	56	84.0	34.0	223.0	36.0	351.0
Jun. 28	57	77.0	13.0	181.0	27.0	0.0
Jun. 29	58	63.0	103.0	143.0	185.0	1642.0
Jul. 3	59	68.0	18.0	115.0	26.0	2802.0
Jul. 4	60	56.0	32.0	106.0	40.0	2408.0

APPENDIX E

COMPUTER PROGRAM FOR CALCULATION OF REGRESSION COEFFICIENTS FOR PREDICTION MODEL IN A BIBLIOGRAPHIC SEARCHING DEPARTMENT USING MULTIPLE LINEAR REGRESSION TECHNIQUE AND ITS OUTPUT

```
C
C
C     ******************************************************************
C
C        SAMPLE MAIN PROGRAM FOR MULTIPLE REGRESSION -- REGR
C
C        PURPOSE
C           (1) READ THE PROBLEM PARAMETER CARD FOR A MULTIPLE REGRES-
C           SION, (2) READ SUBSET SELECTION CARDS, (3) CALL THE SUB-
C           ROUTINES TO CALCULATE MEANS, STANDARD DEVIATIONS, SIMPLE
C           AND MULTIPLE CORRELATION COEFFICIENTS, REGRESSION COEFFI-
C           CIENTS, T-VALUES, AND ANALYSIS OF VARIANCE FOR MULTIPLE
C           REGRESSION, AND (4) PRINT THE RESULTS.
C
C        REMARKS
C           THE NUMBER OF OBSERVATIONS, N, MUST BE GREATER THAN M+1,
C           WHERE M IS THE NUMBER OF VARIABLES.  IF SUBSET SELECTION
C           CARDS ARE NOT PRESENT, THE PROGRAM CAN NOT PERFORM MULTIPLE
C           REGRESSION.
C           AFTER RETURNING FROM SUBROUTINE MINV, THE VALUE OF DETER-
C           MINANT (DET) IS TESTED TO CHECK WHETHER THE CORRELATION
C           MATRIX IS SINGULAR.  IF DET IS COMPARED AGAINST A SMALL
C           CONSTANT, THIS TEST MAY ALSO BE USED TO CHECK NEAR-
C           SINGULARITY.
C
C        SUBROUTINES AND FUNCTION SUBPROGRAMS REQUIRED
C           CORRE  (WHICH, IN TURN, CALLS THE SUBROUTINE NAMED DATA)
C           ORDER
C           MINV
C           MULTR
C
C        METHOD
C           REFER TO B. OSTLE, 'STATISTICS IN RESEARCH', THE IOWA STATE
C           COLLEGE PRESS', 1954, CHAPTER 8.
C
C     ******************************************************************
C
C     THE FOLLOWING DIMENSIONS MUST BE GREATER THAN OR EQUAL TO THE
C     NUMBER OF VARIABLES, M..
C
0001       DIMENSION XBAR(30),STD(30),D(30),RY(30),ISAVE(30),B(30),
     1            SR(30),T(30),W(30)
C
C     THE FOLLOWING DIMENSION MUST BE GREATER THAN OR EQUAL TO THE
C     PRODUCT OF M*M..
C
0002       DIMENSION RX(900)
C
C     THE FOLLOWING DIMENSION MUST BE GREATER THAN OR EQUAL TO
C     (M+1)*M/2..
C
0003       DIMENSION R(450)
C
C     THE FOLLOWING DIMENSION MUST BE GREATER THAN OR EQUAL TO 10..
C
0004       DIMENSION ANS(10)
C
C     ******************************************************************
C
```

```
C       IF A DOUBLE PRECISION VERSION OF THIS ROUTINE IS DESIRED, THE
C       C IN COLUMN 1 SHOULD BE REMOVED FROM THE DOUBLE PRECISION
C       STATEMENT WHICH FOLLOWS.
C
C      DOUBLE PRECISION XBAR,STD,RX,R,D,B,T,RY,DET,SP,ANS,SUM
C
C       THE C MUST ALSO BE REMOVED FROM DOUBLE PRECISION STATEMENTS
