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FINSYS-2: Subsystem TABLE-2 and OUTPUT-2

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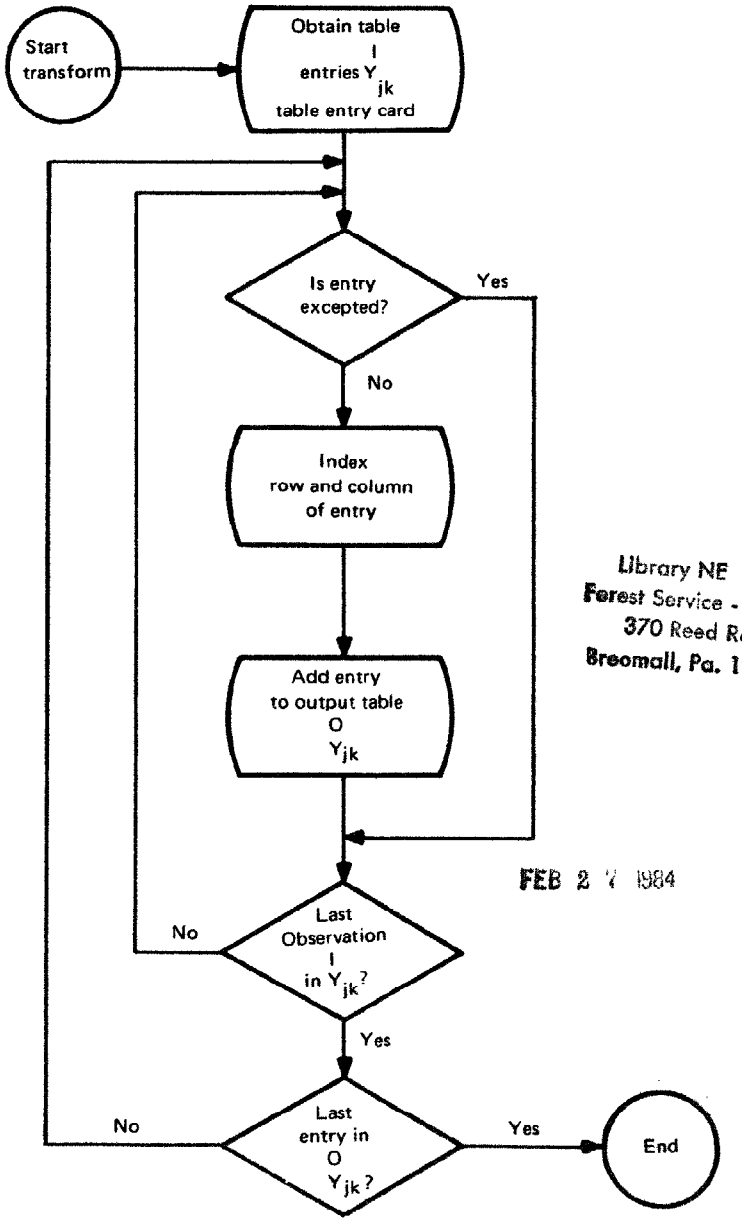

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ABSTRACT

Describes a computer software package for use in developing statistical tables from a resource inventory data set. The flexibility of the system in performing user-designated table-making functions also is described. Full instructions for operating the system are included.

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PREFACE

Since the original version of FINSYS was published in 1967, many people have modified and added to the system programs and documentation to make the general system more flexible and easier to use. This major revision includes an accumulation of changes that make the general system more usable to a broad spectrum of users.

The initial revision of the system programs was made by Dr. Warren E. Frayer, Colorado State University, in cooperation with the Forest Service. He was guided by a committee of Forest Service specialists including the authors; David A. Neebe, Washington Office; and John Berger, Pacific Northwest Forest and Range Experiment Station.

The Renewable Resources Evaluation unit at the Intermountain Forest and Range Experiment Station further modified the systems programs and documentation. Major contributions were made by the following members of the Intermountain Station staff:

> Gary L. Carroll, text revisions; Terrence S. Throssell, Gary W. Clendenen and James C. Schaefer, program and text revisions; Shirley H. Waters, Donald L. Johnson, and Jack W. Homeyer, program revisions.

The FINSYS-2 programs may be requested from either of the two addresses below. The preferred method of distributing program files is by a user-supplied computer tape. Requests should specify the computer to be used and program file specifications.

> Forest Inventory and Analysis, Northeastern Forest Experiment Station, 370 Reed Road, Broomall, Pennsylvania 19008; phone (215)461-3037.

or

> Forest Inventory and Analysis, Intermountain Forest and Range Experiment Station, 507 25th Street, Ogden, Utah 84401; phone (801)625-5377.

Further information concerning the use of FINSYS-2 for specific applications or sampling designs can be obtained by contacting the authors.

The computer program described in this publication is available on request with the understanding that the U.S. Department of Agriculture cannot assure its accuracy, completeness, reliability, or suitability for any other purpose than that reported. The recipient may not assert any proprietary rights thereto nor represent it to anyone as other than a Government-produced computer program. For cost information, please write: Forest Inventory and Analysis, Northeastern Forest Experiment Station, 370 Reed Road, Broomall, PA 19008.

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I. INTRODUCTION

This is a description of operating instructions and basic information for users of FINSYS-2 Subsystems TABLE-2 and OUTPUT-2. This publication is a revision of "The Northeastern Forest-Inventory Data Processing System"--(Wilson and Peters 1967 a, b, c, d, e, f).

One of the major projects of the Forest Service is a nationwide forest survey, which is designed to obtain useful and timely information about the timber resources of the United States. In the course of the surveys, which are made mainly on a state-by-state basis, great masses of detailed data are collected about timber volumes, growth, timber cut, and other characteristics of the timber resource.

Over the years, the volume of information obtained from forest survey work has increased greatly. The task of compiling and analyzing this mass of data with mechanical computing machines was both cumbersome and time-consuming.

With the advent of high-speed electronic computers, the Northeastern Forest Experiment Station devised the Northeastern Forest-Inventory Data-Processing System (FINSYS). Although this revision of the original FINSYS system accomplishes the same purposes as the original, the user can handle a greater variety of data-processing options with less effort. The revised system, FINSYS-2, is not compatible with the earlier version, so present users of the system must alter their processing controls to use the new version. However, the data handling concepts are similar and the benefits gained may well be worthwhile.

TABLE-2 and OUTPUT-2 are the part of the FINSYS-2 system that is designed specifically to reduce large amounts of sample data to tables of statistics. TABLE-2 produces sample summary output which is designed for use as input to OUTPUT-2 to produce tables of statistics for the sampled populations. EDIT-2 which edits data with some computational capability is described in Barnard and Born (1978).

Each of the FINSYS-2 Subsystems is composed of a single large computer program, with a number of subroutines. These programs are controlled by a number of specified processing options.

The programs are written in the standard FORTRAN IV language, and are operative on UNIVAC, CDC, IBM, Honeywell, and other computers throughout the United States. They will operate with little or no modification on comparable systems.

Also available for use with TABLE-2 is PARMS (Throssell 1979), a program which automatically modifies the dimensioned space according to the requirements of the user. The PARMS program is not required to use TABLE-2, but it provides efficient and automatic allocation of storage when job requirements vary with users of the same computer or data sets. PARMS is available for UNIVAC, CDC, and IBM systems, and it could be modified for use with other large computer systems.

This report includes programing information that will be useful if the programs must be modified for any reason. Detailed instructions for setting up and executing jobs are also given.

The principal value of the programs lies in their versatility. While applying a standard, straightforward procedure to the reduction of data, they provide a large amount of freedom in fitting both inputs and outputs to the requirements of particular data-reduction problems. Within the context of the programs, the origin of the input data is immaterial; a data set that is to be processed may be sample data, but it need not be. The data set is simply a collection of values for one or more attributes of one or more objects (sampling units) that are to be reduced to tables of statistics that characterize the set. A data set might be a complete set of samples, a sampling stratum, or a single sample. Similarly, the output tables may summarize any elements of data from the data set. Several different tables, each representing all or a selected part of the input data, may be used to form these summaries. And, in order that both the inputs and the outputs may be variable, the details of the procedures by which one is converted to the other are also variable. Consequently, the programs can be applied to a wide variety of data-reduction problems.

A. TABLE-2 OUTPUTS

The primary outputs from TABLE-2 are sets of statistical tables. One set of output tables is produced for each set of sample input data. An output set may consist of up to 40 (153 optional) two-dimensional tables. No table in the set may have more than 201 rows and 101 columns, including the row and column subtotals and totals that are formed for every table.

The content of the tables in an output set depends entirely upon the demands of the particular application. Any attribute of the sampling units in a data set can be summarized by categories determined from other sampling-unit attributes.

In addition there is a choice of statistics representing sampling options, to be provided for every cell of each table in output data set. The choices are:

1. Simple sums over sampling units.

2. Means over sampling units.

3. Means and their variances over sampling units.

4. Means, their variances, and their covariances with the grand mean over the sampling units (for use when the data set summaries are to be used to make ratio estimates).

5. Means and their variances over sampling units, with unequal probabilities of selection for sampling units. (Options 1-4 assume equal probabilities of selection for sampling units within a data set.) This option also allows the sampling unit to be divided into more than one data set within a population.

All output sets from a program run are written on a single file of binary records for rapid transmission to OUTPUT-2, in which the tables are labeled and printed as population statistics after appropriate weighting and summing. The relationship between the output options in TABLE-2 and the ones used in OUTPUT-2 is discussed in the section on data inputs for OUTPUT-2. For the purpose of debugging the Job Control Deck, the alternative of printing the tables in block form as BCD records is also available. A binary file can be written with this option, if desired.

During execution, the program prints a job summary consisting of messages of three types: those that identify errors in the Job Control Deck that have halted execution, those identifying errors in input records (or the Job Control Deck) that cause the record to be deleted but processing to continue, and those that signal successful reading of the Job Control Deck and identify the data sets and numbers of sampling units that have been processed.

B. TABLE-2 DATA INPUTS

The data input to the program consists of a single file of ordered unit records. Each record in the file must have exactly the same format as every other record. The file contains the data from sets of observed sampling units. How the sampling units are represented by the unit records depends upon the characteristics of the particular problem. The key is the way in which the field observations were made.

If all attributes were actually observed on the sampling unit as a whole (a plot, for example), the sampling unit observation would consist of a single value for each attribute. The sampling unit observation could then be represented by a single unit record.

If, however, all attributes were observed on subdivisions of the sampling unit (on trees in the plot, for example), then there would be several values for each attribute. In this case, one unit record would be required to represent each observed value of the set of attributes, so the sampling unit as a whole would be represented by a set of unit records equal in number to the number of subdivisions on which observations were made.

Generally, attributes of both kinds are observed on sampling units. In this case, there must still be a unit record to represent each subdivision observed, but the unit record format must also provide for entry of the single-valued attributes observed on the sampling unit as a whole. These values are repeated in every unit record of the set representing the sampling unit.

An additional possibility arises if attributes are actually observed on the sampling unit as a whole, on subunits of the sampling unit, and on subdivisions of the subunits. This is simply an extension of the previous case. The unit record format must provide for recording the values of all three kinds of attributes. There will be one unit record representing each observed subdivision of the subunits. The values of attributes observed on the subunits will be repeated in each record of the subset representing the subunit; and, as before, the values of attributes observed on the sampling unit as a whole will be repeated in each record of the whole set representing the sampling unit.

In summary, then, the individual unit record always represents the smallest subdivision of a sampling unit that has been directly observed, whatever that may be. The maximum allowable number of unit records in the sets representing sampling unit sets is specified on a control card. The unit records must have a common format, and appropriate values for each of up to three kinds of attributes actually observed on a sampling unit must be recorded in every unit record. There is no provision for header cards of any kind.

The order of the unit records in the input file also depends on the characteristics of the problem. The unit records must always be ordered by subunits, if any, within sampling units. In turn, the sampling unit sets must always be ordered into data sets. The significance of the data set is that it contains all the data required to make one set of output tables. What the data set represents in terms of the population that has been sampled depends upon the methods of sampling and of compilation that are employed. In stratified sampling, it will represent a sampling stratum. In other types of sampling, it will generally represent any kind of geographical or other unit for which output tables of statistics are required. Any number of data sets may be contained in the input file.

If required by the problem, the data sets themselves may be ordered into groups; and these groups, in turn, into still larger groups. For example, if stratified sampling has been employed in each of several geographical areas covering the population sampled, then the data sets must be ordered by geographical area. However, it must be remembered that all data sets processed in a single production run are subject to the same set of processing rules.

C. TABLE-2 LOGIC AND PROCEDURES

The program consists of seven principal phases or steps connected in a simple and straightforward manner (fig. 1). The first step simply reads and stores in the computer all of the control information contained in the Job Control Deck.

The second step reads a set of unit records representing a sampling unit and stores all of the data in blocks, according to the kind of attributes represented in each data field. Consequently, all input data for a sampling unit are available throughout the processing of that sampling unit.

The third step executes the CALCUL subroutine. This step is provided to allow the calculation of data field values from information in more than one unit record of the sampling unit set, since this kind of operation cannot be performed in a unit record editing process.

The fourth step produces the facsimile output tables at the sampling unit level. This key step in the compilation process is discussed in detail later.

The fifth step adds the completed sampling unit tables to the output tables being accumulated for the data set; and if required, also adds tables of squares and of cross-products (of cells with totals) to special data set tables used to compute variances and covariances.

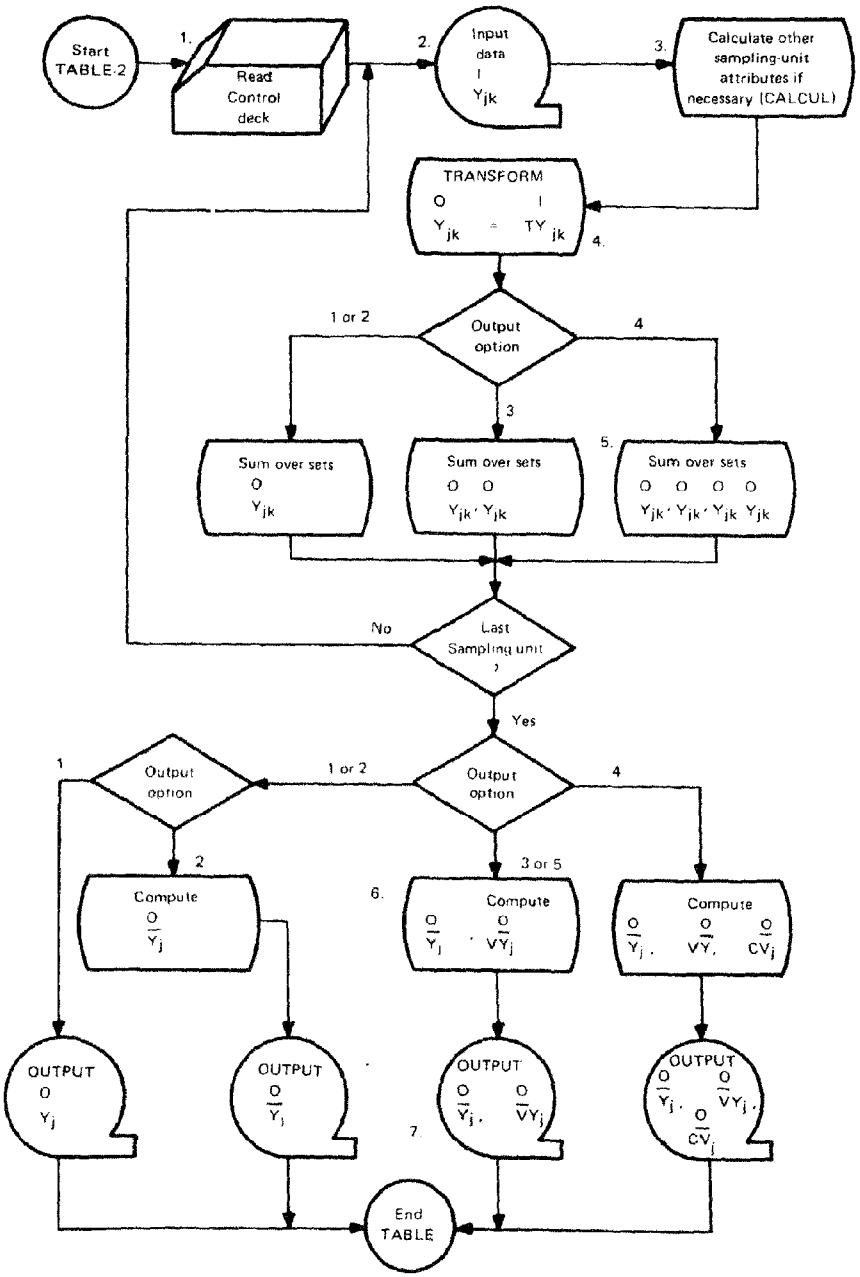

Figure 1.--A generalized flow chart of TABLE-2

Steps two to five are repeated until every sampling unit in the data set has been processed. Then, the sixth step computes the required statistics for each output table from the sums that have been accumulated. The tabulated statistics are written on a file in binary mode (or printed, if the debugging output option has been taken) in the seventh and final step.

If there are additional data sets to be processed, the program then returns to step two and the cycle is repeated for each successive set.

The formation of final output tables begins with the formation of facsimile output tables for each input sampling unit, in sequence. The formation of these tables is governed entirely by a general table-making procedure provided in the program in conjunction with information about the relationships between sampling unit data and output tables in a given application that is conveyed to the program in the Job Control Deck.[1]

---

[1]The process of forming the facsimile output tables for the sampling units is similar in concept to a matrix transformation:

$$ {}^{O}_{Y} = T\ {}^{I}_{Y} $$

where ${}^{O}_{Y}$ = a given two-dimensional facsimile output table in which an input attribute is tabulated according to the values of two other attributes;

T = the transform that controls the process, consisting of the general table-making procedure and the control information for a given job;

and

${}^{I}_{Y}$ = a two-dimensional array of sampling unit input in which the data are tabulated according to observation (rows) and attribute (columns).

The general procedure (fig. 2) provides that each observed value of a given attribute[2] is summed (entered) into a given facsimile table in a particular row and column (table cell), unless conditions are specified under which certain values of the attribute are not to be entered. The procedure also provides that up to 10 attributes may be entered in a given table. The general procedure can form almost any kind of tabulation of sampling unit data.

The information provided in the TABLE-2 Job Control Deck defines the particular set of tables required. For each table, the following information is given:

1. A short, unique name by which the table can be identified.

2. The dimensions (number of rows and number of columns including subtotals but excluding row and column totals) of the table.

3. The attributes in the sampling unit data that are to be summed into the table. The values of these attributes must be expressed as real or floating-point numbers (F format).

4. The attributes in the sampling unit data that determine the row and the column (table cell) in the table into which each value of the entry attribute is to be summed. The values of these attributes must be expressed as integer or fixed-point numbers (I format).

5. The operations (and input tables, if any) by which values of the index attributes are converted to row and column indexes are chosen from among the five operations that are available in the program:

---

[2]The number of entries of a given attribute per sampling unit depends upon the kind of attribute and the number of subdivisons of the sampling unit on which it was observed. If the attribute was observed on the sampling unit as a whole, it has only one value, so only one entry is made in the appropriate facsimile tables. If the attribute was observed on a subdivision of a sampling unit, there will be as many values (and as many entries in the table) as there were subdivisions of the sampling unit. The general procedure automatically enters each observed value of an attribute, using information about the attribute classification furnished with the input record description in the Job Control Deck.

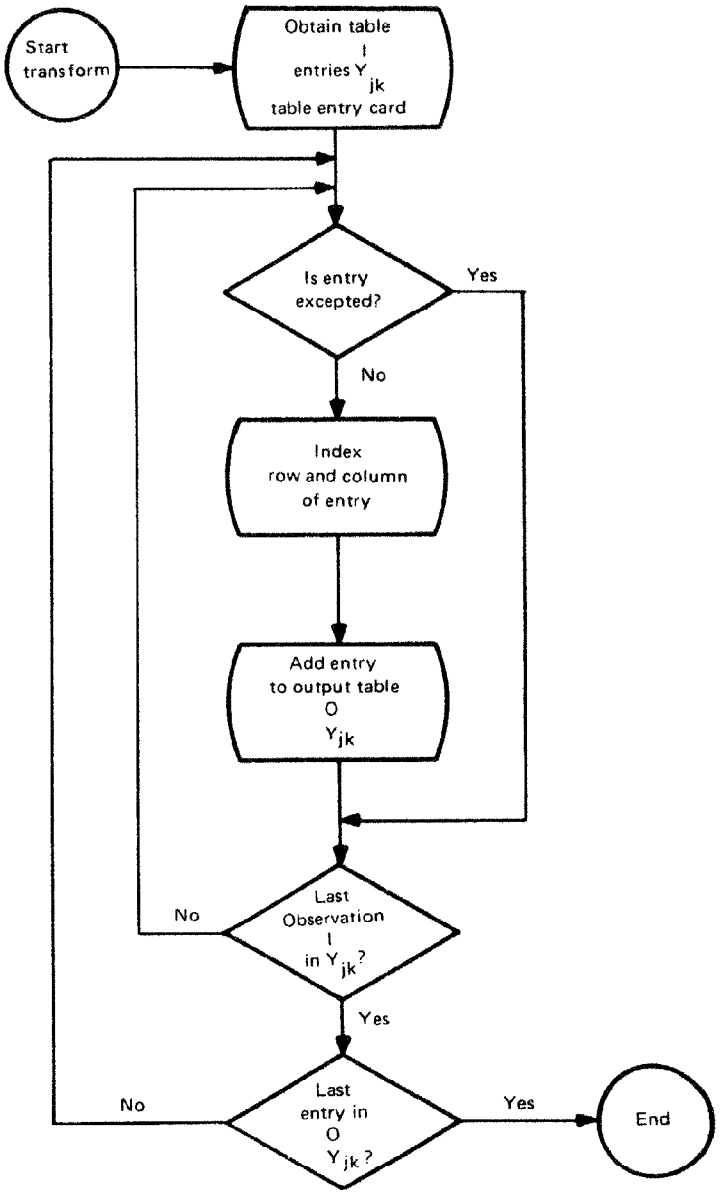

Figure 2.--Flow chart of transform operations in TABLE-2

(a) LIST, the operation that defines an index as the position in a list occupied by a given value of an index attribute. An input table contains the list of all values the given attribute is allowed to assume. For example, assume the following relationships between the values of an attribute and the rows of an output table into which an entry is to be made: when the value is 1, the entry is in the second row; when the value is 2, the entry is in the third row; when the value is 4, the entry is in the fourth row; and when the value is 6, the entry is in the first row. Because there are four possible values of the index attribute in one-to-one correspondence with a row index, there must be four entries in the input table: 0006, 0001, 0002, and 0004. "Dummy" values must be included in the list if subtotals are to be produced with the LIST operation to allow for the position of each subtotal in the list.

(b) RANGE, the operation that defines an index position in a list occupied by a range of values that contains a given value of an attribute. An input table contains the list of ranges that cover all possible values for the given attribute. As with the LIST operation, space must be included in the input table if subtotals are used.

For example, assume the following relationships between the values of an attribute and the columns of an output table into which an entry is to be made: when the value of the index attribute is less than 50, the entry is to be made in column 1; when the value is between 50 and 73, inclusive, the entry is to be made in column 2; and when the value is between 74 and 99, inclusive, the entry is in the third column. There must be three entries in the input table: 00000049, 00500073, and 00740099. "Dummy" ranges must be included in the table if subtotals are to be produced with the RANGE operation.

(c) LOOKUP, the operation that defines an index as the value in one list of values whose position corresponds to the position in another list occupied by a given value of an attribute. An input table provides both lists. For example, assume the following relationships between the values of a given attribute and the rows of an output table into which an entry is to be made: when the value is 1 or 7, the entry is in the first row; when the value is 2, 3, or 4, the entry is in the second row; and, when the value is 5 or 6, the entry is in the third row. Since seven values of the attribute are allowed there must be seven entries in the input table:

00010001, 00020002, 00030002, 00040002, 00050003, 00060003, and 00070001. The row or column for a subtotal must not be specified in the LOOKUP input table.

(d) EQUATE, the operation that defines an index as equal to a given value of an attribute. No input table is required. The row or column for a subtotal must not be a value of the attribute for an EQUATE operation.

(e) CONST, the operation that defines an index as equal to a given constant. No input table is required but the constant must be specified along with the operation name. The row or column for a subtotal must not be specified by the CONST operation.

6. The conditions under which a value of an entry attribute is not to be summed into a given facsimile output table are referred to as exceptions. Each condition requires the specification of an attribute, a constant, and a relation operator. The exception (no entry) is whenever a value of the attribute bears the specified relation to the constant. Up to 10 conditions may be applied to any entry attribute providing that the total number specified in the Job Control Deck does not exceed 100.

D. OUTPUT-2 OUTPUTS

The primary outputs from OUTPUT-2 are printed tables of statistics for sampled populations, selected from among the tabular summaries produced for the data sets (samples) in TABLE-2.

The basic statistics put out for each selected table are cell-by-cell sums (including row and column subtotals and totals) of the sampling unit attributes contained in the table over all sampling units in the population. The corresponding variances of these sums (except that the zero variances for populations wholly contained in the samples are not printed) is an option provided by the program. In addition, tables of the corresponding standard errors of estimate, expressed either in absolute terms or as percentages, may be obtained on an optional basis.

Each statistic for each of the selected output tables is printed in the format specified for that table in the TABLE-2 Job Control Deck. A maximum of 51 rows and 5 columns are printed per page, complete with table title, row and column headings (as supplied in the OUTPUT-2 Job Control Deck), and the name of the statistic. Larger tables are printed on multiple pages, each page being fully labeled.

Outputs equivalent to those just described can also be obtained on an optional basis for groups of populations. These statistics are simple sums of the individual population statistics.

In addition to, or in place of, these primary outputs, other modified outputs of the same general format can be obtained. For example, tables of population totals and their variances can be replaced by tables of means and their variances. Under certain conditions, the tables of population statistics can be replaced by tables of sample statistics; or, under an appropriate assumption of homogeneity within the population, by tables of statistics for particular segments of the population. However, modifications of this kind require judicious choice of a successful combination of input data, weights, expansion factors, and processing options. They should not be undertaken without a thorough understanding of the sampling method, the estimating problem, and the program logic and procedures.

E. OUTPUT-2 DATA INPUTS

The data input to OUTPUT-2 must be a single file of binary records that contains the data set (sample) summaries for all populations that are to be processed in a given run. It may also contain summaries of data sets that are not to be processed in the run. These will simply be passed over during processing. A set of tables produced on punched cards during a previous run may also be included as data input under an update option. Entries in these tables will be added to the results produced during the current run.

The file produced for these samples in TABLE-2 is the appropriate input to OUTPUT-2, provided that care has been taken to reconcile the output option of TABLE-2 with the processing option of OUTPUT-2. It is also necessary that the data set summaries applicable to a given population appear one after the other and in known order in the input file. Consequently, the same order should appear in the input file to TABLE-2.

F. OUTPUT-2 LOGIC AND PROCEDURES

The underlying logic and procedures of OUTPUT-2 are quite simple (fig. 3). The first step always is to read the Job Control Deck into the computer, interpret the specifications it contains, and store the necessary information. The interpretation includes the setting up of the processing option (see below) and the output options specified in the Job Control Deck. The Job Control Deck also contains the labels to be printed with the output tables, and all weights and expansion factors required in processing the job. In the general case, this setup phase is followed by several distinct phases in which the actual processing is accomplished.

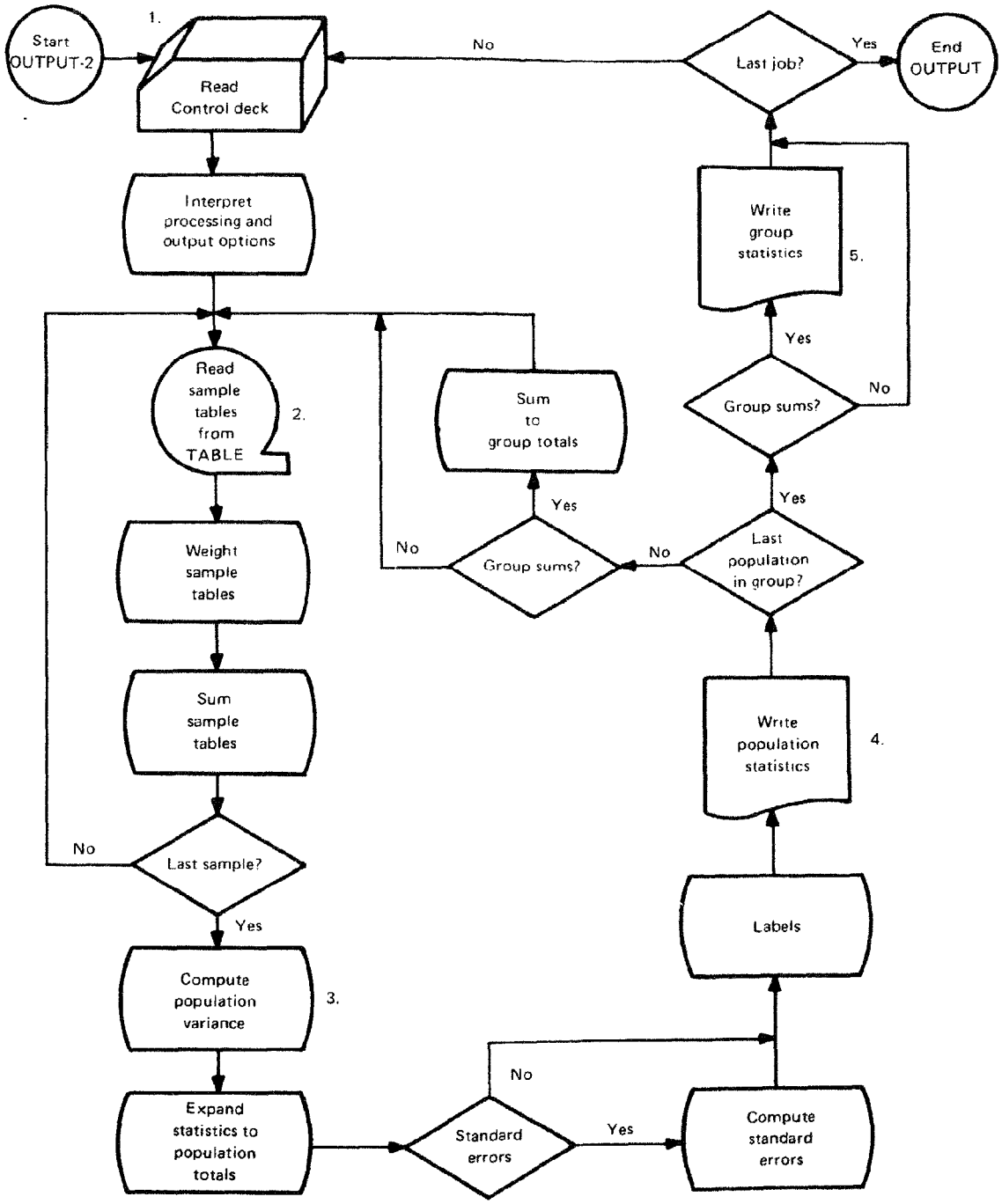

Figure 3.--A generalized flow chart of OUTPUT-2

First, the entire set of tabular summary data for a data set (stratum) from a given population is read into the computer; and the selected tables are weighted and summed to population totals. This phase is repeated until all samples from the population have been processed.

Second, the final population variances are computed and, if elected, so are the standard errors of estimate. After all statistics are multiplied by the appropriate expansion factors for the estimate, the tables of population statistics are printed. At this point, the tables of population statistics will be summed to totals for groups of populations, if that option has been specified. This phase is repeated until all populations specified for the job have been processed and printed.

In the final phase, the tables of statistics for groups of populations, if any, are written and the program branches back to the beginning--the reading of the Job Control Deck for the next job. This phase is repeated until all jobs in the processing run have been completed, at which point the program is halted and the run is finished.

The program provides six processing or sampling options that are all special cases of the general case just described. The processing options consist of various combinations of the procedures contained in the first and second processing phases. Each option is described in detail later. In brief, they are:

1. Direct estimates of population parameters as simple sums of sample summaries; for example, when samples contain all elements of the population. These estimates require data input resulting from output option 1 or 2 of TABLE-2.

2. Direct estimates of population parameters as expansions of summaries from a single sample; for example, a case of simple random sampling. These estimates require data input resulting from output option 3 or 5 of TABLE-2.

3. Direct estimates of population parameters as expansions of the weighted sums of summaries from several samples, using known weights; for example, stratified random sampling from known strata. These estimates require data input resulting from output option 3 or 5 of TABLE-2.

4. Direct estimates of population parameters as expansions of the weighted sums of summaries from several samples, using estimated weights; for example, stratified random sampling with double sampling for stratification. These estimates require data input resulting from output option 3 or 5 of TABLE-2.

5. Ratio estimates of population parameters analogous to those of processing option 4, except that each cell of the tabular sample summaries is converted to a ratio of the tabular total and multiplied by an independent estimate of the tabular sample total before weighting and summing. These estimates require data input resulting from output option 4 of TABLE-2.

6. Ratio estimates of population parameters analogous to those of processing option 4, except that each cell of the tabular weighted sums of the several samples is converted to a ratio of the tabular total and multiplied by an independent estimate of the tabular (population) total before computing the final variances and expanding the statistics. These estimates require data input resulting from output option 4 of TABLE-2.

G. TABLE-2 AND OUTPUT-2 DESCRIPTION SUMMARY

The foregoing has described how TABLE-2 and OUTPUT-2 are designed to carry out a general data-reduction process and to incorporate a great many variations in detail automatically. This design makes the programs applicable to many different data-reduction problems; but their flexibility also means that they cannot provide a fully automatic solution to any problem.

The user always has the responsibility of preparing the Job Control Decks in which the particulars of a given problem are specified. The description of the decks in part II can be used as a checklist in assembling the minimal information required; but successful application of the subsystems demand, in addition, a thorough knowledge of the problems, including the end-use of the results and the origins of the data.

It will be found that the preparation and checking of the Job Control Decks is not easy. The decks contain a great deal of detailed information about the problem, not all of which can be checked by the subsystems before test runs. Consequently, while the subsystems are an efficient means of solving a variety of problems involving large amounts of data or extensive tabulations of data, other means will generally be better for simpler problems.

The special purpose of OUTPUT-2 is to compute tables of population statistics from sample summaries, according to one of several sampling schemes. The subsystem is designed to be used in tandem with TABLE-2 so that both its inputs and outputs are controlled to a large extent by the outputs of that program; therefore, it is not well adapted for independent use in applications that do not also use TABLE-2.

II. USE OF TABLE-2

A. TABLE-2 CONTROL CARD FORMATS

The description and specification of a table-compilation job is presented to the computer through a special deck of data cards referred to as the Job Control Deck. Each card in this deck contains specific pieces of information arranged in a definite format.

In this section each type of control card is described. The description gives the format of the cards, the information they must contain, and, where appropriate, the purpose and use of the required information. This section may be used both as a detailed list of instructions for coding the description of a job, and as an outline to follow in the initial stages of job specification in order that the specifications be complete.

1. Job Control Cards

The first two cards in the Job Control Deck are the TITLE CARD and the INPUT/OUTPUT CONTROL CARD. They contain the job identification and the general instructions concerning the kind of data input and output required. Both cards must always be present in the Job Control Deck. The set of job control cards is shown in figure 4.

TITLE CARD

Columns	Contain	Explanation
1-80	AAA...A	80 alphameric characters, giving a descriptive title for the job. The title will appear in the printed output.

INPUT/OUTPUT CONTROL CARD

Columns	Contain	Explanation
1-5	INPUT	Card label.
6	b	
7-9	XXX	3 numeric characters, giving the total number of data fields in each input record. The number must be right-justified in the field.

10	b	
11	1	The input records are in binary mode.
	2	The input records are in BCD mode on tape or disk.
	3	The input records are in BCD mode on cards.
	4	The input records are in standard CDC or IBM BCD mode on tape or disk. This option is only for the UNIVAC @ FOR system and may require modification for other systems.
	5	The records are in UNIVAC NTRAN blocked binary mode on tape. For this option, the blocking factor must be specified in columns 74-75. This option is only for the UNIVAC @ FOR system.
12	b	
13-18	XXXXXX	6 numeric characters, giving the total number of input records to be processed. The number must be right-justified in the field. If left blank (b) or zero (0), an end-of-file check terminates normal processing after the last record is read.
19	b	
20	X	The total number of input format cards from 1 to 5 for BCD input. This field is used only if column 11 contains a 2, 3, or 4. The use of 0 or b is interpreted as 1.
21	b	
22-27	OUTPUT	Card label.
28	b	

29	1	Construct output tables of sampling unit sums over sets of sampling units.
	2	Construct output tables of sampling unit means over sets of sampling units.
	3	Construct output tables of sampling unit means and their variances over sets of sampling units.
	4	Construct output tables of sampling unit means, their variances, and covariances of table cells with table totals over sets of sampling units.
	5	Construct output tables of sampling unit means and their variances over sets of sampling units where sampling units are selected with specified probabilities. If this option is used, the SAMPLING OPTION 5 CONTROL CARD must be used (described later).
30	b	
31	b or 0	Output written on logical unit LU2 in binary mode. This option is used for normal production processing.
	1	Output is printed in BCD (F format) on logical unit LU6. This option is used when debugging a Job Control Deck.
	2	Output written on logical unit LU2 in binary mode and also printed in BCD (F format) on logical unit LU6.
32	b	
33	b or 0	No listing of the Job Control Deck (with exception of TITLE CARD).
	1	List entire Job Control Deck.
	2	List Job Control Deck with exception of input tables.

34	b	
35-37	XXX	The number of indexing errors at which processing is to be terminated. These errors relate to row or column indexes which will not fit within specified output table dimensions. The use of b or 0 allows an unlimited number. The number must be right-justified in the field.
38-40	bbb	
41-45	XXXXX	The maximum number of input records per sampling unit. The number must be right-justified in the field. This field is required only when using PARMS.
46-48	XXX	The maximum number of subunits per sampling unit. The number must be right-justified in the field. This field is required only when using PARMS.
49-73	bbb...b	
74-75	XX	The blocking factor of the input data file. This field is used only if column 11 contains a 4 or 5. The number must be right-justified in the field. This field is required only with input option 4 or 5.
76	b	
77-80	xxx	The number of characters per record on the input data file. This field is used only if column 11 contains a 4. The number must be right-justified in the field. This field is required only with input option 4 or 5.

2. Input Table Cards

This section describes each type of card required in the Job Control Deck to provide the input tables used in the table indexing operations.

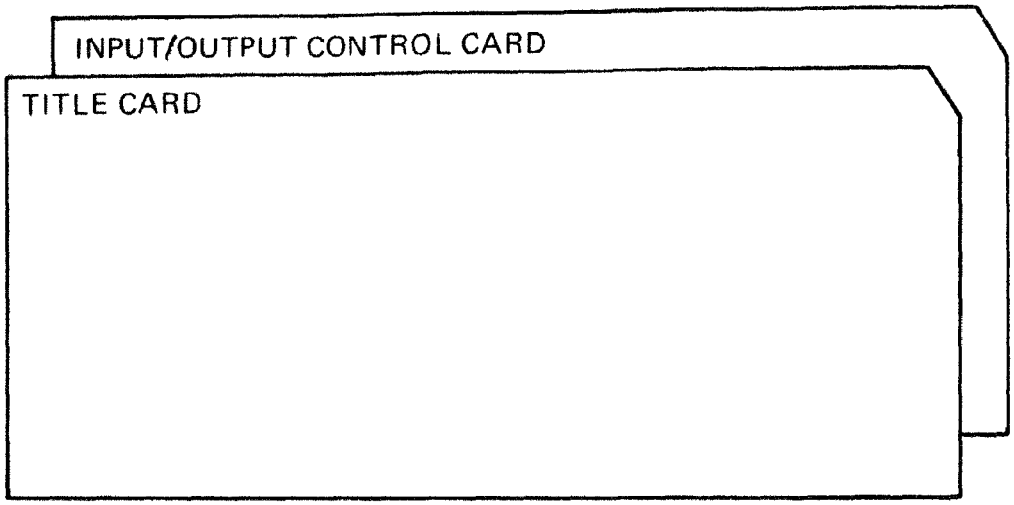

Figure 4.--Order of job control cards in the Job Control Deck for TABLE-2

The NO INPUT TABLES CARD is to be used if the job does not require input tables for indexing. In this case no other input table cards need be used.

A maximum of 40 input tables may be put in the Job Control Deck, and the tables may be in any order. However, all tables must be placed in the Job Control Deck as a group, and the last card of the group must be the END OF INPUT TABLES CARD.

Two types of cards are required for each input table, and the cards for each input table must appear as a set. The first card of each set is the INPUT TABLE NAME CARD that gives a unique name to the table and controls the input of the table to the computer. The remaining cards of each set are repetitions of the INPUT TABLE ENTRY CARD in which a single input table entry appears. As many of these cards follow the INPUT TABLE NAME CARD as there are entries in the table. Input tables must also contain cards to allow for subtotal positions when LIST or RANGE operations are used.

Comments for use in describing the input tables or entries can be punched in the remaining columns of the two types of cards. These comments will appear in the printed output assuming the proper listing option has been selected.

The card following the last INPUT TABLE ENTRY CARD for a table must either be an INPUT TABLE NAME CARD or an END OF INPUT TABLES CARD. Input table card sets are shown in figure 5.

NO INPUT TABLES CARD

Columns	Contain	Explanation
1-4	NONE	A control word, signifying there are no input tables in the Job Control Deck.

INPUT TABLE NAME CARD

Columns	Contain	Explanation
1-4	AAAA	4 alphameric characters, giving a unique name for the input table.
5	b	
6-10	XXXXX	5 numeric characters, giving the number of entries in the table just named. The number must be right-justified in the field.

11	b	
12	1	There is only one field in a table entry.
	2	There are two fields in a table entry. This is required for tables to be used with the LOOKUP or RANGE operations.
13-80	AAA...A	68 alphameric characters, giving a description of the input table. The description will appear in the printed output if column 33 in the INPUT/OUTPUT CONTROL CARD contains a 1.

INPUT TABLE ENTRY CARD(S)

Columns	Contain	Explanation
1-4	XXXX	4 numeric characters, containing the value of the first field of a table entry. The number must be right-justified in the field.
5-8	XXXX	4 numeric characters, containing the value of the second field of a table entry, if any. The value must be right-justified in the field. A second field is required only if the table is to be used in the LOOKUP or RANGE operations.
9-80	AAA...A	72 alphameric characters, giving a description of the input table entry. The description will appear in the printed output if column 33 in the INPUT/OUTPUT CONTROL CARD contains a 1.

END OF INPUT TABLES CARD

Columns	Contain	Explanation
1-3	END	A control word, signifying the end of all input tables. This card must always follow the last table entry card of the last input table in the Job Control Deck. This card is not used if the NO INPUT TABLES CARD has been used.

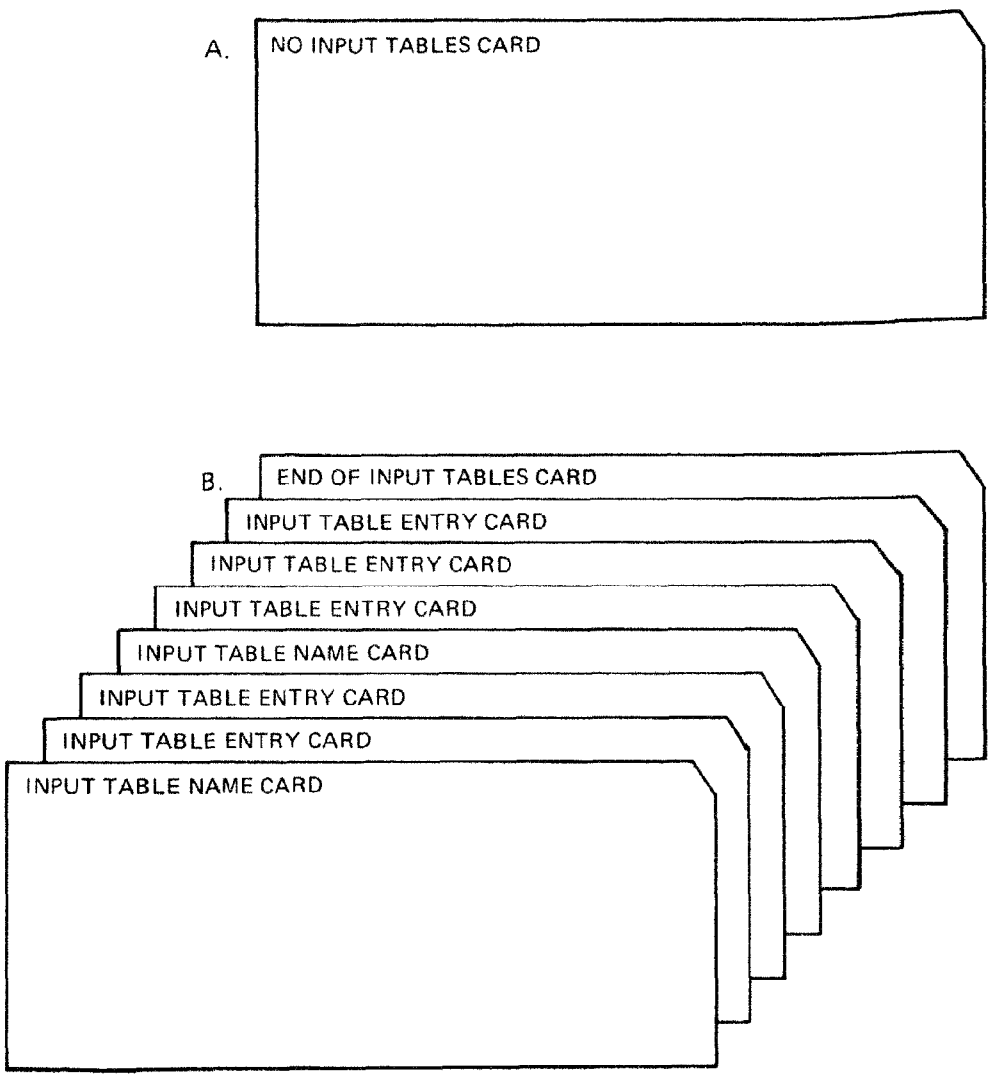

Figure 5.--Order of input table cards in the Job Control Decks; A, when the job does not require input tables and B, when the job does require input tables with two and three entries respectively.

3. Output Table Cards

The control cards described in this section are used to define the output tables that are to be compiled from the input data for this job. The maximum number of tables that may be defined in one run is 40 and the maximum dimensions of any table are 201 rows by 100 columns, including the row and column subtotals and totals. The definition of output tables is subject to the additional restriction that the total number of cells in all tables defined is limited by the sampling option chosen and the available storage in the computer. This restriction is discussed further in part III.

The definition of an output table gives the information required to produce the output table from the input data. The information is contained in a group of cards for each output table defined. The groups must be placed in the Job Control Deck in the order that the tables are to appear in the final output.

The first card in a group of cards defining an output table is the OUTPUT TABLE DEFINITION CARD. On this card the user assigns the table a unique name, gives its dimensions, specifies the number of entries in the table per unit record, and provides for the output of subtotals or totals, if any. Up to three OUTPUT TABLE DEFINITION CONTINUATION CARDS can be used, if necessary.

Next in the group comes a set of cards (described below) in which the table entries are defined. There must be as many of these cards as there are table entries specified on the first card. Each of the TABLE ENTRY CARDS completely defines one table entry.