C       APPEARING IN OTHER ROUTINES USED IN CONJUNCTION WITH THIS
C       ROUTINE.
C
C       ******************************************************************
C
0005        1 FORMAT(A4,A2,I5,3I2)
0006        2 FORMAT(25H1MULTIPLE REGRESSION.....A4,A2//6X,14HSELECTION.....I2//
           1)
0007        3 FORMAT(9HOVARIABLE,5X,4HMEAN,6X,8HSTANDARD,6X,11HCORRELATION,4X,
           110HREGRESSION,4X,10HSTD. ERROR,5X,8HCOMPUTED/6H   NO.,18X,9HDEVIATE
           2ION,7X,6HX VS Y,7X,11HCOEFFICIENT,3X,12HOF REG.COEF.,3X,7HT VALUE)
0008        4 FORMAT(1H,I4,6E14.5)
0009        5 FORMAT(10H DEPENDENT)
0010        6 FORMAT(1HO/10H INTERCEPT,10X,E16.5//23H MULTIPLE CORRELATION   ,E13
           1.5//23H STD. ERROR OF ESTIMATE,E13.5//)
0011        7 FORMAT(1HO,21X,39HANALYSIS OF VARIANCE FOR THE REGRESSION//5X,19HSP
           1OURCE OF VARIATION,7X,7HDEGREES,7X,6HSUM OF,10X,4HMEAN,12X,7HF VAL
           2UE/30X,10HOF FREEDOM,4X,7HSQUARES,9X,7HSQUARES)
0012        8 FORMAT(30H ATTRIBUTABLE TO REGRESSION   ,I6,3E16.5/30H DEVIATION FR
           1OM REGRESSION    ,I6,2E16.5)
0013        9 FORMAT(1H ,5X,5HTOTAL,19X,I6,E16.5)
0014       10 FORMAT(36I2)
0015       11 FORMAT(1H ,15X,18HTABLE OF RESIDUALS//9H CASE NO.,5X,7HY VALUE,5X,9
           110HY ESTIMATE,6X,8HRESIDUAL)
0016       12 FORMAT(1H ,I6,F15.5,2E14.5)
0017       13 FORMAT(53H1NUMBER OF SELECTIONS NOT SPECIFIED.  JOB TERMINATED.)
0018       14 FORMAT(52HOTHE MATRIX IS SINGULAR.  THIS SELECTION IS SKIPPED.)
C
C       ******************************************************************
C
C       READ PROBLEM PARAMETER CARD
C
0019       ICOUNT=0
0020      100 READ(5,1) PR,PR1,N,M,NS,IS
C          PR.........PROBLEM NUMBER (MAY BE ALPHAMERIC)
C          PR1........PROBLEM NUMBER (CONTINUED)
C          N..........NUMBER OF OBSERVATIONS
C          M..........NUMBER OF VARIABLES
C          NS.........NUMBER OF SELECTIONS
C       IS.........NUMBER OF SETS OF DATA
C
C       LOGICAL TAPE 13 IS USED AS INTERMEDIATE STORAGE TO HOLD INPUT
C       DATA.  THE INPUT DATA ARE WRITTEN ON LOGICAL TAPE 13 BY THE
C       SPECIAL INPUT SUBROUTINE NAMED DATA.  THE STORED DATA MAY BE USED
C       FOR RESIDUAL ANALYSIS.
C
0021       REWIND 13
0022       ICOUNT=ICOUNT+1
C
0023       IO=0
0024       X=0.0
```

```
      C
0025        WRITE(6,201) N,M,IO
0026      201 FORMAT(' NO. OF OBSERVATIONS - ',I3/
     1          ' NO. OF VARIABLES - ',I2/
     2          ' OPT. CODE - 0 MEANS READ DATA THRU PROGRAM - ',I2)
0027        CALL CORRE (N,M,IO,X,XBAR,STD,RX,R,D,B,T)
      C
0028        REWIND 13
      C
      C     TEST NUMBER OF SELECTIONS
      C
0029        IF(NS) 108, 108, 109
0030      108 WRITE (6,13)
0031        GO TO 300
      C
0032      109 DO 200 I=1,NS
0033        WRITE (6,2) PR,PR1,I
      C
      C     READ SUBSET SELECTION CARD
      C
0034        READ (5,10) NRESI,NDEP,K,(ISAVE(J),J=1,K)