Finally, the end of all output table definition cards is signaled by the END OF OUTPUT TABLES CARD. Output table definition card sets are shown in figure 6.

OUTPUT TABLE DEFINITION CARD

Columns	Contain	Explanation
1-12	DEFINEbTABLE	Card label.
13	b	
14-17	AAAA	4 alphameric characters, giving a unique name for an output table.
18	b	

19-21	XXX	3 numeric characters, giving the number of rows in the output table (including rows for subtotals but excluding a row for column totals). The number must be right-justified in the field.
22	A	The alphabetic character X, signifying "by", as in rows "by" columns.
23-24	XX	2 numeric characters, giving the number of columns in the output table (including columns for subtotals but excluding a column for row totals). The number must be right-justified in the field.
25	b	
26-27	XX	2 numeric characters, giving the total number of entries to be made in the table from each unit record (or unit record set) processed.
28	b	
29	b or 0	A row of column totals is to be produced.
	1	Suppress the row of columm totals.[3]
30	b or 0	A column of row totals is to be produced.
	1	Suppress the column of row totals.[3]
31	b	
32	b	No subtotals.
	R	A row of subtotals is to be produced.
	C	A column of subtotals is to be produced.
33-35	XXX	The sequential number of the first row (or column) to be included in the subtotal.

[3]Not to be used if column 29 of the INPUT/OUTPUT CONTROL CARD contains a 4.

36-38	XXX	The sequential number of the last row (or column) to be included in the subtotal. Must be equal to or larger than the number entered in columns 3335.
39-41	XXX	3 numeric characters, giving the number of the row (or column) where the subtotal is to be placed.
42-74		Repetition of the format for columns 31-41 for up to 3 additional table subtotals. (Each set begins with a blank.)
75-79	bbbbb	
80	b or 0	An OUTPUT TABLE DEFINITION CONTINUATION CARD does not follow.
	1	A continuation card follows with additional row or column subtotal specifications.

OUTPUT TABLE DEFINITION CONTINUATION CARD(S)

Columns	Contain	Explanation
1-77	bAXXX...X	Repetition of the format for columns 31-41 on the OUTPUT TABLE DEFINITION CARD for up to 7 additional table subtotals. Up to 3 continuation cards may be used allowing a maximum of 25 subtotals to be specified. Used only if column 80 of the OUTPUT TABLE DEFINITION CARD contains a 1.
78-79	bb	
80		Repetition of the format for column 80 on the OUTPUT TABLE DEFINITION CARD.

OUTPUT TABLE ENTRY CARD(S)

Columns	Contain	Explanation
1-4	AAAA	4 alphameric characters, giving the name of the output table in which the entry will be made. The name must appear exactly as given in columns 14-17 of the OUTPUT TABLE DEFINITION CARD.
5-6	bb	
7-12	LISTbb	Define the row index of the table entry as the position number, in a list of all possible values, of the value in the data field specified in columns 14-16 of this card.
	RANGEb	Define the row index of the table entry as the position number, in a list of all appropriate ranges, of the range that contains the value in the data field specified in columns 14-16 of this card.
	LOOKUP	Define the row index of the table entry as the value in a list that is paired with the value in the data field specified in columns 14-16 of this card.
	EQUATE	Define the row index of the table entry as the value in the data field specified in columns 14-16 of this card.
	CONSTb	Define the row index of the table entry as the constant contained in columns 14-16 of this card.
13	b	
14-16	XXX	3 numeric characters, giving the value required in the operation named in columns 7-12 of this card. The value must be right-justified in the field. If the named operation is LIST, RANGE, LOOKUP, or EQUATE, the value will be the identification number of the required data field. If the named operation is CONST, the value will be the required constant.

17	b	
18-21	AAAA	4 alphameric characters, giving the name of the input table containing the list required in the operation named in columns 7-12 of this card. The name must appear exactly as given in columns 1-4 of an INPUT TABLE NAME CARD. These columns are left blank if the operation named is EQUATE or CONST.
22	b	
23-28	AAAAAA	The same as columns 7-12, except that the operation is used to define the column index.
29	b	
30-32	XXX	The same as columns 14-16, except that the value is used to define the column index.
33	b	
34-37	AAAA	The same as columns 18-21, except that the input table is used to define the column index.
38	b	
39-41	XXX	3 numeric characters, giving the identification number of the data field to be entered in the output table. The number must be right-justified in the field.
42	b	
43-45	XXX	3 numeric characters, giving the identification number of the first exception applying to the table entry. The number must be right-justified in the field.
46-72		Repetition of columns 43-45 format for up to 9 additional exceptions applying to the table entry.

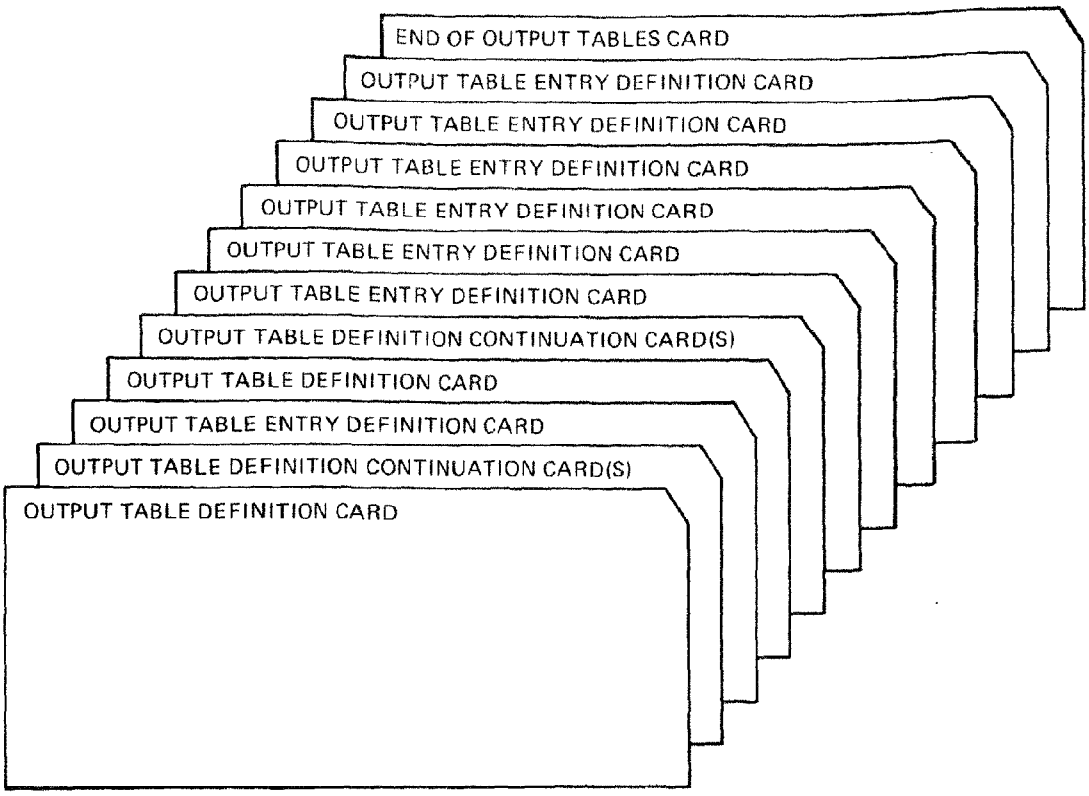

Figure 6.--Order of output definition cards in Job Control Deck. This setup calls for two output tables, with one and six entries respectively.

END OF OUTPUT TABLES CARD

Columns	Contain	Explanation
1-3	END	A control word, signifying the end of all output table definition and entry cards. It must follow the last entry card of the last output table.

4. Output Table Entry Exception Cards

Output table entry exceptions are used on the OUTPUT TABLE ENTRY CARDS discussed previously. Each exception to a table entry is referenced by a number. Each exception acts like a FORTRAN IF statement. Multiple exceptions on an OUTPUT TABLE ENTRY CARD act like a series of IF statements connected with the FORTRAN logical connector OR. A maximum of 100 OUTPUT TABLE ENTRY EXCEPTION CARDS may appear in the Job Control Deck. If no exceptions are used, the only card present is the NO EXCEPTIONS CARD. If exceptions are used, the last card in the exceptions card set is the END OF EXCEPTIONS CARD. The OUTPUT TABLE ENTRY EXCEPTION CARD set is shown in figure 7.

NO EXCEPTIONS CARD

Columns	Contain	Explanation
1-4	bbbb	
5-8	NONE	A control word, signifying that no OUTPUT TABLE ENTRY EXCEPTION CARDS are included in the Job Control Deck.

OUTPUT TABLE ENTRY EXCEPTION CARD(S)

Columns	Contain	Explanation
1-3	XXX	3 numeric characters, giving an assigned number to the exception specified on this card. The number must be right-justified in the field. Up to 100 exceptions are allowed.
4	b	
5-15	NObENTRYbIF	Card label.
16	b	

17-19	XXX	3 numeric characters, giving the identification number of the data field required in the exception operation. The number must be right-justified in the field.
20	b	
21-22	LT	This entry is not made if the value in the data field specified in columns 17-19 is less than the value of the constant in columns 24-28 of this card.
	LE	This entry is not made if the value in the data field specified in columns 17-19 is less than or equal to the value of the constant in columns 24-28 of this card.
	EQ	This entry is not made if the value in the data field specified in columns 17-19 is equal to the value of the constant in columns 24-28 of this card.
	NE	This entry is not made if the value in the data field specified in columns 17-19 is not equal to the value of the constant in columns 24-28 of this card.
	GE	This entry is not made if the value in the data field specified in columns 17-19 is greater than or equal to the value of the constant in columns 24-28 of this card.
	GT	This entry is not made if the value in the data field specified in columns 17-19 is greater than the value of the constant in columns 24-28 of this card.
23	b	
24-28	XXXXX	5 numeric characters, giving the value of the constant required for the exception. The number must be right-justified in the field.

29-80	AAA...A	52 alphameric characters, giving a description of the exception. The description will appear in the printed output if column 33 in the INPUT/OUTPUT CONTROL CARD contains 1 or 2.

END OF EXCEPTIONS CARD

Columns	Contain	Explanation
1-4	bbbb	
5-7	END	A control word, signifying the end of all exception cards. It must follow the last exception card in the Job Control Deck. It is not used if the NO EXCEPTIONS CARD is used.

5. Input Record Description Cards

This group of cards contains a description of the physical configuration of the input data and the kind of information contained in the data fields of each record. The individual cards are described below in the order in which they must appear in the Job Control Deck.

The first of these seven types, the input record format card(s), is optional; it is used only if the input records are written in binary coded decimal (BCD). It contains a FORTRAN format specification which describes each input data field. The format continuation cards are also optional, being used only if the complete format specification cannot be punched on the first format card.

Although the input data fields can be described by any appropriate format specification, special note should be made of the fact that values of data fields to be entered into output tables must be expressed as floating-point numbers (F format) and values of data fields to be used in setting row and column indexes and exceptions must be expressed as fixed-point numbers (I format) before the output tables can be made. If possible, therefore, data field values should be expressed properly in the input file (whether written in binary or BCD); otherwise, they will have to be converted to the proper expression using the CALCUL subroutine.

The INPUT FIELDS IDENTIFICATION CARD must always be present. It is used to record the data fields that uniquely identify the data set, the sampling unit, and the subunit, if any, to which each record in the input data belongs. A change in the value of any one of the data set

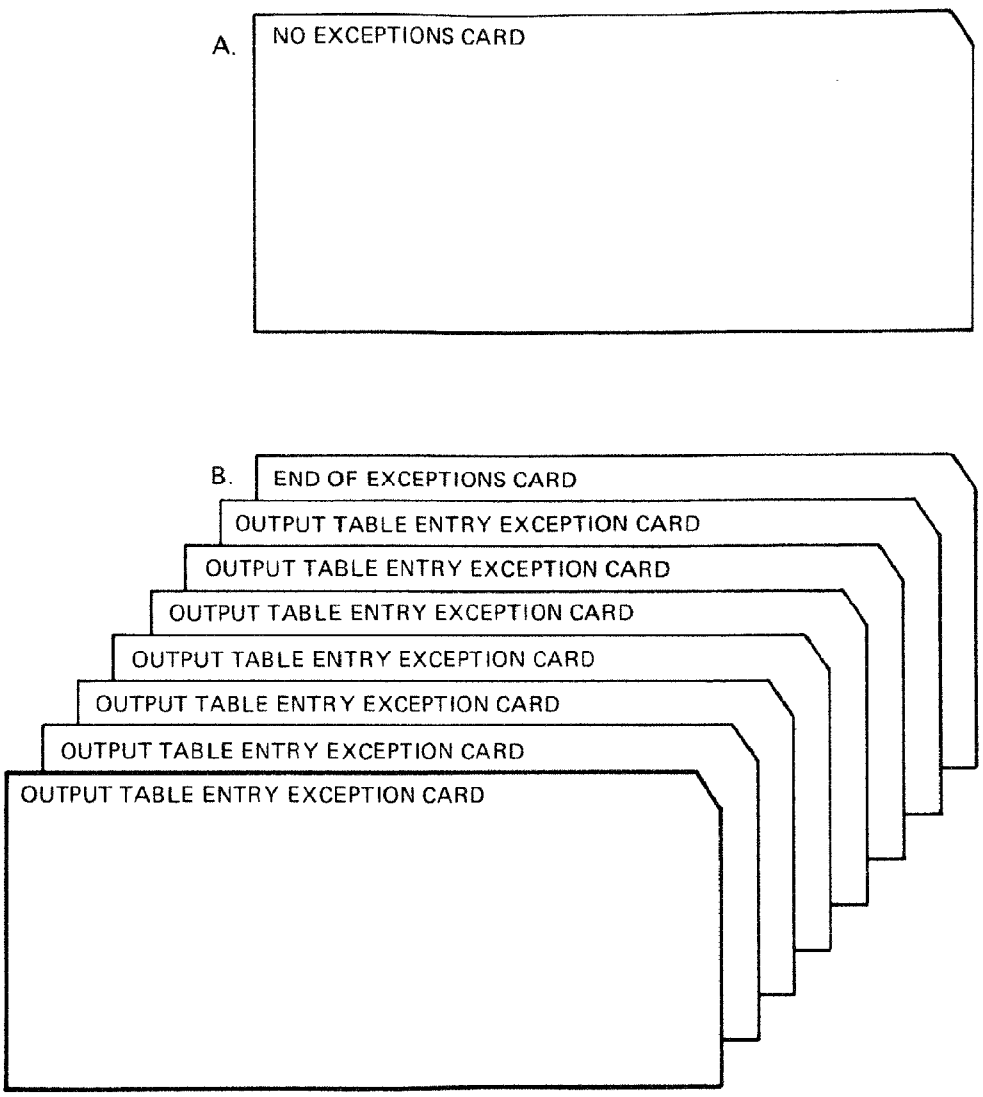

Figure 7.--Order of OUTPUT TABLE ENTRY EXCEPTION CARDS IN Job Control Deck; A, when the job does not require OUTPUT TABLE ENTRY EXCEPTION CARDS and B, when the job requires seven OUTPUT TABLE ENTRY EXCEPTION CARDS for TABLE-2

identification fields signals the end of a data set and causes the execution of the final computations and output of the summary tables for the data set. The data set identification will also appear in the output file preceding the output tables for the data set. A change in the value of any one of the sampling unit identification fields signals the end of the sampling unit input records and causes the sampling unit facsimile output tables to be summed into the data set output tables.

The INPUTS FIELDS IDENTIFICATION CARD also contains an option to search for a specific data set on the input data file. If this option is selected, an INPUT SEARCH CONTROL CARD must be included in the Job Control Deck. It is used to specify the values of the data fields that define the data set to be processed. Processing begins with the first encountered record which contains these values. Termination of processing will occur when (1) the number of records specified on the INPUT/OUTPUT CONTROL CARD has been processed, (2) an end-of-file is encountered, or (3) a record encountered contains values of the first record in the remaining data sets that are not to be processed.

The next three types of control cards are used to classify the data fields of input records according to the way that the information they contain was observed. The input record VARIABLE FIELDS CARD is used to record the identification numbers of data fields that contain attributes observed on subdivisions of subunits, or sample units if no subunits. The input record SEMIVARIABLE FIELDS CARD is used to record the identification numbers of data fields that contain attributes observed on subunits of sampling units. The input record CONSTANT FIELDS CARD is used to record the identification numbers of data fields that contain attributes observed on a sampling unit as a whole.

Every data field (input or otherwise) that is recorded in any other control card of the Job Control Deck or is used in the CALCUL subroutine must be identified on one of the above three field cards. Other data fields in the input record may also be identified in these cards, but this is optional. If a field is not identified in one of these cards, it will not be available for use by the program.

The last card in this series is the SAMPLING OPTION 5 CONTROL CARD. It is used only if output option 5 is specified on the INPUT/ OUTPUT CONTROL CARD. The card contains fields defining the number of sampling units in the sampled population and the data fields required only for option 5 processing. The set of input record description cards is shown in figure 8.

INPUT FORMAT CARD(S) (Optional)

Columns	Contain	Explanation
1	(	
2-80	AAA...A	Alphameric characters containing a FORTRAN format specification that describes the format of the input records. Used only if the input records are in BCD mode. The format is continued, if necessary, on additional cards and ends with a right parenthesis in the last column used. The total number of format cards must be equal to the number specified in column 20 of the INPUT/OUTPUT CONTROL CARD. Data fields to be used in indexing operations must have I (fixed-point) specification; those to be used as table entries must have E or F (floating-point) specification; otherwise, they must be converted to the proper expression in the CALCUL subroutine.

INPUT FIELDS IDENTIFICATION CARD

Columns	Contain	Explanation
1-11	DATAbSETbID	Card label.
12	b	
13-15	XXX	3 numeric characters, giving the identification number of the first data field of a set of data fields in which a data set is identified. The number must be right-justified in the field.
16-27	XXX...X	Repetition of format for columns 13-15, giving the identification numbers of up to 4 additional data fields needed to define a data set. The values for these data fields appear on the DATA INPUT IDENTIFICATION CARD in OUTPUT-2 to identify the population to be processed.
28	b	

29	b or 0	AN INPUT SEARCH CONTROL CARD is not to be used.
	1	An INPUT SEARCH CONTROL CARD follows.
30	b	
31-43	SAMPLINGbUNIT	Card label.
44	b	
45-47	XXX	3 numeric characters, giving the identification number of the first data field of a set of data fields in which a sampling unit is identified. The number must be right-justified in the field.
48-59	XXX...X	Repetition of format for columns 45-47, giving the identification numbers of up to 4 additional data fields needed to define a data set.
60	b	
61-68	SUBbUNIT	Card label.
69	b	
70-72	XXX	3 numeric characters, giving the identification number of the data field in which a subunit, if any, of a sampling unit is identified. The number must be right-justified in the field.

INPUT SEARCH CONTROL CARD (Optional)

Columns	Contain	Explanation
1-5	XXXXX	5 numeric characters, giving a value of the data field specified in columns 13-15 of the INPUT FIELDS IDENTIFICATION CARD. Values for the remaining fields are given in the following columns and processing begins with the first record containing these values. The number must be right-justified in the field. Used only if column 29 of INPUT FIELDS IDENTIFICATION CARD contains a 1.

6-25	XXX...X	Repetition of format for columns 1-5, giving the initial values of the data fields specified in columns 16-27 of the INPUT FIELDS IDENTIFICATION CARD.
26-30	XXXXX	5 numeric characters, giving a value of the data field specified in columns 13-15 of the INPUT FIELDS IDENTIFICATION CARD. Values for the remaining fields are given in the following columns and processing terminates when one of the following conditions is reached: 1. The number of records specified on the INPUT/OUTPUT CONTROL CARD has been processed. 2. An end-of-file is encountered. 3. When a record containing the values specified here is encountered, processing terminates with the previous record. The number must be right-justified in the field.
31-50	XXX...X	Repetition of format for columns 26-30, giving the final values of the data fields specified in columns 16-27 of the INPUT FIELDS IDENTIFICATION CARD.

VARIABLE FIELDS CARD

Columns	Contain	Explanation
1-8	VARIABLE	Card label.
9-11	XXX	3 numeric characters, giving the identification number of a data field in which the values may vary from one record to another within the set of records for a sampling unit. The number must be right-justified in the field.
12-77	XXX...X	Repetition of format for columns 9-11, giving the identification numbers of up to 22 more variable data fields for use in processing.

78-80	bbb	Specification of variable data fields is continued on the next card.
	END	A continuation card does not follow.

VARIABLE FIELDS CONTINUATION CARD(S) (Optional)

Columns	Contain	Explanation
1-8	bbbbbbbb	
9-77	XXX...X	Same as format for columns 9-80 of the VARIABLE FIELDS CARD. Any number of continuation cards may be used.
78-80	bbb	Specification of variable data fields is continued on the next card.
	END	A continuation card does not follow.

SEMIVARIABLE FIELDS CARD

Columns	Contain	Explanation
1-8	SEMIbVAR	Card label.
9-11	XXX	3 numeric characters, giving the identification number of a data field in which the values may vary from one set of subunit records to another, and which are constant within the sets of subunit records. The number must be right-justified in the field.
12-77	XXX...X	Repetition of format for columns 9-11, giving the identification numbers of up to 22 more semivariable data fields for use in processing.
78-80	bbb	Specification of semivariable data fields is continued on the next card.
	END	A continuation card does not follow.

SEMIVARIABLE FIELDS CONTINUATION CARD(S) (Optional)

Columns	Contain	Explanation
1-8	bbbbbbbb	
9-77	XXX...X	Same as format for columns 9-80 of the SEMIVARIABLE FIELDS CARD. Any number of continuation cards may be used.
78-80	bbb	Specification of semivariable data fields is continued on the next card.
	END	A continuation card does not follow.

CONSTANT FIELDS CARD

Columns	Contain	Explanation
1-8	CONSTANT	Card label.
9-11	XXX	3 numeric characters, giving the identification number of a data field in which the values may vary from one sampling unit to another; and which are constant within sampling units. The number must be right-justified in the field.
12-77	XXX...X	Repetition of format for columns 9-11, giving the identification numbers of up to 22 more constant data fields for use in processing.
78-80	bbb	Specification of constant data fields is continued on the next card.
	END	A continuation card does not follow.

CONSTANT FIELDS CONTINUATION CARD(S) (Optional)

Columns	Contain	Explanation
1-8	bbbbbbbb	
9-77	XXX...X	Same as format for columns 9-80 of the CONSTANT FIELDS CARD. Any number of continuation cards may be used.

78-80	bbb	Specification of constant data fields is continued on the next card.
	END	A continuation card does not follow.

SAMPLING OPTION 5 CONTROL CARD (Optional)

This card is used only if column 29 of the INPUT/OUTPUT CONTROL CARD contains a 5.

Columns	Contain	Explanation
1-18	NO.bSAMPLINGbUNITS	Card label.
19	b	
20-24	b or 0	Each sampling unit is wholly contained in a single data set (sampling stratum).
	XXXXX	5 numeric characters, specifying the total number of sampling units if the sampling units are subdivided into more than one data set. The number must be right-justified in the field. (This field must be b or 0 for use with OUTPUT sampling option 2.)
25-27	bbb	
28-34	AREAbID	Card label.
35	b	
36-38	XXX	3 numeric characters, specifying the identification number of the input data field containing the sampling unit area sampled within the data set (stratum). If the subunit field is blank or zero on the INPUT FIELDS IDENTIFICATION CARD, then this field must be defined on the CONSTANT FIELDS CARD. If the subunit has been specified on the INPUT FIELDS IDENTIFICATION CARD, this field may be defined on either the SEMIVARIABLE or CONSTANT FIELDS CARD. If defined at the semivariable level, then this field identifies the field containing the area of the subunit. The number must be right-justified.