      C        NRESI.....OPTION CODE FOR TABLE OF RESIDUALS
      C                          0  IF IT IS NOT DESIRED.
      C                          1  IF IT IS DESIRED.
      C           NDEP.....DEPENDENT VARIABLE
      C           K.....NUMBER OF INDEPENDENT VARIABLES INCLUDED
      C           ISAVE.....A VECTOR CONTAINING THE INDEPENDENT VARIABLES
      C                          INCLUDED
      C
0035        WRITE(6,204) NRESI,NDEP,K,(ISAVE(J),J=1,K)
0036      204 FORMAT('1','OPT. CODE - 0 MEANS TABLE OF RESIDUALS NOT READ. - ',
     1    I12/' NO. OF DEPENDENT VARIABLES - ',I2/
     2    ' NO. OF INDEPENDANT VARIABLES - ',I2/' ',30I4)
0037        CALL ORDER (M,R,NDEP,K,ISAVE,RX,RY)
      C
0038        CALL MINV (RX,K,DET,B,T)
      C
      C     TEST SINGULARITY OF THE MATRIX INVERTED
      C
0039        IF(DET) 112, 110, 112
0040      110 WRITE (6,14)
0041        GO TO 200
      C
0042      112 CALL MULTR (N,K,XBAR,STD,D,RX,RY,ISAVE,B,SB,T,ANS)
      C
      C     PRINT MEANS, STANDARD DEVIATIONS, INTERCORRELATIONS BETWEEN
      C     X AND Y, REGRESSION COEFFICIENTS, STANDARD DEVIATIONS OF
      C     REGRESSION COEFFICIENTS, AND COMPUTED T-VALUES
      C
0043        MM=K+1
0044        WRITE (6,3)
0045        DO 115 J=1,K
0046        L=ISAVE(J)
0047      115 WRITE (6,4) L,XBAR(L),STD(L),RY(J),B(J),SB(J),T(J)
0048        WRITE (6,5)
0049        L=ISAVE(MM)
0050        WRITE (6,4) L,XBAR(L),STD(L)
      C
```

```
      C     PRINT INTERCEPT, MULTIPLE CORRELATION COEFFICIENT, AND STANDARD
      C     ERROR OF ESTIMATE
      C
0051        WRITE (6,6) ANS(1),ANS(2),ANS(3)
      C
      C     PRINT ANALYSIS OF VARIANCE FOR THE REGRESSION
      C
0052        WRITE (6,7)
0053        L=ANS(8)
0054        WRITE (6,8) K,ANS(4),ANS(5),ANS(10),L,ANS(7),ANS(9)
0055        L=N-1
0056        SUM=ANS(4)+ANS(7)
0057        WRITE (6,9) L,SUM
0058        IF(NRESI) 200, 200, 120
      C
      C     PRINT TABLE OF RESIDUALS
      C
0059      120 WRITE (6,2) PR,PR1,I
0060        WRITE (6,11)
0061        MM=ISAVE(K+1)
0062        DO 140 II=1,N
0063        READ (13) (W(J),J=1,M)
0064        SUM=ANS(1)
0065        DO 130 J=1,K
0066        L=ISAVE(J)
0067      130 SUM=SUM+W(L)*R(J)
0068        RESI=W(MM)-SUM
0069      140 WRITE (6,12) II,W(MM),SUM,RESI
0070        REWIND 13
0071      200 CONTINUE
0072        IF (ICOUNT.LT.IS) GO TO 100
0073      300 CONTINUE
0074        END
```

```
0001          SUBROUTINE DATA(M,D)
0002          DIMENSION D(6),J(6)
0003          M=5
0004          READ(5,1)(J(I),I=1,M)
0005        1 FORMAT(5I4)
0006          DO 3 I=1,M
0007          D(I)=J(I)
0008        3 CONTINUE
0009          WRITE(6,2)(D(I),I=1,M)
0010        2 FORMAT('0',F6.1,3X,F6.1,3X,F6.1,3X,F6.1,3X,F6.1)
0011          WRITE(13)(D(I),I=1,M)
0012          RETURN
0013          END
```

OPT. CODE - 1 MEANS TABLE OF RESIDUALS REQUIRED = 1 **RESULT - I**
NO. OF DEPENDENT VARIABLES - 1
NO. OF INDEPENDANT VARIABLES - 4
2 3 4 5

VARIABLE NO.	MEAN	STANDARD DEVIATION	CORRELATION X VS Y	REGRESSION COEFFICIENT	STD. ERROR OF REG.COEF.	COMPUTED T VALUE
2	110.88333	57.94038	0.13979	0.08178	0.02044	4.00124
3	98.75000	54.74258	0.40762	0.11439	0.02142	5.34105
4	35.78333	57.69501	0.00085	0.01386	0.01837	0.75476
5	2316.75000	1253.50391	0.38612	0.00325	0.00083	3.90136
DEPENDENT 1	75.23332	10.38969				

INTERCEPT	46.84235
MULTIPLE CORRELATION	0.67891
STD. ERROR OF ESTIMATE	7.90082

ANALYSIS OF VARIANCE FOR THE REGRESSION

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE
ATTRIBUTABLE TO REGRESSION	4	0.29355E 04	0.73388E 03	0.11757E 02
DEVIATION FROM REGRESSION	55	0.34333E 04	0.62423E 02	
TOTAL	59	0.63688E 04		

MULTIPLE REGRESSION.....SAMPLE

SELECTION..... 1

TABLE OF RESIDUALS - I

CASE NO.	Y VALUE	Y ESTIMATE	RESIDUAL
1	91.00000	88.20480	2.79520
2	91.00000	75.87932	15.12068
3	88.00000	75.33659	12.66341
4	84.00000	80.31311	3.68689
5	89.00000	74.87621	14.12379
6	96.00000	91.86464	4.13536
7	89.00000	78.41650	10.58350
8	91.00000	81.94746	9.05254
9	70.00000	70.76874	-0.76874
10	84.00000	81.79437	2.20563
11	56.00000	67.93652	-11.93652
12	63.00000	66.92082	-3.92082
13	77.00000	77.51289	-0.51289
14	81.00000	72.82675	8.17325
15	70.00000	75.87856	-5.87856
16	58.00000	67.64316	-9.64316
17	63.00000	59.94286	3.05714
18	70.00000	66.05289	3.94711
19	56.00000	65.57147	-9.57147
20	56.00000	65.34334	-9.34334
21	63.00000	66.68402	-3.68402
22	70.00000	73.18282	-3.18282
23	70.00000	77.76186	-7.76186
24	77.00000	82.60881	-5.60881
25	63.00000	71.11850	-8.11850
26	66.00000	70.12132	-4.12132
27	70.00000	70.63069	-0.63069
28	74.00000	74.06671	-0.06671
29	73.00000	73.20801	-0.20801
30	70.00000	71.27927	-1.27927
31	70.00000	74.07809	-4.07809
32	77.00000	72.08893	4.91107
33	77.00000	76.23891	0.76109
34	84.00000	83.73837	0.26163
35	89.00000	74.92978	14.07022
36	84.00000	72.86705	11.13295
37	84.00000	72.40967	11.59033
38	82.00000	76.74081	5.25919
39	83.00000	86.69640	-3.69640
40	63.00000	66.46913	-3.46913
41	75.00000	69.26035	5.73965
42	77.00000	72.55054	4.44946
43	68.00000	72.82790	-4.82790
44	77.00000	77.97415	-0.97415
45	80.00000	86.14098	-6.14098
46	73.00000	71.68417	1.31583
47	70.00000	77.88037	-7.88037
48	70.00000	76.03400	-6.03400
49	70.00000	85.44249	-15.44249
50	84.00000	81.75055	2.24945
51	91.00000	100.06381	-9.06381
52	91.00000	81.21814	9.78186

53	77.00000	76.98665	0.01335
54	70.00000	72.87289	-2.87289
55	81.00000	73.17407	7.82593
56	84.00000	76.77242	7.22758
57	77.00000	68.98485	8.01515
58	63.00000	79.52588	-16.52588
59	68.00000	70.93770	-2.93770
60	56.00000	69.96654	-13.96654