39-41	bbb	
42-55	PROBABILITYbID	Card label.
56	b	
57-59	XXX	3 numeric characters, specifying the identification number of the input data field containing the sampling unit scaled probability of selection. This must be a constant field and defined on the CONSTANT FIELDS CARD. The number must be right-justified. Scaled probability is the true probability times the total number of sampling units selected.

END OF CONTROL DECK CARD

Columns	Contain	Explanation
1-19	ENDbOFbCONTROLbDECK	A control word, signifying the last card in the Job Control Deck.

DATA CARDS

Columns	Contain	Explanation
1-80	XXX...X	Input data punched according to the format on the INPUT FORMAT CARD. Used only if column 11 of the INPUT/OUTPUT CONTROL CARD contains a 3 (BCD card input).

B. TABLE-2 OPERATION

This section provides information necesssary to set up and process sample summarization jobs with TABLE-2. It is, in part, a summary of information given elsewhere.

1. Program Restrictions -- Standard Procedure

The TABLE-2 carries restrictions on the overall size and on certain dimensions of the problem that can be handled in a single processing run. These restrictions result primarily from the way in which the available storage capacity of the computer has been allocated to various uses in the program. However, the program has been constructed so that the more important of these allocations can readily

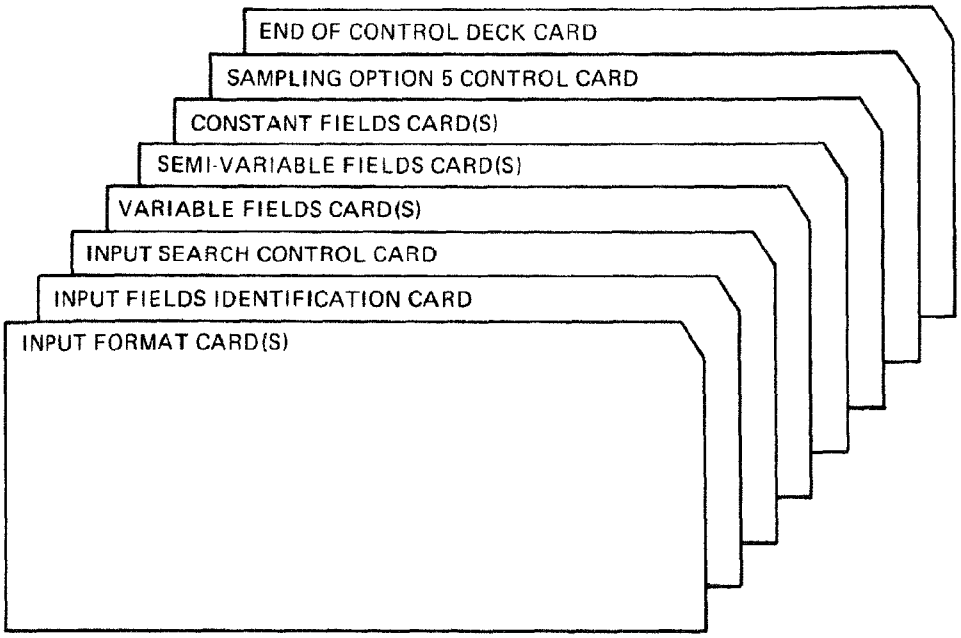

Figure 8.--Order of input record description cards in Job Control Deck

be changed if a problem of substantially different relative dimensions is encountered. The modification of dimensioned space is described in part III. The restrictions are:

a. The number of data fields in each input record must be no greater than 132.

b. The number of variable data fields must be no greater than 69.

c. The number of semivariable data fields must be no greater than 69.

d. The number of constant data fields must be no greater than 69.

e. The number of data fields used for data set identification must be no greater than 5.

f. The number of data fields used for sampling unit identification must be no greater than 5.

g. The subunit identification, if any, must be contained in a single data field.

h. The total number of cells in all input and output tables must be no greater than 10,000.

i. The number of input tables must be no greater than 40.

j. The number of output tables must be no greater than 40 (153 optional).

k. The number of rows including subtotals and totals in each output table must be no greater than 201.

l. The number of columns including subtotals and totals in each output table must be no greater than 100.

m. The number of output table entries per record in each output table must be no greater than 10.

n. The total number of OUTPUT TABLE ENTRY EXCEPTION CARDS must be no greater than 100.

2. Job Control Deck Setup

The Job Control Deck consists of all the punched cards through which processing specifications, necessary constants, and other data (exclusive of the data to be processed) are entered into the computer. These cards, and the logical groups into which they fall, have been described in the previous section. The assembly of the groups of control cards to form the Job Control Deck is shown in figures 9-14.

It should be noted that the monitor input deck consists of the program deck, followed by the Job Control Deck, with system control cards interspersed (fig. 15). The latter cannot be described in detail here because they vary from one computer system to another. For more information about them, see the systems representative at the computer center where the processing will be done.

3. Input Data Setup

Data input must be in the form of a single file of records. Multiple record files for a job must be grouped into a single file or be processed in multiple passes of the program. The file may be written either in binary or BCD mode.

Each record must have the same format. Values in data fields to be entered in output tables should be expressed as floating-point numbers (F format), while those in data fields to be used in setting row and column table indexes and exceptions should be expressed as fixed-point numbers (I format). Values can be changed from I to F format or vice versa in subroutine CALCUL (see part III).

The records must be sorted by sampling unit, and the sets of records for each sampling unit must be sorted by the data set (stratum) to which they belong. Additional sorting is permitted but not required. It will depend on how the output is to be used (see OUTPUT-2).

When the sampling unit attribute desired for entry into an output table is area (acres, hectares), an area constant field is required in the input file. This field is usually defined on the CONSTANT FIELDS CARD and contains an area expansion factor when using sampling option 1 and 1.0 (one unit area) when using sampling options 2, 3, and 4. The value in this field is a constant for each sample unit, or subunit of a sample unit as applied in sampling option 5.

The value is also 1.0 when using sampling option 5, except when blank or zero are not specified in columns 20-24 of the SAMPLING OPTION 5 CONTROL CARD. In this case, the area value is computed using the following formula, for each subunit of a sampling unit. This case also requires that the field containing the constant be defined as a field on the SEMIVARIABLE FIELDS card.

$$\text{Area Constant (AC)} = \frac{A_{hik}}{\sum_{k=1}^{n} A_{hik}} = \frac{A_{hik}}{A_{hi}} = 0 < AC \leq 1.0$$

Where: A_{hik} = area of sampling unit subunit "k" of sampling unit "i" in stratum "h".

A_{hi} = total area of sampling unit "i" in stratum "h".

n = number of sampling unit subunits in stratum "h".

4. Messages Printed During Execution

Several messages are written during normal processing. These include a listing of the Job Control Deck (if called for), the output tables (if called for), a message signifying that each input table was read correctly, messages stating that the entire Job Control Deck was read, the amount of storage specified and used, the number of records and sampling units read in each data set, the number of data sets processed, the total number of input records processed, and a list of the output tables produced.

If problems are encountered in reading the Job Control Deck or processing the data, other messages are printed. These messages are listed and explained below.

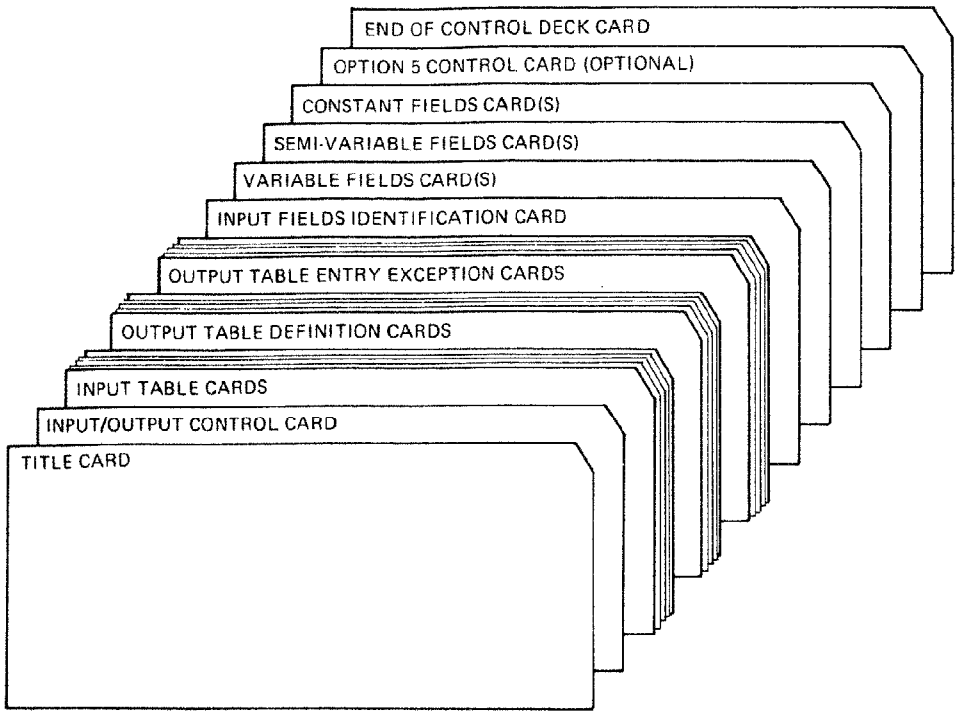

Figure 9.--TABLE-2 Job Control Deck setup for binary data tape input where processing begins on first record of input data

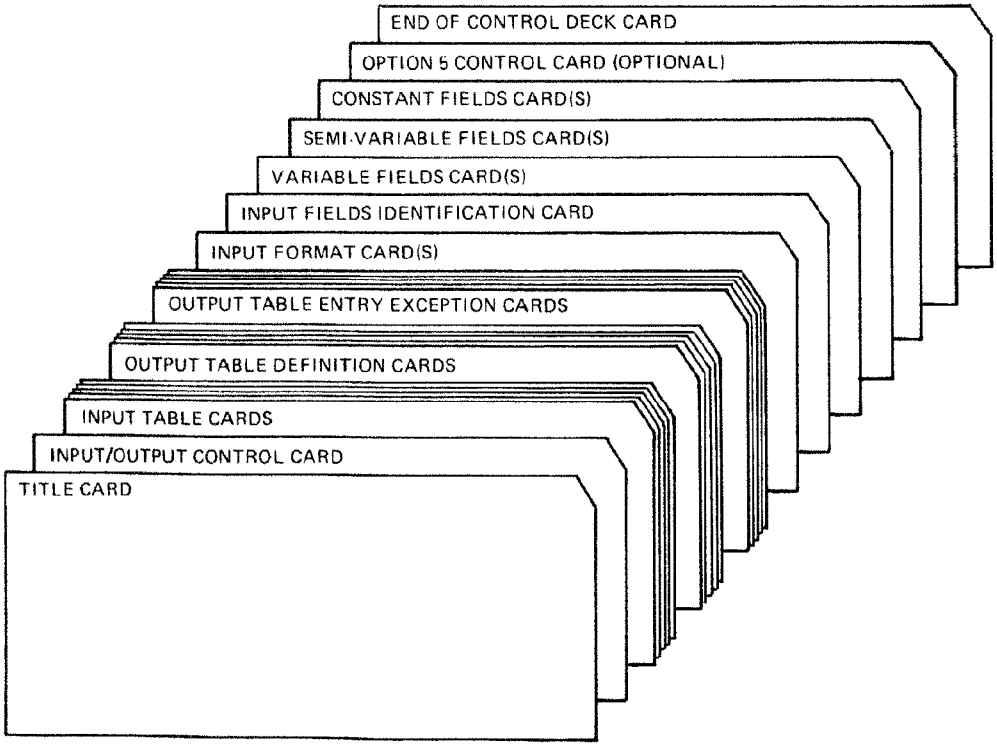

Figure 10.--TABLE-2 Job Control Deck setup for BCD data tape input where processing begins on first record of input data

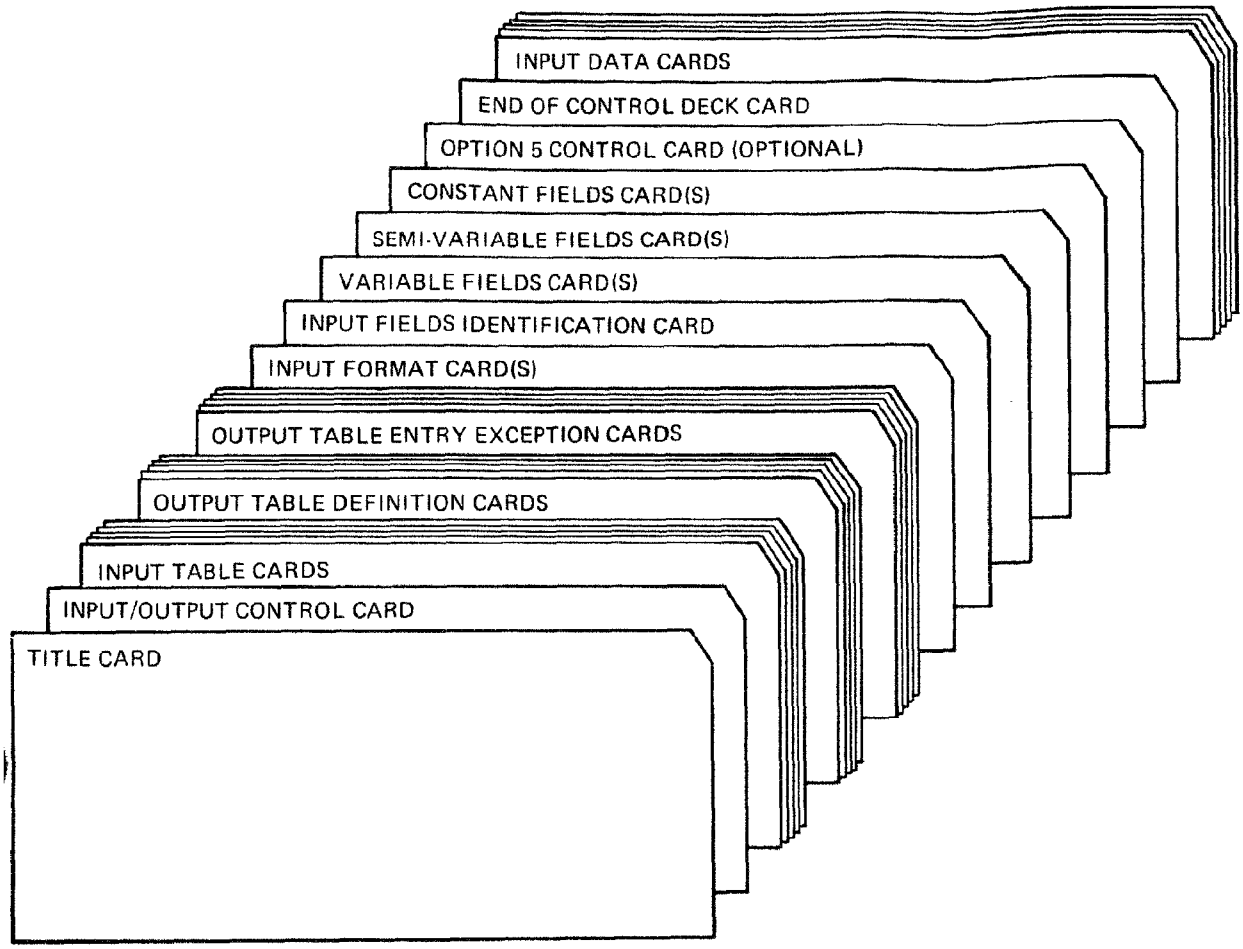

Figure 11.--TABLE-2 Job Control Deck setup for BCD data cards input where processing begins on first record of input data

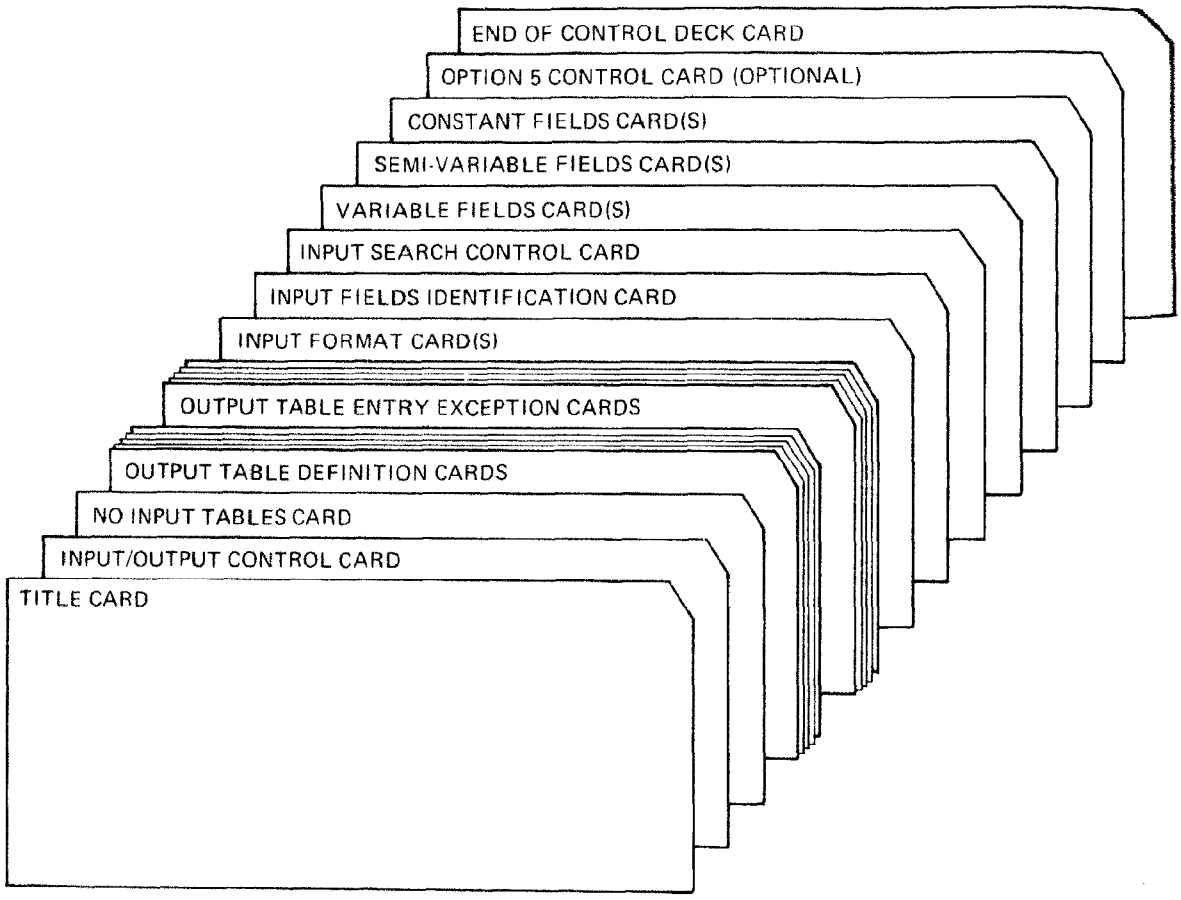

Figure 12.--TABLE-2 Job Control Deck setup for BCD data tape input with no input tables and where processing does not begin on first record of input data

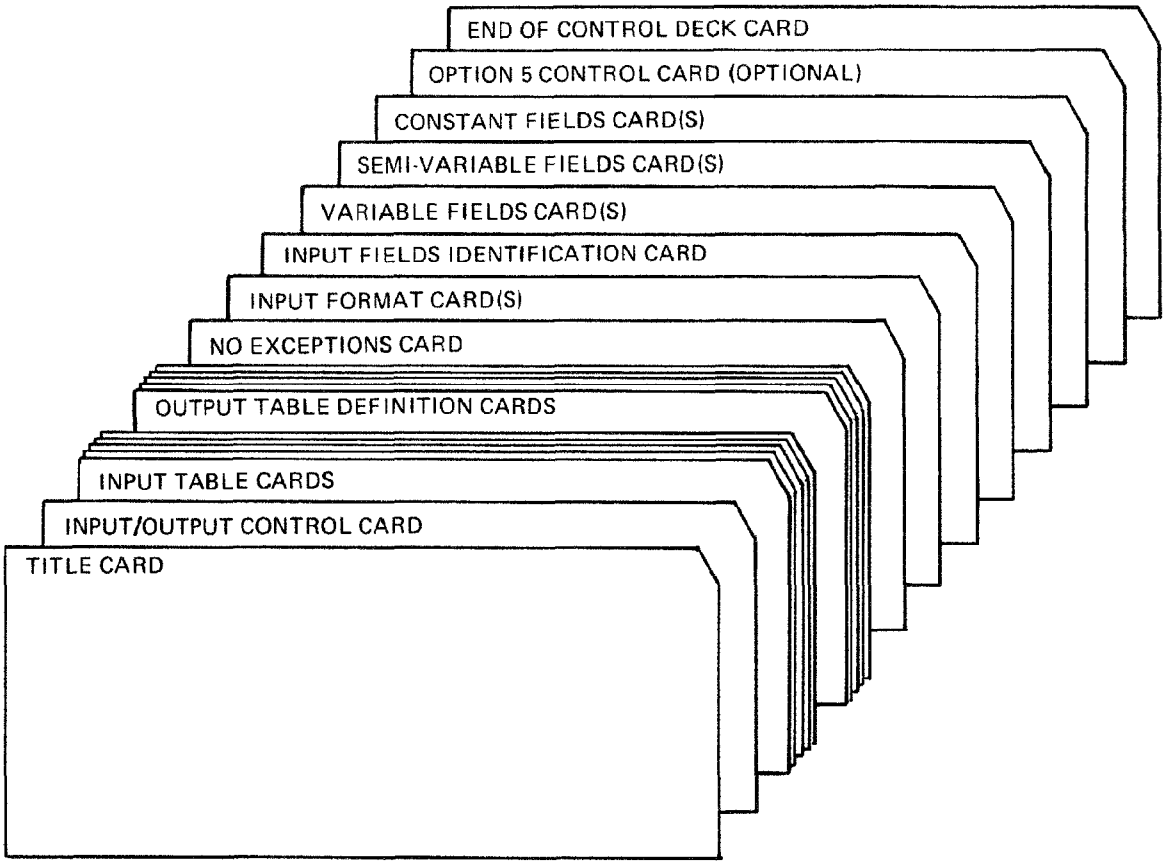

Figure 13.--TABLE-2 Job Control Deck setup for BCD data tape input with no OUTPUT TABLE ENTRY EXCEPTION CARDS where processing begins with first record of input data

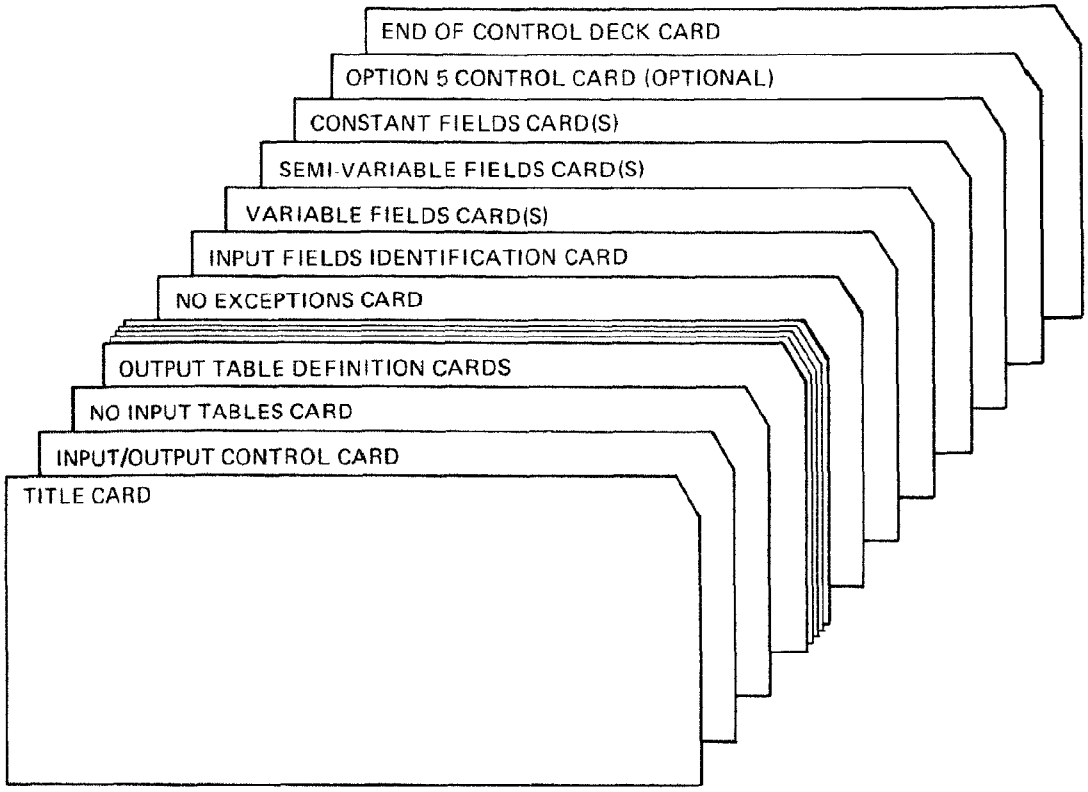

Figure 14.--TABLE-2 Job Control Deck setup for binary data tape input with no input tables, no exceptions, and where processing begins with first record of input data

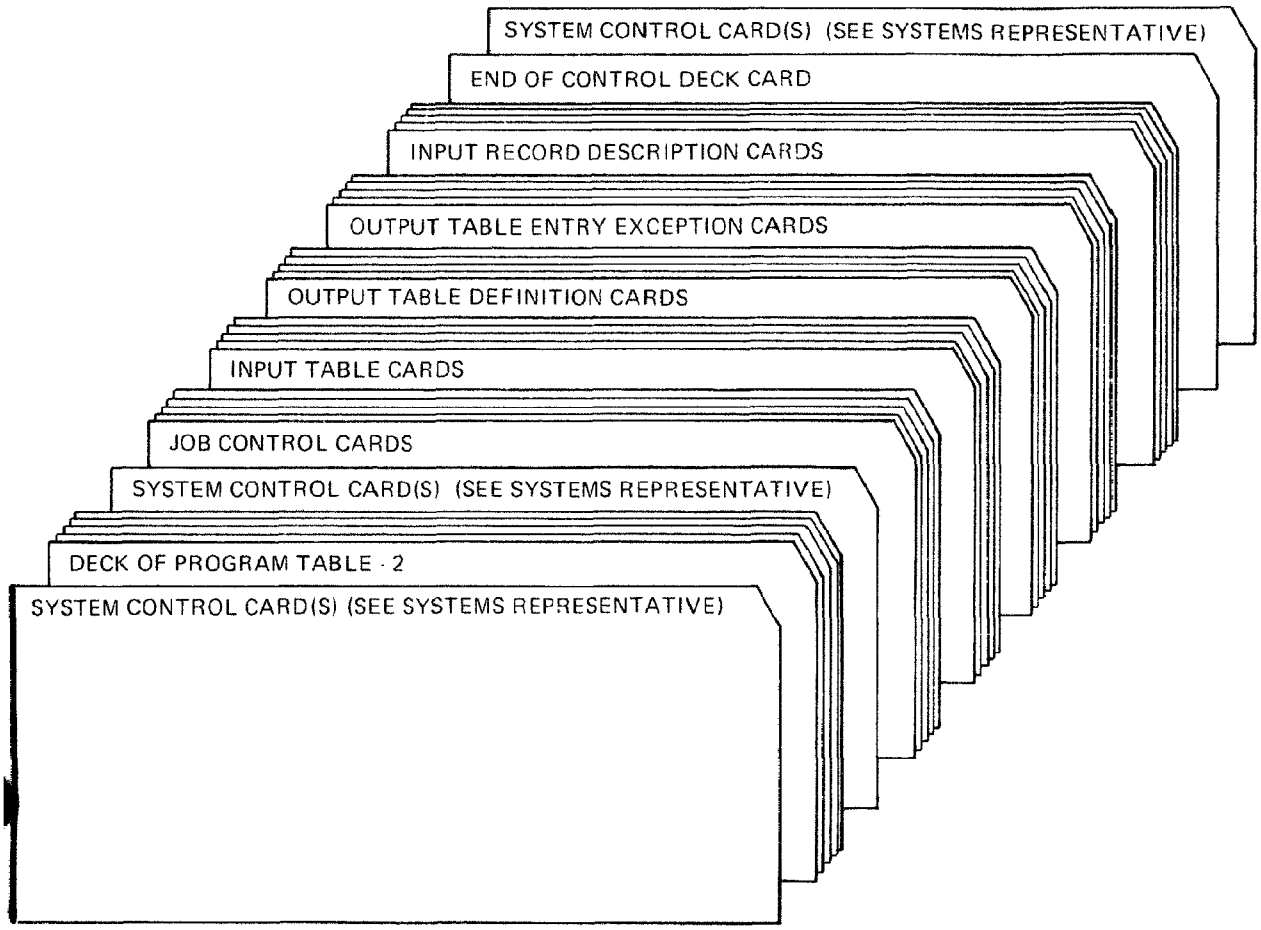

Figure 15.--Job Control Deck setup, illustrating the kinds of cards that are necessary and the order in which they must be arranged

SUB1 Messages

1. THE VALUE OF L123 IS NOT LARGE ENOUGH. THE PRESENT VALUE IS XXXX. IT MUST BE CHANGED TO XXXX.

This message is printed when L1+L2+L3 or LVAR is larger than the specified value of L123. The value of L123 and the dimension of NPOS must be set equal to the value designated in the message.

2. THE INPUT/OUTPUT CONTROL CARD IS INCORRECT.

An invalid designation has been given for a card label or field on the control card.

3. INPUT MODE 4 REQUIRES BCD TAPE BLOCKING FACTOR AND NUMBER OF CHARACTERS PER RECORD.

The BCD tape blocking factor and number of characters per record must be specified on the INPUT/OUTPUT CONTROL CARD when using input option 4.

4. INPUT MODE 5 REQUIRES BINARY TAPE BLOCKING FACTOR.

The binary tape blocking factor must be specified on the INPUT/OUTPUT CONTROL CARD when using input option 5.

5. A TABLE NAME CARD IS INCORRECT. THE TABLE NAME IS AAAA.

An invalid designation has been given for a field on a name card.

6. INPUT TABLE AAAA EXCEEDED DIMENSIONED SPACE.

The number or length of input tables must be reduced or the dimensioned space must be increased.

7. TABLE AAAA CONSISTING OF XXXXX CARDS HAS BEEN READ CORRECTLY.

This message prints each time an input table has been read successfully.

8. THE NUMBER OF ALLOWABLE OUTPUT TABLES HAS BEEN EXCEEDED. XXX HAVE BEEN CALLED FOR. XXX ARE ALLOWED.

The number of output tables must be reduced or the dimensioned space must be increased.

9. TABLE DEFINITION CARDS ARE OUT OF ORDER. TABLE AAA.

A definition card has an incorrect card label or the cards are out of order.

10. AN INVALID SPECIFICATION HAS BEEN GIVEN FOR ROW AND COLUMN TOTALS.

An invalid designation has been given for the row and column totals field on an OUTPUT TABLE DEFINITION CARD.

11. AN ILLEGAL NUMBER OF ENTRIES HAS BEEN SPECIFIED FOR TABLE AAAA. THE NUMBER OF ENTRIES IS XXX.

The number of entries must be reduced or the dimensioned space increased.

12. A SUBTOTAL SPECIFICATION IS INCORRECT.

A subtotal specification for rows or columns has been partially omitted or an invalid symbol or number has been used.

13. TABLE AAAA HAS EXCEEDED DIMENSIONED SPACE.

The number or length of output tables must be reduced or the dimensioned space must be increased.

14. AN OPERATION FOR TABLE AAAA IS INVALID. IT IS AAAAAA.

An operation for a table entry for the table named is invalid.

15. THE NAME AAAA IS NOT THE NAME OF AN INPUT TABLE.

An input table name given on an OUTPUT TABLE ENTRY CARD cannot be found in the list of input tables.

16. THE LAST EXCEPTION IS OF INCORRECT FORM OR HAS AN EXCEPTION NUMBER GREATER THAN ALLOWED. THE ALLOWED MAXIMUM = XXXX.

The last exception read (and listed if called for) contains an error. If the exception number is too large, it must be reduced or the dimensioned space increased.

17. INPUT FIELDS IDENTIFICATION CARD IS INCORRECT.

A card label is incorrect or identification data fields have not been specified for data sets or sampling units.

18. THE NUMBER OF VARIABLE FIELDS EXCEEDS THE NUMBER OF FIELDS ALLOWED FOR (XXX) OR THE LAST CARD DID NOT HAVE END IN COLS. 7880.

Correct the card or increase dimensioned space.

19. A VARIABLE FIELDS CARD IS INCORRECT.

A card label is incorrect or a negative number has been given for a data field.

20. ILLEGAL DATA FIELD XXX. THE PROGRAM HAS DIMENSION LIMIT LVAR = XXX.

A field has been defined with a value greater than the maximum number of fields allowed per input record.

21. DATA FIELD XXX HAS BEEN DEFINED AT TWO OR MORE LEVELS OR MORE THAN ONCE AT THE SAME LEVEL.

A field has been defined at more than one level for example, at both the constant and semivariable levels, or the same field appears more than once at the same level.

22. THE NUMBER OF SEMIVARIABLE FIELDS EXCEEDS THE NUMBER OF FIELDS ALLOWED FOR (XXX) OR THE LAST CARD DID NOT HAVE END IN COLS. 78-80.

Correct the card or increase dimensioned space.

23. A SEMIVARIABLE FIELDS CARD IS INCORRECT.

A card label is incorrect or a negative number has been given for a data field.

24. THE NUMBER OF CONSTANT FIELDS EXCEEDS THE NUMBER OF FIELDS ALLOWED FOR (XXX) OR THE LAST CARD DID NOT HAVE END IN COLS. 78-80.

Correct the card or increase dimensioned space.

25. A CONSTANT FIELDS CARD IS INCORRECT.

A card label is incorrect or a negative number has been given for a data field.

26. THE FIELD USED FOR EXCEPTION NO. XX HAS NOT BEEN DEFINED.

A field used for an exception has been defined with a value greater than the maximum number of fields allowed per input record, or is undefined with a value of zero, or has not been defined at the variable, semivariable, or constant level.

27. THE FIELD USED AS AN ENTRY FOR TABLE AAAA HAS NOT BEEN DEFINED AT THE VARIABLE, SEMIVARIABLE, OR CONSTANT LEVEL.

A field used for a table entry was not defined on the VARIABLE, SEMIVARIABLE, OR CONSTANT FIELDS CARDS.

28. THE FIELD USED FOR THE COLUMN INDEX FOR TABLE AAAA HAS NOT BEEN DEFINED OR IS AT A LOWER LEVEL THAN THE TABLE ENTRY.

A field used for a column index for the table specified has not been included on the VARIABLE, SEMIVARIABLE, OR CONSTANT FIELDS CARDS or was defined at a lower level than the table entry. For example, if the table entry was defined as semivariable, the field in error may have been incorrectly defined at the variable level.

29. THE FIELD USED FOR THE ROW INDEX FOR TABLE AAAA HAS NOT BEEN DEFINED OR IS AT A LOWER LEVEL THAN THE TABLE ENTRY.

A field used for a row index for the table specified has not been included on the VARIABLE, SEMIVARIABLE, OR CONSTANT FIELDS CARDS or was defined at a lower level than the table entry. For example, if the table entry was defined as semivariable, the field in error may have been incorrectly defined at the variable level.

30. THE FIELD USED FOR EXCEPTION NO. XXX HAS NOT BEEN DEFINED OR IS AT A LOWER LEVEL THAN THE TABLE ENTRY FOR TABLE AAAA ENTRY XXX.

A field used for an exception for the table entry specified has not been included on the VARIABLE, SEMIVARIABLE, OR CONSTANT FIELDS CARDS or was defined at a lower level than the table entry. For example, if the table entry was defined as semivariable, the field in error may have been incorrectly defined at the variable level. Check first to see if there is an exception card with the given number.

31. THE OPTION 5 CONTROL CARD IS INCORRECT.

An invalid designation has been given for a field on the control card. The AREA ID and PROBABILITY ID fields must contain a value greater than zero, but less than or equal to the maximum number of fields allowed per input record. The same value cannot be defined for both fields.

32. THE AREA ID MUST BE DEFINED AT THE CONSTANT LEVEL SINCE THE NUMBER OF SAMPLING UNITS IS ZERO.

The AREA ID field on the OPTION 5 CONTROL CARD must contain a value that is defined on the CONSTANT FIELDS CARD since the NO. SAMPLING UNITS field is blank or zero.

33. THE AREA ID IS NOT DEFINED AT THE CONSTANT OR SEMIVARIABLE LEVEL.

The AREA ID field on the OPTION 5 CONTROL CARD must contain a value that is defined on either the CONSTANT FIELDS CARD or the SEMIVARIABLE FIELDS CARD.

34. THE PROBABILITY ID MUST BE DEFINED AT THE CONSTANT LEVEL.

The PROBABILITY ID field on the OPTION 5 CONTROL CARD must contain a value that is defined on the CONSTANT FIELDS CARD.

35. THE END OF CONTROL DECK CARD IS INCORRECT. IT STARTS AAAA.

Cards are out of order in the Job Control Deck or the card label of the END OF CONTROL DECK CARD is incorrect.

36. THE CONTROL DECK HAS BEEN READ.

This message prints if all control cards have been read and no errors have been detected.

37. STORAGE UTILIZATION SUMMARY...

This message prints after the Job Control Deck has been read. It describes the amount of storage that has been defined for the input and output tables and the number of words of core required.

SUB2 Messages

38. READ ERROR ON INPUT TABLE.

An error has occurred while trying to read an input record using input option 4. The illegal characters must be corrected and the record reread.

39. THE NUMBER OF INPUT RECORDS IS XXX IN EXCESS OF THE XXXXX ALLOWABLE IN SAMPLING UNIT XXXXX XXXXX XXXXX XXXXX XXXXX.

Processing continues with excess records ignored. If the records must be included, the dimensioned space must be enlarged.

40. THE NUMBER OF SUBUNITS IS IN EXCESS OF THE XXX ALLOWABLE IN SAMPLING UNIT XXXXX XXXXX XXXXX XXXXX XXXXX.

Processing continues with the records for the excess subunits ignored. If the records must be included, the subunit codes must be corrected if they are wrong or out of order, or the dimensioned space must be enlarged.

41. THE ROW INDEX CANNOT BE FOUND FOR OUTPUT TABLE AAAA, ENTRY NO. XXX IN SAMPLING UNIT NO. XXXXX XXXXX XXXXX XXXXX XXXXX, RECORD NO. XXXXXX. THE VALUE OF THE DATA FIELD USED TO DEFINE THE INDEX IS XXXXX.

The entry is not made, but processing continues.

42. THE COLUMN INDEX CANNOT BE FOUND FOR OUTPUT TABLE AAAA, ENTRY NO. XXX IN SAMPLING UNIT NO. XXXXX XXXXX XXXXX XXXXX XXXXX, RECORD NO. XXXXXX. THE VALUE OF THE DATA FIELD USED TO DEFINE THE INDEX IS XXXXX.

The entry is not made, but processing continues.

43. THE ROW INDEX = XXX AND IS TOO LARGE FOR OUTPUT TABLE AAAA, ENTRY NO. XXX IN SAMPLING UNIT NO. XXXXX XXXXX XXXXX XXXXX XXXXX, RECORD NO. XXXXXX.

The entry is not made, but processing continues.

44. THE COLUMN INDEX = XXX AND IS TOO LARGE FOR OUTPUT TABLE AAAA, ENTRY NO. XXX IN SAMPLING UNIT NO. XXXXX XXXXX XXXXX XXXXX XXXXX, RECORD NO. XXXXXX.

The entry is not made, but processing continues.

45. THE ROW INDEX = XXX AND IS TOO SMALL FOR OUTPUT TABLE AAAA, ENTRY NO. XXX IN SAMPLING UNIT NO. XXXXX XXXXX XXXXX XXXXX XXXXX, RECORD NO. XXXXXX.

The entry is not made, but processing continues.

46. THE COLUMN INDEX = XXX AND IS TOO SMALL FOR OUTPUT TABLE AAAA, ENTRY NO. XXX IN SAMPLING UNIT NO. XXXXX XXXXX XXXXX XXXXX XXXXX, RECORD NO. XXXXXX.

The entry is not made, but processing continues.

47. XXX ERRORS HAVE OCCURRED. PROCESSING TERMINATED.

The user-specified limit for errors associated with messages 29-34 has been reached.

48. XXXXX RECORDS AND XXXX SAMPLING UNITS WERE READ IN STRATUM XXXXX XXXXX XXXXX XXXXX XXXXX.

This message is printed at the end of each data set processed. The data set identification is taken from the data fields defined on the INPUT FIELDS IDENTIFICATION CARD.

49. XXXXXX TOTAL RECORDS, XXXX DATA SETS HAVE BEEN PROCESSED.

This message is printed after all data sets in the population have been processed.

50. THE NAMES OF THE TABLES	NUMBER OF ROWS INCLUDING TOTALS	NUMBER OF COLUMNS INCLUDING TOTALS
AAAA	XXX	XX

These are summaries which are printed at the end of processing and list all output tables produced.

51.	I/O CARD VALUE[4]	USED THIS RUN	DIFFERENCES IN LOCATIONS
MAXIMUM NUMBER OF INPUT RECORDS PER SAMPLING UNIT	XXXX	XXXX	XLEV3 XXX x XXXX = XXXXX
MAXIMUM NUMBER OF SUBUNITS PER SAMPLING UNIT	XXXX	XXXX	XLEV2 XXX x XXXX = XXXXXX

These are summaries which are printed at the end of processing and list the storage locations specified and used for the storage arrays for variable and semivariable fields.

C. TABLE-2 USE OF CALCULATE SUBROUTINE

TABLE-2 automatically calls a subroutine, CALCUL, once for each sampling unit. The call is executed before the performance of any table making activity for each sampling unit. The subroutine must always be present with the following as a minimum:

```
SUBROUTINE CALCUL(L1, L2, L3, NLEV1, XLEV1, NLEV2, XLEV2, NLEV3,
1XLEV3, LEV2, LEV3, NRECRD, NPOINT, NOCRDS)
```

---

[4]The I/O card value printed is only meaningful for the PARMS procedure. (See TABLE-2 MODIFICATION OF DIEMNSIONED SPACE--PARMS Procedure.)

```
      DIMENSION NLEV1(L1), XLEV1(L1), NLEV2(LEV2,L2),
     1XLEV2(LEV2,L2), NLEV3(LEV3,L3), XLEV3(LEV3,L3)
      RETURN
      END
```

The user may program this subroutine to manipulate or create information for a sampling unit. Only those data fields (currently on the input file or new) which have been specified on one of the input record description cards can be used. These fields are accessed using one of three equivalenced arrays. The arrays and their relationships to the input record description cards are:

Input record description card	Equivalenced array
CONSTANT	NLEV1(*) or XLEV1(*)
SEMI VAR	NLEV2(I,*) or XLEV2(I,*)
VARIABLE	NLEV3(J,*) or XLEV3(J,*)

The * is used here to generalize for the position of the data field on the input record description card. For example, if input data field position 21 on the input file were specified as the second position on the CONSTANT FIELDS CARD, this variable would be referenced in CALCUL as NLEV1(2) or XLEX1(2), depending on the mode.

When variables are identified on the SEMIVARIABLE OR VARIABLE FIELDS CARD, the array used in CALCUL is two-dimensional. The first index identifies the sequential position of each record within a sampling unit and the second index specifies the position of the data field number on the SEMI VAR or VARIABLE card. Two counters, NPOINT and NRECRD, contain a count of the number of SEMI VAR or VARIABLE entries respectively for the sampling unit being processed. Thus the user could access each record of a sampling unit in position 2 of the VARIABLE FIELDS CARD as follows:

```
      DO 100  J=1,NRECRD
      WORD = XLEV3(J,2)
           .
           .
           .
100   CONTINUE
```

A new or modified data field created in subroutine CALCUL is a temporary file change. It is available internally only as long as the appropriate array (NLEV1(*), etc.) is unchanged. Since the information in these arrays changes each time processing begins for the next sampling unit, additional programing is required if the user wishes to retain the values created. A new data file can be written with this routine to retain the modified or new data fields.

D. TABLE-2 MODIFICATION OF DIMENSIONED SPACE

The TABLE-2 carries restrictions on the dimensions and, consequently, the overall size of problem that can be handled in a single processing run. These restrictions are a result of the manner in which dimensioned space has been allocated (table 1) and the total space available in a given operating system. The program has been written so that all modifications of dimensioned space can be made in the main program called TABLE. The subprograms do not have to be changed for this purpose. The use of dimensioned space and the means of changing dimensions are discussed in detail below.

User modification of dimensioned space is not required when using the PARMS procedure with the TABLE-2 Subsystem. The PARMS procedure was developed to make the most efficient use of core storage for individual users of TABLE-2. It allows many users with different dimension requirements to use the same program without constantly determining and modifying dimension limits.

Briefly, PARMS is a FORTRAN program which creates a tailor-made TABLE-2 main program for a given Job Control Deck. The program reads the Job Control Deck and counts items such as the number of input tables, the number of output tables, and the number of exceptions. From this information PARMS determines the dimensions necessary to run the Job Control Deck. The dimensions are used to create a new main program for TABLE 2.

PARMS can extract all the dimensions needed from the Job Control Deck except the following two items: (1) the maximum number of input records per sampling unit, and (2) the maximum number of subunits per sampling unit. The user must determine these values and punch these estimates on the INPUT/OUTPUT CONTROL CARD. PARMS will use these estimates as dimension limits when it creates the new main program for TABLE-2. In turn, the TABLE-2 program will list these estimates and compare them to the values actually used in processing the data. (See TABLE-2 OPERATION, Messages Printed During Execution, Message 46.) The amount of unused core storage, if any, is shown.

Should PARMS be fed a faulty Job Control Deck, it will not print any error messages; instead, it generates a set of default dimensions and creates a new main program for TABLE-2 as previously discussed. The TABLE-2 main program will then execute and report the Job Control Deck errors.

1. Number of Input Records Per Sampling Unit

In TABLE-2, up to 150 input records may be processed per sampling unit. To change this maximum, the following steps must be taken:

Table 1.--*Summary of dimensioned space restrictions, and associated program variables and arrays for TABLE-2*

Item	Restriction	Variable	Arrays
Maximum number of input records per sampling unit	[1]150	LEV3	NLEV3, XLEV3
Maximum number of subunits per sampling unit	[1]10	LEV2	NLEV2, XLEV2
Maximum number of data fields per record	132	[2]LVAR	RECORD
Maximum number of variable data fields	69	[2]L3	NLEV3, XLEV3 LEVEL3
Maximum number of semivariable data fields	69	[2]L2	NLEV2, XLEV2 LEVEL2
Maximum number of constant data fields	69	[2]L1	NLEV1, XLEV1 LEVEL1
Maximum number of cells in all input and output tables	10,000	LTOTAL	IMP, XIMP
Maximum number of input tables	40	LIN	NTIN
Maximum number of output tables	40 (153 optional)	LOUT	NTOUT, NAMES, NCEP, ISUBT
Maximum number of rows in each output table	[3]201	Not applicable	Not applicable
Maximum number of columns in each output table	[3]101	Not applicable	Not applicable
Maximum number of exceptions	100	LEXCPS	NEXCEP
Maximum number of exceptions per table entry	10	MAX	NCEP
Maximum number of entries per table	10	MAXI	NCEP
Maximum number of subtotals (25) per table x 4, plus 4	104	LSUBT1	IMT
Maximum number of subtotals (25) per table x 4, plus 2	102	LSUBT2	ISUBT
Maximum number of data fields referenced in the program. This value must be set to the larger of LVAR or (L1+L2+L3)		L123	NPOS

[1]When using the optional PARMS procedure, these values are assigned on the INPUT/OUTPUT CONTROL CARD.