INPUT II

NO. OF OBSERVATIONS - 60

NO. OF VARIABLES - 4

DATE (1972)	DAYS	T	x_1	x_2	x_4
Jan. 17	1	91.0	272.0	107.0	2116.0
Jan. 18	2	91.0	125.0	95.0	2189.0
Jan. 19	3	88.0	184.0	82.0	1251.0
Jan. 20	4	84.0	154.0	89.0	2800.0
Jan. 21	5	89.0	210.0	54.0	1270.0
Jan. 24	6	96.0	204.0	101.0	5164.0
Jan. 25	7	89.0	121.0	49.0	4945.0
Jan. 26	8	91.0	164.0	75.0	3851.0
Jan. 27	9	70.0	165.0	34.0	2013.0
Jan. 28	10	84.0	196.0	50.0	4062.0
Jan. 31	11	56.0	151.0	18.0	2057.0
Feb. 1	12	63.0	138.0	47.0	1051.0
Feb. 2	13	77.0	183.0	39.0	3459.0
Feb. 3	14	81.0	147.0	86.0	1269.0
Feb. 4	15	70.0	119.0	119.0	1751.0
Feb. 7	16	58.0	171.0	26.0	1182.0
Feb. 8	17	63.0	96.0	26.0	700.0
Feb. 9	18	70.0	131.0	32.0	1488.0
Feb. 10	19	56.0	152.0	14.0	1445.0
Feb. 11	20	56.0	132.0	40.0	963.0
Feb. 14	21	63.0	106.0	78.0	44.0
Feb. 15	22	70.0	177.0	95.0	307.0
Feb. 16	23	70.0	158.0	125.0	1138.0

DATE (1972)	DAYS	T	x_1	x_2	x_4
Feb. 17	24	77.0	142.0	134.0	2715.0
Feb. 18	25	63.0	146.0	27.0	2845.0
Feb. 21	26	66.0	125.0	56.0	920.0
Feb. 22	27	70.0	144.0	49.0	1971.0
Feb. 23	28	74.0	139.0	64.0	2626.0
Feb. 24	29	73.0	155.0	55.0	2276.0
Feb. 28	30	70.0	118.0	50.0	2363.0
May. 23	31	70.0	58.0	119.0	2348.0
May 24	32	77.0	64.0	118.0	1970.0
May 25	33	77.0	40.0	130.0	2716.0
May 26	34	84.0	85.0	126.0	4727.0
May 29	35	89.0	41.0	125.0	3155.0
May 30	36	84.0	68.0	70.0	3299.0
May 31	37	84.0	89.0	89.0	2102.0
Jun. 1	38	82.0	89.0	190.0	234.0
Jun. 2	39	83.0	46.0	154.0	5667.0
Jun. 5	40	63.0	44.0	90.0	1751.0
Jun. 6	41	75.0	40.0	106.0	2143.0
Jun. 7	42	77.0	55.0	94.0	2876.0
Jun. 8	43	68.0	39.0	95.0	3414.0
Jun. 9	44	77.0	131.0	98.0	2803.0
Jun. 12	45	80.0	195.0	106.0	3428.0
Jun. 13	46	73.0	110.0	71.0	2291.0
Jun. 14	47	70.0	93.0	94.0	3871.0
Jun. 15	48	70.0	60.0	134.0	2717.0

DATE (1972)	DAYS	T	x_1	x_2	x_4
Jun. 16	49	70.0	45.0	199.0	3663.0
Jun. 19	50	84.0	142.0	148.0	1182.0
Jun. 20	51	91.0	110.0	300.0	2869.0
Jun. 21	52	91.0	59.0	157.0	3421.0
Jun. 22	53	77.0	28.0	171.0	2496.0
Jun. 23	54	70.0	72.0	91.0	2926.0
Jun. 26	55	81.0	25.0	166.0	1502.0
Jun. 27	56	84.0	34.0	223.0	351.0
Jun. 28	57	77.0	13.0	181.0	0.0
Jun. 29	58	63.0	103.0	143.0	1642.0
Jul. 3	59	68.0	18.0	115.0	2802.0
Jul. 4	60	56.0	32.0	106.0	2408.0

OPT. CODE - 1 MEANS TABLE OF RESIDUALS REQUIRED - 1 RESULT - II
NO. OF DEPENDENT VARIABLES - 1
NO. OF INDEPENDANT VARIABLES - 3
2 3 4