[2]The variable L123 must always be set equal to L1+L2+L3 or LVAR, whichever is larger. The dimension of NPOS in program TABLE must be set equal to L123.

[3]Restricted by OUTPUT-2.

a. The variable named LEV3 must be set equal to the desired maximum value.

b. The DIMENSION statement must be changed so that the first dimension of the arrays NLEV3 and XLEV3 equals the new value of LEV3.

2. Number of Subunits Per Sampling Unit

Only 10 subunits may be processed per sampling unit. To change this maximum, the following steps must be taken:

a. The variable named LEV2 must be set equal to the desired maximum value.

b. The DIMENSION statement must be changed so that the first dimension of the arrays NLEV2 and XLEV2 equals the new value of LEV2.

3. Number of Data Fields Per Record

Up to 132 data fields may be contained in a record. To change this maximum, the following steps must be taken:

a. The variable named LVAR must be set equal to the desired maximum value.

b. The DIMENSION statement must be changed so that the dimension of the array RECORD equals the new value of LVAR.

c. If the new value of LVAR is larger than the value of the variable named L123, the variable named L123 must be set equal to the new value of LVAR and the DIMENSION statement must be changed so that the dimension of the array NPOS equals the new value of L123.

4. Number of Variable Data Fields Per Record

Up to 69 data fields may be specified as containing variable values (see VARIABLE FIELDS CARD). To change this maximum, the following steps must be taken:

a. The maximum must be a multiple of 23. The variable named L3 must be set equal to the desired maximum value plus one.

b. The DIMENSION statement must be changed so that the dimension of LEVEL3 and the second dimension of arrays NLEV3 and XLEV3 equals the new value of L3.

c. If the sum of the values of the variables named L1, L2, and L3 is larger than the value of the variable named L123, the variable named L123 must be set equal to the sum and the DIMENSION statement must be changed so that the dimension of the array NPOS equals the new value of L123.

5. Number of Semivariable Data Fields Per Record

Description is exactly the same as for the number of variable data fields per record except that, in step 1, L3 is replaced by L2; and, in step 2, LEVEL3, NLEV3, XLEV3, and L3 are replaced by LEVEL2, NLEV2, XLEV2, and L2, respectively.

6. Number of Constant Data Fields Per Record

Description is exactly the same as for the number of variable data fields per record except that, in step 1, L3 is replaced by L1; and, in step 2, LEVEL3, NLEV3, XLEV3, and L3 are replaced by LEVEL1, NLEV1, XLEV1, and L1, respectively, and "second dimension" is simply "dimension."

7. Number of Cells in All Input and Output Tables

Up to 10,000 locations are available for storing all input and output tables. To change this maximum, the following steps must be taken:

a. The variable named LTOTAL must be set equal to the desired maximum value.

b. The DIMENSION statement must be changed so that the dimension of the arrays IMP and XIMP equals the new value of LTOTAL.

The space required for storage can be computed as

$$\sum_{i=1}^{m} e_i + K \sum_{j=1}^{n} r_j c_j + (rc)_{max}$$

where

m = the total number of input tables.

e_i = the total number of entries in the ith input table.

K = a multiplier, the value of which depends on the output table option (column 29 of INPUT/OUTPUT CONTROL CARD)

OPTION	K
1 or 2	1
3	2
4	3
5	3

n = the total number of output tables.

r_j = the number of rows in the jth output table, including a row of column totals if called for.

c_j = the number of columns in the jth output table including a column of row totals if called for.

$(rc)_{max}$ = the number of cells in the largest output table.

8. Number of Input Tables

Up to 40 input tables may be used. To change this maximum, the following steps must be taken:

a. The variable named LIN must be set equal to the desired maximum value.

b. The DIMENSION statement must be changed so that the first dimension of the array NTIN equals the new value of LIN.

9. Number of Output Tables

Up to 40 output tables may be specified. To change this maximum, the following steps must be taken:

a. The variable named LOUT must be set equal to the desired maximum value.

b. The DIMENSION statement must be changed so that the first dimension of the arrays NTOUT, NCEP, and ISUBT and the dimension of the array NAMES equal the new value of LOUT.

10. Number of Output Table Exceptions

Up to 100 output table exceptions may be used. To change this maximum, the following steps must be taken:

a. The variable named LEXCPS must be set equal to the desired maximum value.

b. The DIMENSION statement must be changed so that the first dimension of the array NEXCEP equals the new value of LEXCPS.

11. Number of Exceptions Per Table Entry

Up to 10 exceptions are allowed per table entry. To change this maximum, the following steps must be taken:

a. The variable named MAX must be set equal to the desired maximum.

b. The DIMENSION statement must be changed so that the third dimension of the array NCEP equals the new value of MAX.

c. The FORMAT statements used for reading and printing the OUTPUT TABLE ENTRY CARD(S) must be changed to accommodate a new value of MAX if it is larger than the original value.

12. Number of Table Entries Per Output Table

Up to 10 entries are allowed per output table. To reduce this maximum, the following steps must be taken:

a. The variable named MAXI must be set equal to the desired maximum.

b. The DIMENSION statement must be changed so that the second dimension of the array NCEP equals the new value of MAXI.

13. Number of Subtotals Per Output Table

Up to 25 subtotals are allowed per output table. To modify this limit, the following steps must be taken:

a. Find out the maximum number of subtotals used by any output table in the Job Control Deck.

b. Look up the values for dimension limits LSUBT1 and LSUBT2 in the following table for the given number of subtotals:

Number of subtotals	LSUBT1	LSUBT2
0-4	17	18
5-11	46	46
12-18	75	74
19-25	104	102
26-32	133	130
33-39	162	158
40-46	191	186
47-53	220	214
54-60	249	242
↓	↓	↓
etc. in steps of 7	etc. in steps of 29	etc. in steps of 28

c. Change the dimension limit of array IMT to LSUBT1.

d. Change the second dimension limit of array ISUBT to LSUBT2.

e. Change the assignment values of LSUBT1 and LSUBT2 to the new limits.

E. TABLE-2 PROGRAMING FEATURES

The following items will be of interest to programers who plan to modify the program for use on other computers or with other operating systems.

1. Tape Assignments

The logical unit assignments are as follows:

Unit	Use
LU1=1	Input file for data when tape input is used (LU1=10 for FCCC version)
LU2=2	Output file for binary tables
LU5=5	Program and Job Control Deck input and input file for data when card input is used
LU6=6	Output file for Job Control Deck listing, printed messages, and printed tables

These file assignments can be changed to fit local conditions by changing the values of variables LU1, LU2, LU5, and LU6 in the main program.

2. Subprogram Names and Functions

TABLE	Main calling program in which dimension of arrays are set. Calls subroutines SUB1 and SUB2.
SUB1	Reads and codes all cards in the Job Control Deck.
SUB2	Reads input data and forms tables for each sampling unit.
VARIAN	Computes means, variances, and covariances for data sets and writes final output tables. Called from subroutine SUB2.
CALCUL	User-written subroutine to manipulate existing data fields and generate new ones. Called from subroutine SUB2.

3. Important Arrays and Variables

The following are the principal arrays and variables used in TABLE-2:

Array	Dimension	Description
IMP,XIMP	LTOTAL	Fixed- and floating-point storage array for all input and output tables.
NTIN	LINx4	Indexing information for all input tables; where LIN is the maximum number of input tables, and locations in the second dimension are used as follows: 1=The name of an input table. 2=The beginning location of a table in IMP. 3=The last location of a table in IMP. 4=The number of fields in each table entry.
NTOUT	LOUTx77	Indexing information for all output tables; where LOUT is the maximum number of output tables, and locations in the second dimension are used as follows: 1=The number of rows in an output table, including a row of column totals if called for. 2=The number of columns in an output table, including a column of row totals if called for. 3=The beginning location in XIMP of a facsimile output table less 1 less the number of rows in the table. 4=The beginning location in XIMP of a final output table, less 1 less the number of rows in the table. 5=The beginning location in XIMP of the sums of squares for a final output table, less 1 less the number of rows in the table.

		6=The beginning location in XIMP of sums of cross-products, less 1 less the number of rows in the table. 7=The number of entries to be made in an output table. 8=The sequence number of the input table used in defining the row index for the first entry in the output table. 9=The code of the operation to be used in defining the row index for the first entry in the output table. 10=The identification number of the data field or value of the constant to be used in defining the row index for the first entry in the output table. 11-13=Same as 8-10, except that the information relates to defining the column index of the first entry in the output table. 14=The identification number of the data field to be used as the first entry in the output table. 15-77=Repetition of the descriptions of 8-14 for the second through tenth entries of the output table.
NEXCEP	LEXCPSx3	Storage array for table entry exceptions, where LEXCPS is the maximum number of exceptions and locations of the second dimension are used as follows: 1=The identification number of the data field to which an exception applies. 2=The value of the constant to be used in making the exception. 3=The operator to be used in making the exception.
NCEP	LOUTxMAXIxMAX	Indexing information for exceptions, where LOUT is the maximum number of output tables, MAXI is the maximum number of entries per table, and MAX is the maximum number of exceptions per entry.

NPOS	L123	Storage array for the storage (machine) locations of the data fields of an input record.
NLEV1, XLEV1	L1	Fixed- and floating-point storage array for data fields defined as constant fields.
NLEV2, XLEV2	LEV2xL2	Fixed- and floating-point storage array for data fields defined as semivariable fields.
NLEV3, XLEV3	LEV3xL3	Fixed- and floating-point storage array for data fields defined as variable fields.
RECORD	LVAR	Storage array into which each individual input record is read, where LVAR is the maximum number of data fields in an input record.
LEVEL1	L1	Storage array for the identification numbers of data fields defined as constant fields.
LEVEL2	L2	Storage array for the identification numbers of data fields defined as semivariable fields.
LEVEL3	L3	Storage array for the identification numbers of data fields defined as variable fields.
IDST	6	Storage array for identification numbers of the data fields defined as data set identification (DATA SET ID).
IDNOW	6	Storage array for the identification data fields for the current data set.
L1ID	6	Storage array for identification numbers of the data fields defined as sampling unit identification.
L1NOW	6	Storage array for the identification data fields for the current sampling unit.

L2ID	1	Storage for the identification number of the data field defined as subunit identification, if any.
L2NOW	1	Storage for the identification data field for the current subunit.
FMT	100	Storage array for the input record format.
IVAR	1	The number of data fields in each input record.
NOCRDS	1	The total number of records to be read from the input file.
IOCRDS	1	The current number of records read from the input file.
MODE	1	The mode in which the input file is to be read: 1=Binary on logical unit LU1. 2=BCD on logical unit LU1. 3=BCD on logical unit LU5 (card input).
NUNIT	1	The number of sampling units read for the current data set.
JRECRD	1	The number of records read for the current data set.
NPOINT	1	The number of subunits read for the current sampling unit.
NRECRD	1	The number of records read for the current sampling unit.
NTABLE	1	The total number of output tables defined in the Job Control Deck.
ITABLE	1	The index number of the output table currently being processed.
NAMES	LOUT	Storage array for output table names.
INDEX	2	Temporary storage for row and column indexes.

IMT	LSUBT1	Temporary storage for subtotal designations.
ISUBT	LOUTxLSUBT2	Storage for subtotal designations, where LOUT is the maximum number of output tables and the second dimension is used as follows: 1=Option for formation of a row of columns totals. 0=Construct a row of column totals. 1=Suppress column totals. 2=Option for formation of a column of row totals. 0=Construct a column of row totals. 1=Suppress row totals. 3=Designation of first subtotal for an output table. 0=No subtotal. 1=Row subtotal. 2=Column subtotal. 4=First row (or column) to be included in subtotal. 5=Last row (or column) to be included in subtotal. 6=Row (or column) where subtotal is to appear in output table. 7-102=Repetition of the designations, for 3-6 for up to 24 additional subtotals for an output table.
ISETS	11	Storage for values of data fields used for data set identification. The values are used to search the input file for the list of records to be used as input. The dimension is used as follows: 1=Designation of whether a search is to be made. 0=No search; use all records. 1=Search input file for start and end of records to be used. 2-6=Initial values of the data fields used for data set identification. Processing starts when a record with these values is found.

		7-11=Final values of the data fields used for data set identification. Processing terminates with the last record before the record which contains these values.
MAXI	1	The maximum number of table entries per output table.
MAX	1	The maximum number of exceptions per output table entry.
NOUTPT	1	Designation of form of output. 0=Output table written in binary on unit LU2. 1=Output tables written in BCD on unit LU6. 2=Output tables written in binary on unit LU2 and in BCD on unit LU6.
MAXERR	1	The maximum number of errors allowed in the run.
NOPT	1	The option designating how output tables are formed. 1=Sums over sets of sampling units. 2=Means over sets of sampling units. 3=Means and variances over sets of sampling units when sampling units are selected with equal probabilities. 4=Means, variances, and covariances of table cells with table totals over sets of sampling units. 5=Means and variances over sets of sampling units when sampling units are selected with unequal probabilities.

F. TABLE-2 OUTPUT TABLE FORMATS

Two alternative output table formats are available. The option is exercised in column 31 of the INPUT/OUTPUT CONTROL CARD.

In normal job processing, this column is left blank (not punched) and the table output is written on a file in binary mode. This form of output provides for rapid transmission of the output tables to OUTPUT-2 in which they may be weighted, summed, labeled, and printed or written on a tape or disk file according to the sampling and table- selection options available in OUTPUT-2.

If column 31 of the INPUT/OUTPUT CONTROL CARD is punched with a 1 or 2, the table output will be printed in BCD mode (F format). This alternative will normally be used only in debugging program changes or Job Control Decks. If punched with a 1 no further processing of the output data is possible.

The general order of the table output is the same for both alternatives. All table output from the job is in a single file. For the binary file output, this means there is only one end-of-file mark in the output file and it appears after the last record output from the job.

Within the file, the sets of output tables for each input data set are in the same order as the data sets appear in the input file. Within the data set, the output tables are in the same order as the corresponding OUTPUT TABLE DEFINITION CARDS in the Job Control Deck. The output for a given table varies with the output option given in column 29 of the INPUT/OUTPUT CONTROL CARD.

If the option is:

1 Only the table of sums is given for each output table.

2 Only the table of means is given for each output table.

3 or 5 The table of means, followed immediately by the table of the variances of the means, is given for each output table.

4 The table of means, followed immediately by the table of the variances of the means, in turn, followed immediately by the table of covariances of means, is given for each output table.

In the binary file output, three types of records are used. The first type is repeated as the first record of each data set output. The pair of records of the second and third types are repeated for every output table within the data set. The three types of records are described below:

Record number	Word number	Description
1	1	A number equal to one plus the number of identification words that follow in this record. This number is one greater than the number of data set identification fields specified in columns 13-27 of the INPUT FIELD IDENTIFICATION CARD.
	2	The value of the data set identification field specified in columns 13-15 of the INPUT RECORD IDENTIFICATION FIELDS CARD.
	3-6	Values of the remaining data set identification fields specified in columns 16-27 of the INPUT RECORD IDENTIFICATION FIELDS CARD.
	7	The total number of output tables for the data set which follow this record. This number is equal to the number of OUTPUT TABLE DEFINITION CARDS in the Job Control Deck.
	8	The total number of sampling units in the data set.
2	1	An output table name, as given in columns 14-17 of an OUTPUT TABLE DEFINITION CARD.
	2	The number of rows, including column subtotals and totals, in the output table named in word 1 of this record. This number is one greater than the number punched in columns 19-21 of the OUTPUT TABLE DEFINITION CARD for this output table.
	3	The number of columns, including row subtotals and totals, in the output table named in word 1 of this record. This number is one greater than the number punched in columns 23-24 of the OUTPUT TABLE DEFINITION CARD for this output table.
	4	The total length of the output table named in word 1 of this record. The value depends on the number of rows and columns in the table and the output option given in column 29 of the INPUT/OUTPUT CONTROL CARD.

3	1	The value in the first element or cell of the first column of the output table named in the preceding record 2, word 1. If the output option specified in column 29 of the INPUT/ OUTPUT CONTROL CARD is 1, the value will be a sum over the sampling units of the data set. Otherwise, it will be a mean over the sampling units.
	2-r	The values in the remaining cells of the first column of the table, where r is the number of rows given in the preceding record 2, word 2.
	(r+1)-(rxc)	The values in the cells of the remaining columns of the output table, where r and c are the numbers of rows and columns given in the preceding record 2, words 2 and 3, respectively.
	((rxc)+1)-2(rxc)	The values of the variances of the cells of the output table named in the preceding record 2, word 1. These words appear in the record only if output options 3 or 4 is punched in column 29 of INPUT/OUTPUT CONTROL CARD. Otherwise, the record ends with word (rxc).
	(2(rxc)+1)-3(rxc)	The values of the covariances between the cells and the total of the output table named in the preceding record 2, word 1. These words appear in the record only if output option 4 is punched in columns 29 of the INPUT/OUTPUT CONTROL CARD. Otherwise, the record ends with word (rxc) (output options 1 and 2) or with word 2 (rxc) (output option 3).

In the printed BCD output the numbers are in floating-point format (F format). Essentially the same arrangement is followed as with the binary output, except that the output is broken into lines. There are 10 entries (or cells) per line in columnar sequence, and as many lines are printed as necessary to record all the table entries.

For example, a table that has been defined as having 10 rows and 15 columns will appear printed in the following way: line 1 will represent column 1, rows 1-10; line 2 will represent column 1, row 11; and column 2, rows 1-09. Row 11 of column 1 is the total of column 1 that has been provided by the program. The next line represents column 2, rows 10-11; and column 3, rows 1-8; and so forth through the entire table. If the option provides for tables of variances, these follow the last element of the means; and if the option provides for tables of covariances, these follow the last element of the table of variances.

The table is identified by a printed line that gives the table name, the entire number of rows and columns, and the entire number of cells represented in the printed tables. This number is merely the number of rows plus 1 times the number of columns plus 1 times the number of tables represented. If only means are printed, the number is 1; if means and variances are printed, the number is 2; if means, variances, and covariances the number is three.

G. TABLE-2 SUMMARY OF ESTIMATING PROCEDURES

In this section, the five output options available in TABLE-2 are presented in detail.

Vector notation is used to make the presentation of computing procedures compact and easy to read. An input vector, Y^{I}, is a one-dimensional array representing a sampling unit attribute. An output vector, Y^{O}, represents an output table (in general, a two-dimensional array or matrix) summarizing the sampling unit attribute. A final output vector, Y^{F}, represents an estimate of the population attribute that corresponds to the sampling unit attribute. Elements of these vectors are represented by y_1^I, y_1^O, y_1^F,

It must not be inferred from what follows that the arithmetic is the arithmetic of vectors or matrices, though, in general, it is correct vector arithmetic as shown. What is implied is simply the sequential and independent application of the indicated operation to each pair of equivalent elements from the two vectors. In this sense, the procedures will generalize to the case of matrices; otherwise, they will not.

Other notational conventions adopted here are the use of a bar over an attribute symbol ($\bar{Y}$) to symbolize the arithmetic mean of an attribute, and the use of a dot that replaces a subscript ($Y_{\cdot jk}$) to indicate the sum over all members of the set represented by the subscript.

OPTION 1.--Transform and Sum Sampling Unit Attributes Over Sets of Sampling Units

Compute: $Y^{0}_{j.}$

Given: A set (j = 1) of Y^{I}_{jk}, and T

Where:

j = Subscript for the jth sample stratum or set of sampling units

k = Subscript for the kth sampling unit

$Y^{0}_{j.}$ = An output vector (output table) containing the sum of the sampling unit output vectors, Y^{0}_{jk}, which represent a summary of the sampling unit attribute input vectors, Y^{I}_{jk}

Y^{I}_{jk} = An input vector containing a sampling unit attribute (a data field from the input data matrix for a sampling unit)

T = A set of rules whereby the elements of the input data vector, Y^{I}_{jk}, are redistributed (transformed) to form the output vector (table), Y^{0}_{jk}

Procedure: $Y^{0}_{jk} = TY^{I}_{jk}$

Output: $Y^{0}_{j.} = \sum_{k=1}^{P_j} Y^{0}_{jk}$

OPTION 2.--Transform and Compute Means of Sampling Unit Attributes Over Sets of Sampling Units

Compute: $\overline{Y}^{0}_{j.}$

Given sets of Y^{I}_{jk}, P_j, and T

Where:

j = Subscript for the jth sample stratum set of sampling units

k = Subscript for the kth sampling unit

$\overline{Y}^{0}_{j\cdot}$ = An output vector (output table) containing the arithmetic mean of the sampling unit output vectors, $Y^{0}_{jk,}$ which represent a summary of the sampling unit attribute input vectors, Y^{I}_{jk}

Y^{I}_{jk} = An input vector containing a sampling unit attribute (a data field from the input data matrix for a sampling unit)

P_j = The number of input sampling units in the stratum or set

T = A set of rules whereby the elements of the input data vector, $Y^{I}_{jk,}$ are redistributed (transformed) to form the output vector (table), Y^{0}_{jk}

Procedure: $Y^{0}_{jk} = TY^{I}_{jk}$

Output: $\overline{Y}^{0}_{j\cdot} \quad \frac{\sum_{k=1}^{P_j} Y^{0}_{jk}}{P_j}$

Option 3.--Transform and Compute Means and Variances of Sampling Unit Attributes Over Sets of Sampling Units

Compute: $\overline{Y}^{0}_{j\cdot}, \quad V\overline{Y}^{0}_{j\cdot}$

Given: Sets of $Y^{I}_{jk,}$ $P_{j,}$ and T

Where:

j = Subscript for the jth sample stratum or set of sampling units

k = Subscript for the kth sampling unit

$\overline{Y}^{0}_{j\cdot}$ = An output vector (output table) containing the arithmetic mean of the sampling unit output vectors, $Y^{0}_{jk,}$ which represent a summary of the sampling unit attribute input vectors, Y^{I}_{jk}

$V\overline{Y}^{0}_{j\cdot}$ = the variance of $Y^{0}_{j\cdot}$

$\overset{I}{Y}_{jk}$ = An input vector containing a sampling unit attribute (a data field from the input data matrix for a sampling unit)

P_j = The number of input sampling units in the stratum or set

T = A set of rules whereby the elements of the input data vector, $\overset{I}{Y}_{jk}$, are redistributed (transformed) to form the output vector (table), $\overset{0}{Y}_{jk}$

Procedure: $\overset{0}{Y}_{jk} = T\overset{I}{Y}_{jk}$

Output: $$\overset{0}{\overline{Y}}_{j\cdot} = \frac{\sum_{k=1}^{P_j} \overset{0}{Y}_{jk}}{P_j}$$

$$\overset{0}{V\overline{Y}}_{j\cdot} = \frac{\sum_{k=1}^{P_j} (\overset{0}{Y}_{jk} - \overset{0}{\overline{Y}}_{j\cdot})^2}{P_j (P_j - 1)}$$

OPTION 4.--OPTION 3 Modified to Include Computation of Covariances for Ratio Estimates

Compute: $\overset{0}{\overline{Y}}_{j\cdot}$, $\overset{0}{V\overline{Y}}_{j\cdot}$, $\overset{0}{C\overline{V}}_{j\cdot}$

Given: Sets of $\overset{I}{Y}_{jk}$, P_j, and T

Where:

j = Subscript for the jth sample stratum or set of sampling units

k = Subscript for the kth sampling unit

$\overset{0}{\overline{Y}}_{j\cdot}$ = An output vector (output table) containing the arithmetic mean of the sampling unit output vectors, $\overset{0}{Y}_{jk}$, which represent a summary of the sampling unit attribute input vector $\overset{I}{Y}_{jk}$

$\overset{0}{V\overline{Y}}_{j\cdot}$ = The variance of $\overset{0}{\overline{Y}}_{j\cdot}$

$\overset{0}{C\overline{V}}_{j\cdot}$ = The mean covariance of output vectors for sampling units, $\overset{0}{Y}_{jk}$, and the sums (totals) of elements in these vectors $\overset{0}{Y}_{\cdot jk}$

$\overset{I}{Y}_{jk}$ = An input vector containing a sampling unit attribute (a data field from the input data matrix for a sampling unit)

P_j = The number of input sampling units in the stratum or set

T = A set of rules whereby the elements of the input data vector, $\overset{I}{Y}_{jk}$, are redistributed (transformed) to form the output vector (table), $\overset{0}{Y}_{jk}$

Procedure: $\overset{0}{Y}_{jk} = T\overset{I}{Y}_{jk}$

Output: $$\overset{0}{\overline{Y}}_{j\cdot} = \frac{\sum_{k=1}^{P_j} \overset{0}{Y}_{jk}}{P_j}$$

$$\overset{0}{V\overline{Y}}_{j\cdot} = \frac{\sum_{k=1}^{P_j} (\overset{0}{Y}_{jk} - \overset{0}{\overline{Y}}_{j\cdot})^2}{P_j\,(P_j - 1)}$$

$$\overset{0}{C\overline{V}}_{j\cdot} = \frac{\sum_{k=1}^{P_j} (\overset{0}{Y}_{jk} - \overset{0}{\overline{Y}}_{j\cdot})\,(\overset{0}{y}_{\cdot jk} - \overset{0}{\overline{y}}_{\cdot j\cdot})}{P_j\,(P_j - 1)}$$

OPTION 5.--Transform and compute means and variances over sets of sampling units when sampling units are selected with unequal probabilities.[1]

Compute: $A_{j\cdot}$, $VA_{j\cdot}$, $\overset{O}{Z}_{jk}$, $VZ_{j\cdot}$, $\overset{O}{\bar{Y}}_{j\cdot}$, $V\overset{O}{\bar{Y}}_{j\cdot}$, $C\overset{O}{V}_{j\cdot}$

Given: Sets of $\overset{I}{Y}_{jk}$, $\overset{I}{PR}_{jk}$, $\overset{I}{A}_{jk}$, P_j, and T

Where:

j = Subscript for the jth sample stratum or data set.

k = Subscript for the kth sampling unit or portion thereof.