VARIABLE NO.	MEAN	STANDARD DEVIATION	CORRELATION X VS Y	REGRESSION COEFFICIENT	STD. ERROR OF REG.COEF.	COMPUTED T VALUE
2	110.88333	57.94038	0.13978	0.07955	0.02015	3.94857
3	98.75000	54.74271	0.40762	0.11492	0.02132	5.38934
4	2316.75000	1253.50439	0.38613	0.00315	0.00082	3.84390
DEPENDENT 1	75.23332	10.38964				

INTERCEPT	47.77824
MULTIPLE CORRELATION	0.67479
STD. ERROR OF ESTIMATE	7.87033

ANALYSIS OF VARIANCE FOR THE REGRESSION

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE
ATTRIBUTABLE TO REGRESSION	3	0.29000E 04	0.96666E 03	0.15606E 02
DEVIATION FROM REGRESSION	56	0.34688E 04	0.61942E 02	
TOTAL	59	0.63687E 04		

MULTIPLE REGRESSION.....SAMPLE

SELECTION..... 1

TABLE OF RESIDUALS - II

CASE NO.	Y VALUE	Y ESTIMATE	RESIDUAL
1	91.00000	88.36644	2.63356
2	91.00000	75.52353	15.47647
3	88.00000	75.77281	12.22719
4	84.00000	79.06250	4.93750
5	89.00000	74.68304	14.31696
6	96.00000	91.85381	4.14619
7	89.00000	78.58676	10.41324
8	91.00000	81.55453	9.44547
9	70.00000	71.14177	-1.14177
10	84.00000	81.89066	2.10934
11	56.00000	68.32777	-12.32777
12	63.00000	67.46243	-4.46243
13	77.00000	77.69595	-0.69595
14	81.00000	73.34587	7.65413
15	70.00000	76.42680	-6.42680
16	58.00000	68.08618	-10.08618
17	63.00000	60.60422	2.39578
18	70.00000	66.55617	3.44383
19	56.00000	66.02289	-10.02289
20	56.00000	65.90393	-9.90393
21	63.00000	65.31238	-2.31238
22	70.00000	73.74101	-3.74101
23	70.00000	78.29076	-8.29076
24	77.00000	83.01201	-6.01201
25	63.00000	71.44261	-8.44261
26	66.00000	67.05060	-1.05060
27	70.00000	71.06299	-1.06299
28	74.00000	74.44907	-0.44907
29	73.00000	73.58676	-0.58676
30	70.00000	70.34253	-0.34253
31	70.00000	73.45201	-3.45201
32	77.00000	72.62555	4.37445
33	77.00000	74.44165	2.55835
34	84.00000	83.88628	0.11372
35	89.00000	75.32727	13.67273
36	84.00000	71.60733	12.39267
37	84.00000	71.69669	12.30331
38	82.00000	77.42867	4.57133
39	83.00000	86.95804	-3.95804
40	63.00000	67.12807	-4.12807
41	75.00000	69.88147	5.11853
42	77.00000	72.00095	4.99905
43	68.00000	72.53514	-4.53514
44	77.00000	78.27664	-1.27664
45	80.00000	86.25269	-6.25269
46	73.00000	71.89305	1.10695
47	70.00000	78.15306	-8.15306
48	70.00000	76.49542	-6.49542
49	70.00000	85.74722	-15.74722
50	84.00000	79.79953	4.20047
51	91.00000	100.02756	-9.02756
52	91.00000	81.27315	9.72685

53	77.00000	77.50690	-0.50690
54	70.00000	73.16576	-3.16576
55	81.00000	73.56749	7.43251
56	84.00000	77.21390	6.78610
57	77.00000	69.61287	7.38713
58	63.00000	77.56931	-14.56931
59	68.00000	71.23828	-3.23828
60	56.00000	70.07852	-14.07852

ABBREVIATIONS

BIP- Books In Print

BNB- British National Bibliography

BPR- American Book Publishing Record

CAN- Canadiana

CBI- Cumulative Book Index

FB- Forthcoming Books

HL- Holding List

LC- Library of Congress Catalogue

NST- New Serial Titles

NUC- National Union Catalogue

OC- Official Catalogue

PS- Library of Congress Proofslips

PTLA- Publishers Trade List Annual

PW- Publishers' Weekly

PWA- Publishers Weekly Announcements

ULR- Ulrich's International Periodicals Directory

ULS- Union List of Serials

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1970- Served Government of Pakistan for five years

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