$\overset{I}{PR}_{jk}$ = An input vector containing the sampling unit scaled probabilities of selection. Scaled probability equals the true probability weighted by (times) the number of selected sampling units in the jth sampling stratum.

$\overset{I}{A}_{jk}$ = An input vector containing that portion of the area of the kth sampling unit that lies within the jth sampling stratum or data set.

A_{jk} = An intermediate computational vector containing the area values, $\overset{I}{A}_{jk}$, each weighted inversely proportional to the respective scaled probability of selection.

$A_{j\cdot}$ = An intermediate computational vector containing the area value of the jth sampling stratum or data set.

P_j = The number of input sampling units represented in the jth sampling stratum or data set.

$\overset{I}{Y}_{jk}$ = An input vector containing sampling unit attribute values (a data field from the input data for a sampling unit)

$\overset{O}{Y}_{jk}$ = An output vector (table) which is created by redistributing (transforming) the elements of the input vector, $\overset{I}{Y}_{jk}$, by a set of rules, T.

[1]Brickell, J.E. and James C. Schaefer Modifications of an inventory design using stand examinations. Res. Paper INT-___. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station: In press. Principle work deriving the estimation formulae used in Option 5.

$\overset{0}{Z}_{jk}$ = An intermediate computational vector containing the sampling unit attribute values, $\overset{I}{Y}_{jk}$, each multiplied by the respective weighted area, A_{jk}.

$\overset{0}{Z}_{j.}$ = An intermediate computational vector containing the weighted estimated total sampling unit attribute values.

$\overset{0}{\bar{Y}}_{j.}$ = An output vector (table) containing sampling stratum means, each of which is a ratio of the corresponding elements of $\overset{0}{Z}_{j.}$ and $A_{j.}$.

$\overset{0}{VZ}_{j.}$ = An intermediate computational vector containing the estimates of the variances of $\overset{0}{Z}_{j.}$.

$VA_{j.}$ = An intermediate computational vector containing the estimates of the variances of $A_{j.}$.

$C\bar{V}_{j.}$ = An intermediate computational vector containing estimates of the covariances between $\overset{0}{Z}_{j.}$ and $A_{j.}$.

$\overset{0}{V\bar{Y}}_{j.}$ = An output vector (table) containing estimates of the weighted (by probability) variances of $\overset{0}{\bar{Y}}_{j.}$.

Procedure: $\overset{0}{Y}_{jk} = \overset{I}{TY}_{jk}$; $\overset{0}{Z}_{jk} = \overset{0}{Y}_{jk} A_{jk}$; $\overset{0}{Z}_{j\cdot} = \sum_{k=1}^{P_j} \overset{0}{Z}_{jk}$

$A_{j\cdot} = \sum_{k=1}^{P_j} A_{jk}$; Where $A_{jk} = \frac{\overset{I}{A}_{jk}}{\overset{I}{PR}_{jk}}$

$$VA_{j\cdot} = \frac{P_j \sum_{k=1}^{P_j} (A_{jk})^2 - (A_{j\cdot})^2}{(P_j - 1)} \quad ; \quad \overset{0}{VZ}_{j\cdot} = \frac{P_j \sum_{k=1}^{P_j} \overset{0}{(Z_{jk})^2} - \overset{0}{(Z_{j\cdot})^2}}{(P_j - 1)}$$

$$C\overline{V}_{j\cdot} = \frac{P_j \sum_{k=1}^{P_j} \overset{0}{(Z_{jk} A_{jk})} - \overset{0}{(Z_{j\cdot})} \; (A_{j\cdot})}{(P_j - 1)}$$

Output: $\overset{0}{\overline{Y}}_{j\cdot} = \frac{\sum_{k=1}^{P_j} \overset{0}{Y}_{jk} A_{jk}}{A_{j\cdot}} = \frac{\sum_{k=1}^{P_j} \overset{0}{Z}_{jk}}{A_{j\cdot}} = \frac{\overset{0}{Z}_{j\cdot}}{A_{j\cdot}}$

$$\overset{0}{V\overline{Y}}_{j\cdot} = \overset{0}{\overline{Y}}_{j\cdot}^{\,2} \left[\frac{\overset{0}{VZ}_{j\cdot}}{\overset{0}{(Z_{j\cdot})^2}} + \frac{VA_{j\cdot}}{(A_{j\cdot})^2} - \frac{2C\overline{V}_{j\cdot}}{\overset{0}{(Z_{j\cdot})} \; (A_{j\cdot})} \right]$$

III. USE OF OUTPUT-2

A. OUTPUT-2 CONTROL CARD FORMATS

The description and specification of each processing job in a processing run is presented to the computer through a special deck of data cards referred to as the Job Control Deck. Each card in this deck contains specific pieces of information arranged in a definite format.

In this section, each type of control card is described. The description gives the format of the cards, the information they must contain, and, where appropriate, the purpose and use of the required information. This section may be used both as a detailed list of instructions for coding the description of a job and as an outline to follow in the initial stages of job specification in order that the specifications be complete.

1. Run Title Card

This card must be the first card in the Job Control Deck. It simply gives a descriptive title to be printed at the top of each of the job summary pages.

RUN TITLE CARD

Columns	Contain	Explanation
1-80	AAA...A	80 alphameric characters, giving a descriptive title for the entire run.

2. Job Control Cards

The job control cards are the header cards for each job in a processing run. They contain the general specifications for the job as a whole (including table labels). Each group of job control cards in the Job Control Deck is followed by other groups of cards (described below) that give detailed descriptions of job segments.

The first card in the group gives the number of populations to be processed in the job and the processing options to be used. The second card extends the output options by showing which of the sample summary tables given as input are to be processed and printed. These two cards must always be in the Job Control Deck. The other cards shown are optional and are only used when needed for a particular job.

The remaining cards of this group are used to provide labels for each table to be printed as output. These labels must always be supplied for the first job in a processing run, but they may be omitted

in any subsequent job. The last set of labels read will always be used when labels are omitted for a job. This condition requires that the NO TABLE LABELS CARD be the third and final card in the group of job control cards. If only selected tables in a table set are to be processed and printed, the ones not selected do not have to be removed from the label deck. They are bypassed during processing.

The table labels are supplied in complete sets, table by table, and in the order in which the tables occur in the input data file. A set of labels for a table can be described by two methods. The standard method consists of a TABLE TITLE CARD that contains the table name and a descriptive title; a COLUMN HEADING CARD for each column in the table (including the column of row totals at the extreme right of the table); and a ROW HEADING CARD for each row of the table (including the row of column totals at the bottom of the table). The repeat labels method consists of label sets (one set for each unique row or column label group); a TABLE TITLE CARD that contains the table name and a descriptive title; a column set card identifying the set of column labels to use in the table; and a row set card identifying the set of row labels to use in the table.

The entire group of table labels must always be followed by the END OF LABELS CARD. See figures 16-18 for the arrangement of the cards in the deck.

JOB CONTROL CARD

Columns	Contain	Explanation
1-3	JOB	Card label.
4	b	
5	b or 0	No listing of Job Control Deck.
	1	List entire Job Control Deck.
	2	List Job Control Deck with the exception of table labels.
6	b	
7	b or 0	Output to be produced in BCD on tape (logical unit LU1).
	1	Output to be produced on printer (logical unit LU6).

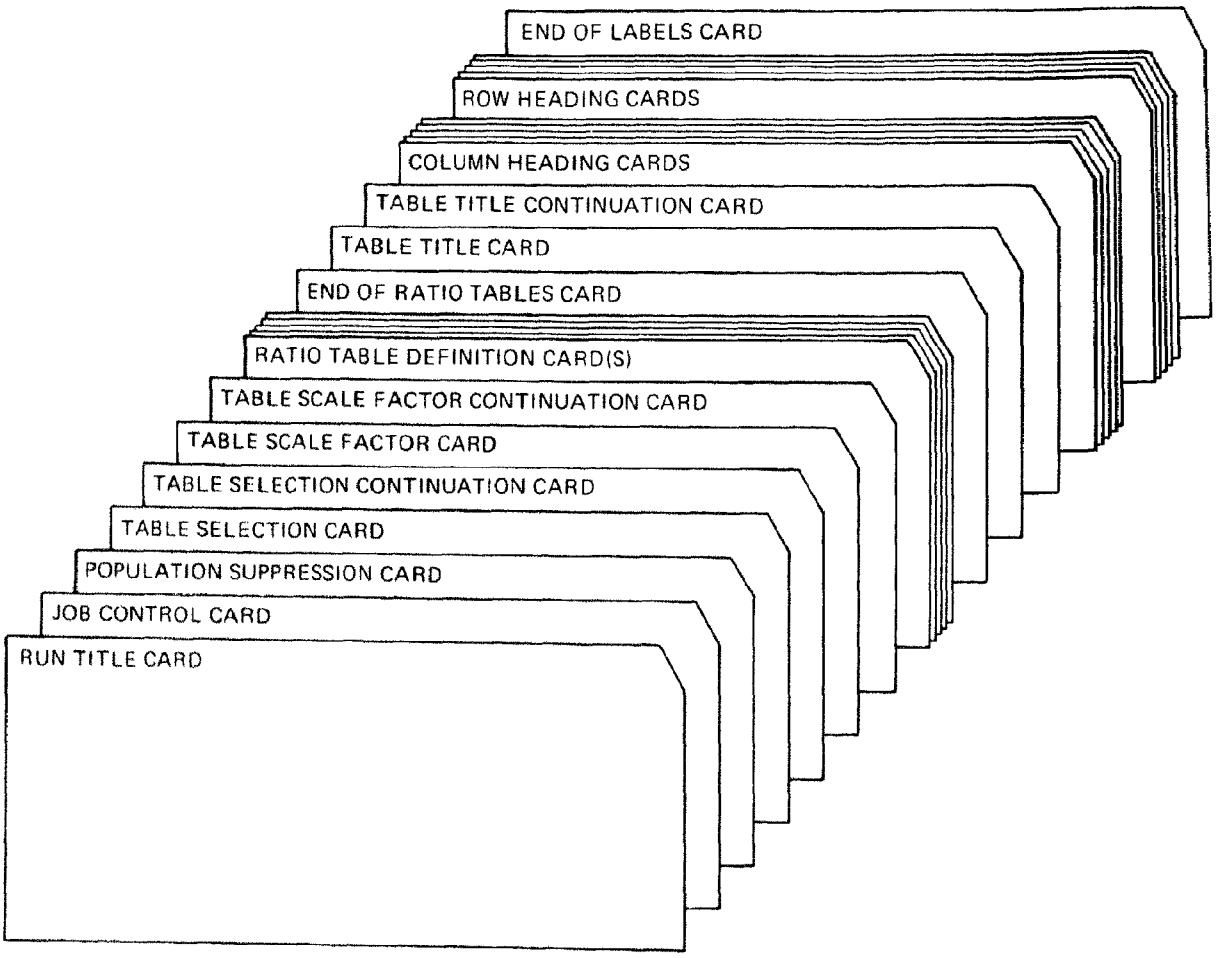

Figure 16.--Arrangement of the cards in the Job Control Deck.

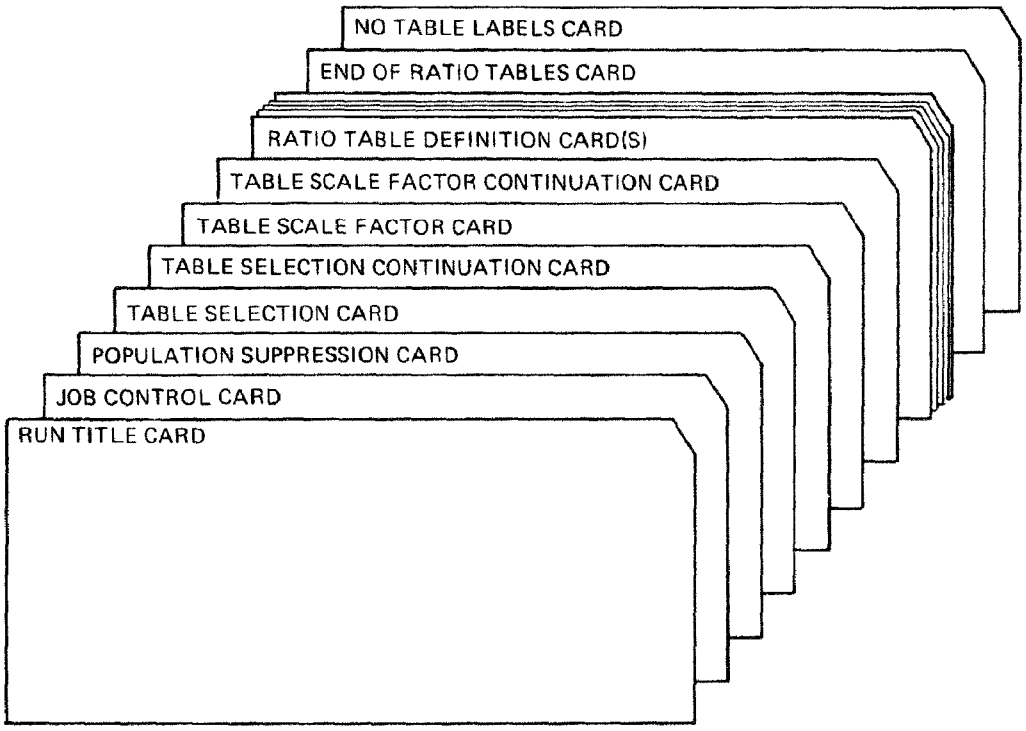

Figure 17.--Arrangement of the cards in the Job Control Deck.

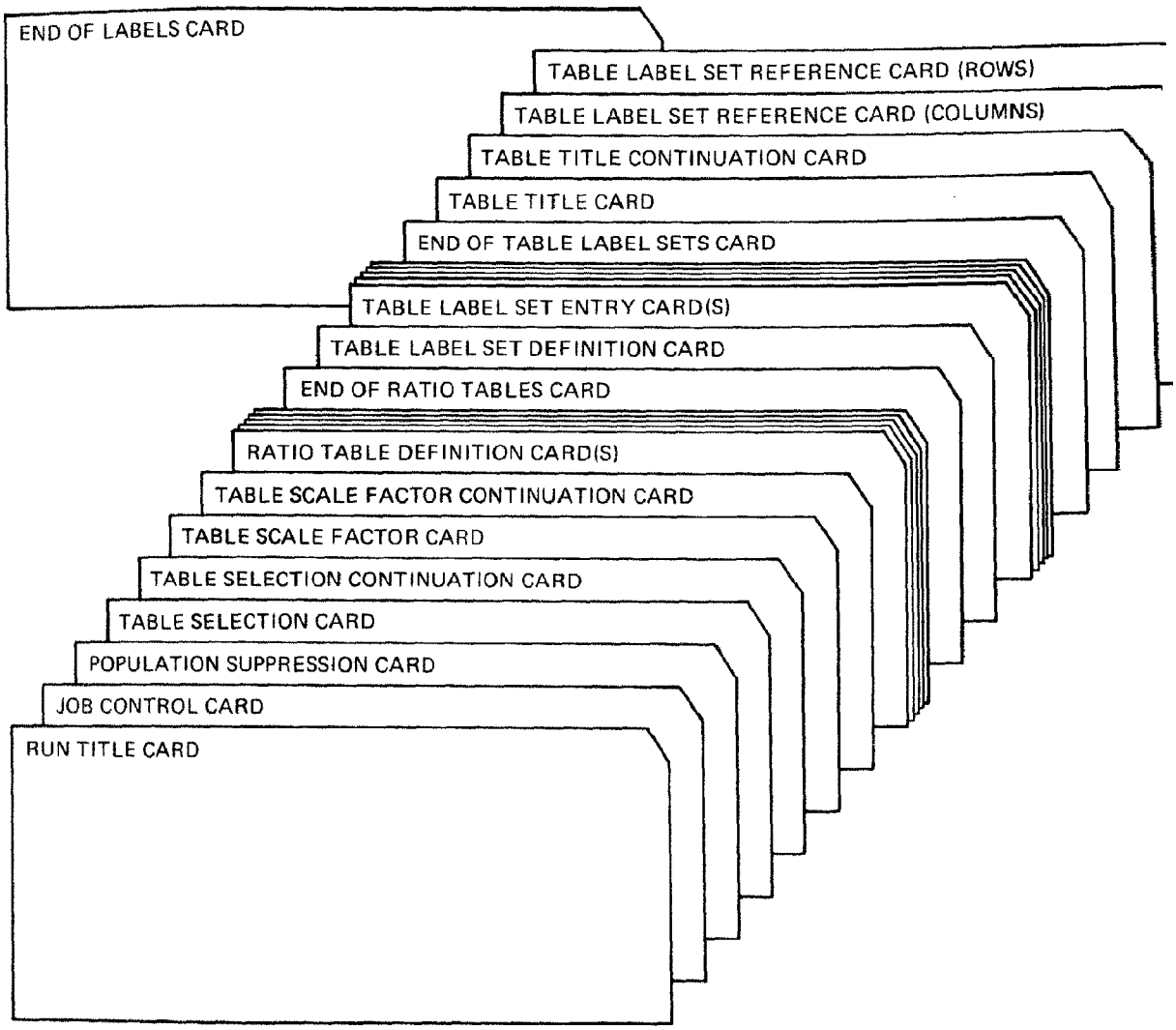

Figure 18.--Arrangement of the cards in the Job Control Deck.

8	b	
9-11	XXX	3 numeric characters, giving the number of populations to be processed in this job. The number must be right-justified in the field.
12	b	
13	b or 0	Do not sum the population tables over all populations in the job.
	1	Sum the population tables and print them. Print all individual population tables.
	2	Sum the population tables and print them. Do not print any individual population tables.
	3	Sum the population tables and print them. Print all individual population tables except those indicated on the POPULATION SELECTION CARD.
14	b	
15	1	The data are to be processed as a 100 percent inventory. Expansion factor must be used even if 1.0.
	2	The data are to be processed as a simple random sample.
	3	The data are to be processed as a stratified random sample with known weights.
	4	The data are to be processed as a stratified random sample with estimated stratum weights (double sampling).
	5	The data are to be processed as a stratified ratio sample with independent estimates of stratum totals and variances.
	6	The data are to be processed as a stratified ratio sample with independent estimates of totals and variances combined over all strata.

16	b	
17	b or 0	For each table specified on the TABLE SELECT CARD, do not produce tables of totals.
	1	Produce tables of totals.
18	b	
19	b or 0	For each table specified on the TABLE SELECT CARD, do not produce tables of variances.
	1	Produce tables of variances.
20	b	
21	b or 0	For each table specified on the TABLE SELECT CARD, do not produce tables of standard errors.
	1	Produce tables of standard errors.
22	b	
23	b or 0	For each table specified on the TABLE SELECT CARD, do not produce tables of standard errors as percentages of totals.
	1	Produce tables of percentages. The standard errors are expressed as percentages of corresponding totals, with an option available for producing the percentages at 1,2,3....9 standard errors.
24	b, 0, or 1	The percentages are to be calculated at one standard error.
	2,....,9	The percentages are calculated at the number of standard errors specified.
25	b or 0	The output is to be produced in floating-point E format (E20.9).
	1	The output is to be produced in floating-point F format (F20.1).

2 The output is to be produced in floating-point COMMAS format.

Examples:

0.0	--	0.0
985.3	--	985.3
3287.4	--	3,287.4
8909224.6	--	8,909,224.6
-78056.5	--	-78,056.5

3 The output is to be produced in floating-point COMMAS format with column spacing adjusted to the size of the table entries. This option has the advantage of saving paper since more columns can be squeezed onto one page. The columns are numbered and the heading associated with each number is printed in a legend at the beginning of each table. Sample printout follows:

TEST RUNS FINSYS-2 OUTPUT-2

T2-F9 AREA by LOCAL TYPE AND MAJOR TYPE
ESTIMATED TOTALS

Computer generated:

(1) =	UNCLASSIFIED	Standard column labels
(2) =	PONDEROSA PINE	
(3) =	FIR-SPRUCE	
(4) =	OTHER SOFTWOODS	
(5) =	HARDWOODS	
(6) =	TOTAL ALL TYPES	

	(1)	(2)	(3)	(4)	(5)	(6)
PONDEROSA PINE	0	40.0	0	0	0	40.0
SPRUCE	0	0	40.0	0	0	40.0
OTHER SOFTWOODS	0	0	0	0	0	.0
ASPEN	0	0	0	0	60.0	60.0
OTHER HARDWOODS	0	0	0	0	100.0	100.0
TOTAL ALL TYPES	0	40.0	40.0	0	160.0	240.0

Note: Column spacing may vary from table to table.

	4	The output is to be produced in floating-point F format (F10.3) with up to 11 columns per page. Only the first 16 characters of the row labels are printed. Only columns 1-8 and 13-20 of the column labels are printed. The column headings are printed on two lines with the first 8 characters printing directly over the last 8 characters. Example follows:

```
Column headings...
AAAAAAAA    BBBBBBBB
CCCCCCCC    DDDDDDDD
   FINAL       TOTAL

Row headings...
RRRRRRRRRRRRRRR
XXXXYYYYZZZZ0000
    GRAND TOTAL

Table as printed...

                    AAAAAAAA  CCCCCCCC     FI
                    BBBBBBBB  DDDDDDDD     TC
RRRRRRRRRRRRRRR      240.000      .000   240.
XXXXYYYYZZZZ0000        .000    60.000    60.
     GRAND TOTAL     240.000    60.000   300.
```

26	b	
27	b or 0	Do not scale the output
	1	Scale the output for estimated totals for those tables specified on the TABLE SCALE FACTOR CARDS. (See description on page 91.)
28	b	
29	b or 0	The Job Control Deck does not contain ratio tables.
	1	Compute and print the ratio tables as specified on the RATIO TABLE DEFINITION CARDS. (See description on page 92.) Ratios can only be computed from estimated totals tables.
30	b	

31	b, 0, or 1	Each table title consists of one TABLE TITLE CARD.
	2	Each table title consists of two TABLE TITLE CARDS.
32	b	
33	b or 0	Do not print the table name on the output tables.
	1	Print the table name offset 2 spaces from the table title on the output tables.
34	b	
35	b, 0, or 1	Single space the row entries on the output tables.
	2	Double space the row entries on the output tables.
36	b	
37	b or 0	Print 'zero' tables (normal operation).
	1	Do not print 'zero' tables.

POPULATION SELECTION CARD (Optional)

This card is only required if option 3 was selected in column 13 of the JOB CONTROL CARD.

This card, if used, is placed immediately following the JOB CONTROL CARD in the Job Control Deck.

Columns	Contain	Explanation
1	b or 0	Print all tables for the first population.
	1	Do not print any tables for the first population.
2-80	XXX...X	Continuation of the format in column 1 for the remaining populations as specified in columns 9-11 of the JOB CONTROL CARD.

TABLE SELECTION CARD

Columns	Contain	Explanation
1-6	TABLES	Card label.
7	b	
8	b or 0	Do not print the first table in the data input.
	1	Produce and print the first table in the data input.
	2	Read an update table of totals to be added to the first table before printing. (Only the totals can be specified for printing, and only the updated totals will be printed. Variances, if present, apply only to the original tables.)
	3	Produce and print the first table and punch it as an update table for later processing.
	4	Read an update table of totals to be added to the first table before printing; also, punch the completed table as an update table for later processing. (Only the totals can be specified for printing, and only the updated totals will be printed.)
9-47	XXX...X	Continuation of the format for column 8 for up to 39 additional tables. If the standard dimension limits are increased; columns 48-80 on this card can be used along with 1 additional continuation card for a maximum of 153 tables. The corresponding dimension limits in OUTPUT-2 must also be increased.

TABLE SELECTION CONTINUATION CARD (Optional)

Columns	Contain	Explanation
1-80	XXX...X	Continuation of designations begun on previous card for up to 80 additional tables.

TABLE SCALE FACTOR CARD (Optional)

This card is required only if option 1 was specified in column 27 of the JOB CONTROL CARD.

This card, if used, is placed immediately after the TABLE SELECT CARD(S) in the Job Control Deck.

Columns	Contain	Explanation
1-6	SCALES	Card label.
7	b	
8	b or 0	Do not scale the output of the estimated totals of the first table in the data input.
	1	Scale the output of the estimated totals of the first table in the data input by a factor of 10. (Round to the nearest 10.) Example: 5678.9 -- would be printed as 567.9
	2	Same as option 1 but using a scale factor of 100.
	3	Same as option 1 but using a scale factor of 1,000.
	4	Same as option 1 but using a scale factor of 10,000.
	n	Same as option 1 but using a scale factor of 10^n when n varies from 5 to 9.
9-80	XXX...X	Continuation of the format for column 8 for up to 72 additional tables.

TABLE SCALE FACTOR CONTINUATION CARD (Optional)

This card is required only if more than 73 tables are being processed.

Columns	Contain	Explanation
1-80	XXX...X	Continuation of designations begun on previous card for up to 80 additional tables.

3. Ratio Table Definition Cards

The cards described for the ratio tables are required only if column 29 of the JOB CONTROL CARD contains a 1.

RATIO TABLE DEFINITION CARD (Optional)

This card is required to define each ratio table you wish to have computed and printed.

Columns	Contain	Explanation
1-4	AAAA	Alphameric name of the ratio table to be computed and printed for each population. The table title and table labels for this table must appear in the set of table labels. See page 95, item b. The two tables used in this operation must have the same dimensions.
5	=	'=' equal sign.
6-9	AAAA	Alphameric name of the table to be used as the dividend. This table must have been specified on the TABLE SELECT CARD(S).
10	/	'/' slash or divide sign.
11-14	AAAA	Alphameric name of the table to be used as the divisor. This table must have been specified on the TABLE SELECT CARD(S).

RATIO TABLE DEFINITION CONTINUATION CARD(S) (Optional)

Columns	Contain	Explanation
1-14		Repetition of the format on the RATIO TABLE DEFINITION CARD. Up to 49 continuation cards may be used allowing a maximum of 50 ratio tables to be specified.

END OF RATIO TABLE DEFINITION CARD (Optional)

Columns	Contain	Explanation
1-3	END	A control word signifying the end of all ratio tables. This card must always follow the last ratio table that is specified

4. Table Labels Cards

This section describes the cards necessary to define each table's title, column, and row headings. This group of cards appears in the Job Control Deck immediately after the TABLE SELECT CARD(S). The optional TABLE SCALE FACTOR CARD and RATIO TABLE CARD(S), if used, follow the TABLE SELECT CARD(S) and precede the table labels cards.

The table labels may be specified in three ways; no labels, standard, or repeat labels. OUTPUT-2 writes the table labels on a scratch file, unit LU3=3.

a. No Labels Specification

Use this form for secondary jobs when stacking several jobs in one run. The first job must define the table labels.

NO TABLE LABELS CARD

Columns	Contain	Explanation
19	NObLABELS	A card label, signifying that table labels are not in the Job Control Deck for the job. This card cannot be used for the first job of a run, because the labels must be present for that job. However, in subsequent jobs using the same labels, this card may be used. (This card can be used for the first job only if the user writes his own file of table labels to use in place of the scratch file, LU3=3.)

b. Standard Labels Specification

This form consists of a group of cards for each table. The first card of the group is for the table title. (Two cards may be used. See JOB CONTROL CARD options for column 31.) Following the table title are cards to describe the column headings, one card per column heading. Following the column heading cards are the row heading cards, one card per row heading.

The labels must appear in the order of their appearance on the TABLE SELECT CARD(S). Ratio tables, if used, must be defined after the regular tables and in the same order as defined on the RATIO TABLE DEFINITION CARD(S). The last card of the table labels must be the END OF LABELS CARD.

TABLE TITLE CARD

Columns	Contain	Explanation
1-4	AAAA	4 alphameric characters, giving a unique name by which a table may be referenced. The name must be left-justified in the field and must appear exactly as given on the OUTPUT TABLE DEFINITION CARD used in TABLE-2.
5-80	AAA...A	76 alphameric characters, giving a descriptive title for a table.

TABLE TITLE CONTINUATION CARD (Optional)

Columns	Contain	Explanation
1-80	AAA...A	Continuation of previous card for up to 80 additional characters for the table title. Used only if column 31 of the JOB CONTROL CARD contains a 2.

COLUMN HEADING CARDS

Columns	Contain	Explanation
1-20	AAA...A	20 alphameric characters, giving a label for a column in an output table. The label should be right-justified in the field. There must be 1 card for each column of the table, and the last card of the group must be the label for the column of row totals (if totals were produced in TABLE-2).

ROW HEADING CARDS

Columns	Contain	Explanation
1-20	AAA...A	20 alphameric characters, giving a label for a row in an output table. The label should be left-justified in the field. There must be 1 card for each row of the table, and the last card of the group must be the label for the row of column totals (if totals were produced in TABLE-2).
21	b or 0	Do not skip any lines after printing this row heading.
	1	Skip 1 line after printing this row heading. This option is usually used to set off subtotals.
	n	Skip n lines after printing this row heading where n varies from 2-9.

c. Repeat Labels Specification

This form is similar to the standard specification except that it usually takes fewer cards. The last card of the table labels must still be the END OF LABELS CARD and the cards for the table titles remain the same, but the column and row heading cards are replaced by references to sets of heading cards. Two TABLE LABEL SET REFERENCE CARDS are required for each table and these cards appear immediately after the TABLE TITLE CARD(S). The first reference card defines the set of column headings while the second reference card defines the set of row headings to use. The user defines these reference sets before the table titles. When the repeat labels specification is used, all row and column labels must appear as sets before the first TABLE TITLE CARD.

Three types of cards are necessary to define the reference sets. The TABLE LABEL SET DEFINITION CARD is used to assign a reference name to the set. The TABLE LABEL SET ENTRY CARDS make up the members of the set. These entry cards are identical to the COLUMN HEADING CARDS and ROW HEADING CARDS of the standard specification. The END OF TABLE LABEL SETS CARD is used to signal the end of all set definitions.

TABLE LABEL SET DEFINITION CARD (Optional)

Columns	Contain	Explanation
1-4	****	4 control characters.
5-8	AAAA	4 alphameric characters, giving a unique name for the table label set.

TABLE LABEL SET ENTRY CARDS (Optional)

Columns	Contain	Explanation
1-20/1-21	AAA...A/AAA...AX	The same as columns 1-20 on the COLUMN HEADING CARDS or 1-21 on the ROW HEADING CARDS depending on which set is being defined.

END OF TABLE LABEL SETS CARD (Optional)

Columns	Contain	Explanation
1-8	********	8 control characters, signaling the end of all table label reference set definitions.

TABLE LABEL SET REFERENCE CARD (Optional)

Columns	Contain	Explanation
1-4	bbbb	
5-8	AAAA	4 alphameric characters, specifying the name of the table label set to use for the column or row labels.

Following is an example of the same set of table labels specified under the standard and repeat labels methods:

Standard Labels Specification

```
T001TABLE 1 TITLE
                BLUE
                 RED
              YELLOW
              ORANGE
1-10
11-20
21-30
T002TABLE 2 TITLE
               SMALL
              MEDIUM
               LARGE
1-10
11-20
21-30
T003TABLE 3 TITLE
                BLUE
                 RED
              YELLOW
              ORANGE
A
B
C
D
E
F
G
H
T004TABLE 4 TITLE
               SMALL
              MEDIUM
               LARGE
A
B
C
D
E
F
G
H
END OF LABELS
```

Repeat Labels Specification

```
****SET1
                BLUE
                 RED
              YELLOW
              ORANGE
****SET2
1-10
11-20
21-30
****SET3
               SMALL
              MEDIUM
               LARGE
****SET4
A
B
C
D
E
F
G
H
********
T001TABLE 1 TITLE
    SET1
    SET2
T002TABLE 2 TITLE
    SET3
    SET2
T003TABLE 3 TITLE
    SET1
    SET4
T004TABLE 4 TITLE
    SET2
    SET4
END OF LABELS
```

END OF LABELS CARD

Columns	Contain	Explanation
1-13	ENDbOFbLABELS	A control word, signifying the end of the deck of table labels. Not used if the NO TABLE LABELS CARD was used.

5. Population Description Cards

The control cards described in this section contain all of the information that is relevant in describing a population as a whole. There must be one group of these cards for each population to be processed in a job. The arrangement of the individual cards in the group for one population is shown in figure 19.

The POPULATION TITLE CARD must always be the first card in the group. It simply contains a descriptive title for the population that will be printed at the top of every page of output for that population.

The DATA INPUT IDENTIFICATION CARD must always be the next card in the group. It contains the identification of the first sample (stratum) to be processed for the population, exactly as it is in the input data file. The identification is used to search the input file for the required sample summary tables. If there is more than one sample for a population, it is assumed that the input data for the additional samples follow immediately after the identified sample in the input file.

The EXPANSION FACTOR CARD is third in the group, and it too must always be included. In addition to the expansion factor by which the population mean is to be multiplied, it contains the number of samples to be processed for the population and the sum of the sample weights.

The POPULATION TABLE TOTALS CARD(S) is used only when processing option 6 is specified in columns 19-21 of the JOB CONTROL CARD. It contains the independent estimates of the population grand mean and grand variance for each one of the output tables. These cards must be ordered as are the equivalent sample summary tables in the input data file created in TABLE-2. Update tables are inserted, when appropriate, before the POPULATION TITLE CARD for the next population, if any.

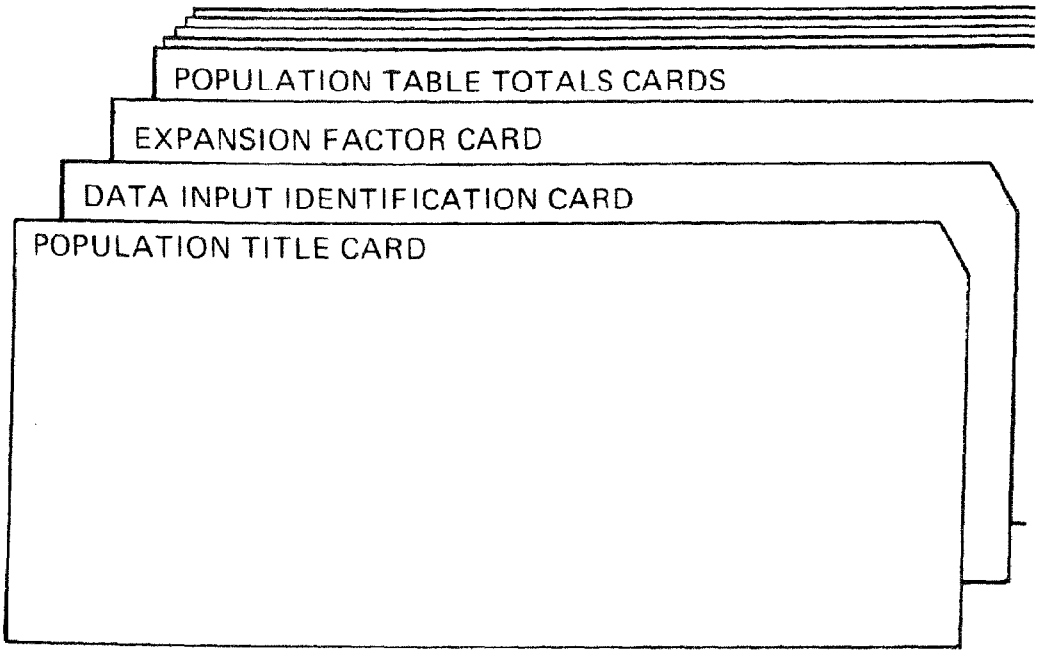

Figure 19.--Order of population description cards in the Job Control Deck. A set of cards like this must be available for ea population in a job using processing option 6. With oth processing options, the last set of cards is not used.

POPULATION TITLE CARD

Columns	Contain	Explanation
1-80	AAA...A	80 alphameric characters, giving a descriptive title for a population. This title is printed at the top of every page of output.

DATA INPUT IDENTIFICATION CARD

Columns	Contain	Explanation
1-11	INPUTbIDENT	Card label.
12	b	
13-20	XXX...X	8 numeric characters, giving the value of the data field appearing first under the data set identification given on the INPUT FIELDS IDENTIFICATION CARD in TABLE-2. The value given here is the initial value; that is, it is the value appearing with the first set of tables for the population.
21-52	XXX...X	Repetition of format of columns 13-20 or the initial values of the remaining data fields specified in the data set identification.

EXPANSION FACTOR CARD

Columns	Contain	Explanation
1-12	EXPANbFACTOR	Card label.
13	b	
14-28	bX.XXXXXXXXEbXX	A 15-character numeric field (E specification), giving the value of the expansion factor (normally the size of the population that has been sampled, such as area of a forest district) by which every cell of every output table for the population will be multiplied. This value is referred to by the symbol "wt" in the summary of estimating procedures.

29	b	
30-32	XXX	3 numeric characters, giving the number of sampling strata in the population. The number must be right-justified in the field. If the sampling option given in column 15 of the JOB CONTROL CARD is 1 or 2, this field must contain 1.
33	b	
34-48	bX.XXXXXXXXEbXX	A 15-character numeric field (E specification), giving the sum of the sample weights. If the sampling option given in column 15 of the JOB CONTROL CARD is 1 or 2, this value must be 0.00000000E 00. This value is referred to by the symbol "n" in the summary of estimating procedures.

POPULATION TABLE TOTALS CARD(S) (Optional)

This set of cards is used only when processing option 6 is specified in column 15 of the JOB CONTROL CARD.

Columns	Contain	Explanation
1-12	TABLEbTOTALS	Card label
13	b	
14-28	bX.XXXXXXXXEbXX	A 15-character numeric field (E specification), giving the mean value for a population of the grand total cell of an output table. This value is referred to by the symbol "t" in the summary of estimating procedures.
29	b	
30-44	bX.XXXXXXXXEbXX	A 15-character numeric field (E specification), giving the variance of the mean value in columns 14-28. This value is referred to by the symbol "vt..." in the summary of estimating procedures.

6. Sample Description Cards

The control cards described in this section appear in the Job Control Deck only if the information they contain--sample weights, and independent estimates of the sample means and variances of the grand total cell of each output table--is required by the processing option being used. If these cards are required, they must appear as a set following each set of population description cards. The arrangement of the individual cards in the group is shown in figure 20.

The SAMPLE WEIGHT CARD is not used when processing option 1 or 2 is specified in column 15 of the JOB CONTROL CARD. Otherwise, there must be one card of this type for each sample in a given population. Each card contains the weight by which sample values will be multiplied before summing to population values. It also contains a second weight that may be used when estimates for a segment of the population are being made. The order of these cards in the set must be the same as that of the sample summaries in the data input file.

The SAMPLE TABLE TOTALS CARD(S) is used only when processing option 5 is specified in column 15 of the JOB CONTROL CARD. It contains the independent estimates of sample (or stratum) mean and variance for one output table. There must be as many of these cards in the set for a sample as there are output tables, and they must be ordered in the set according to the order listed on the TABLE SELECTION CARD. The set for each sample immediately follows the corresponding SAMPLE WEIGHT CARD for that sample.

SAMPLE WEIGHT CARDS (Optional)

Columns	Contain	Explanation
1-12	STRATUMbWTS.	Card label.
13	b	
14-28	bX.XXXXXXXXEbXX	A 15-character numeric field (E specification), giving the value of the weight to be applied to the data for a sampling stratum. This value is referred to by the symbol "n_j" in the summary of estimating procedures.

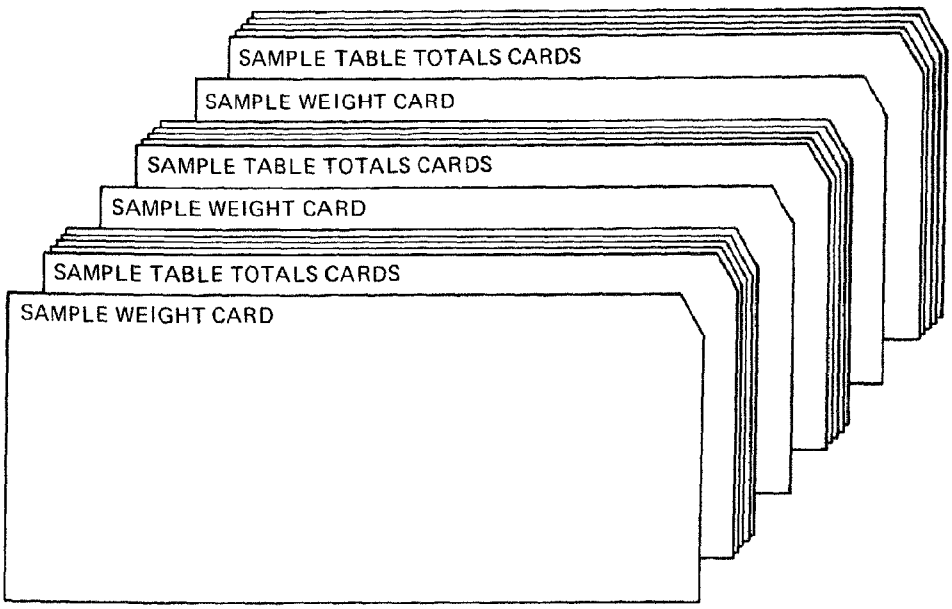

Figure 20.--Order of sample description cards in the Job Control Deck. The setup for a population with three samples, using processing option 5, is illustrated.

29	b	
30-44	bX.XXXXXXXXEbXX	A 15-character numeric field (E specification), giving the value of the adjustment factor to be applied to the variances for a sampling stratum when compiling estimates for a fraction of the population. This value is referred to by the symbol "n/n_j" in the summary of estimating procedures. If the value is 0.00000000Eb00, it indicates that estimates for the population as a whole are being compiled, so the adjustment factor will not be applied.

SAMPLE TABLE TOTALS CARDS (Optional)

Columns	Contain	Explanation
1-12	TABLEbTOTALS	Card label.
13	b	
14-28	bX.XXXXXXXXEbXX	A 15-character numeric field (E specification), giving the mean value for a sampling stratum of the grand total cell of an output table. This value is referred to by the symbol "$\bar{t}_j$" in the summary of estimating procedures.
29	b	
30-44	bX.XXXXXXXXEbXX	A 15-character numeric field (E specification), giving the variance of the mean value in columns 14-28. This value is referred to by the symbol "$v\bar{t}_j$" in the summary of estimating procedures.

UPDATE TABLE CARDS

If update tables have been punched using options 3 or 4 of the TABLE SELECTION CARD, they must be added to the control cards at this point if options 2 or 4 are specified.

7. Population Group Title Card

This card is used in the Job Control Deck only if sums over all populations in the job (see Job Control Card, column 13) are required as output. It gives a descriptive title for the group of populations represented by these sums. The title is printed at the top of every page of the "sums" output. If used, the card is placed in the Job Control Deck following all other control cards for a given job.

POPULATION GROUP TITLE CARD (Optional)

Columns	Contain	Explanation
1-80	AAA...A	80 alphameric characters, giving a descriptive title for the tables of sums over populations in the group.

END OF RUN CARD

Columns	Contain	Explanation
1-3	END	A control word, signifying the end of the Job Control Deck. This card must always be the last card in the Job Control Deck to show that there are no more jobs to be processed.

B. OUTPUT-2 OPERATION

The use of OUTPUT-2 to obtain population statistics by processing sample summary data is covered in the information given below. To facilitate checking the setup of processing runs, some of the information given is a resume of material covered elsewhere.

1. Program Restrictions

The program carries limitations on the overall size and on certain dimensions of processing problems that can be handled in a single processing run. They are:

a. The total number of summary tables for a given sample in the data input file cannot exceed 40.

b. The total number of storage locations available to produce output tables of statistics for a given population is 40,000. The limitations on the numbers of cells in all output tables for the population is more stringent and depends on the processing option being used. (See formula on page 62.)

c. The number of rows in an individual output table cannot exceed 201.

d. The number of columns in an individual output table cannot exceed 100.

e. The number of ratio tables cannot exceed 50.

f. The number of table label sets defined under the repeat labels specification of table labels cannot exceed 150.

These restrictions result primarily from the way in which the available storage capacity of the computer has been allocated to various uses in the program. However, the program has been constructed so that the more important of these allocations can readily be changed if a problem of substantially different relative dimensions is encountered.

2. Job Control Deck Setup

The Job Control Deck consists of all the punched cards through which processing specifications, necessary constants, and other data (exclusive of the data to be processed) are entered into the computer. These cards, and the logical groups into which they fall, have been described in the previous section. The assembly of the groups of control cards to form the Job Control Deck, as well as the placement of the Job Control Deck in the monitor input deck, are shown in figure 21.

It should be noted that the monitor input deck consists of the program deck, followed by the Job Control Deck, with system control cards interspersed. The latter cannot be described in detail here because they vary from one computer installation to another. For more information about them, see the systems representative at the computer center where the processing will be done.

3. Input Data Setup

The normal data input is a magnetic tape file written in the binary mode and containing all the tables of sample statistics to be processed in a given run. The tables will be grouped in known order (see the order of the OUTPUT TABLE DEFINITION CARDS in the Job Control Deck for TABLE-2) within each sample, and the samples will be grouped in known order (see the order of the data sets in the data input file to TABLE-2) within the population. Because the input data file is searched for the proper data each time a population is to be processed, the population data may be in any order and the file may also contain extraneous data which will be skipped in processing. However, all data to be processed must be contained in a single file. If it is in multiple files, it must be processed in multiple passes.

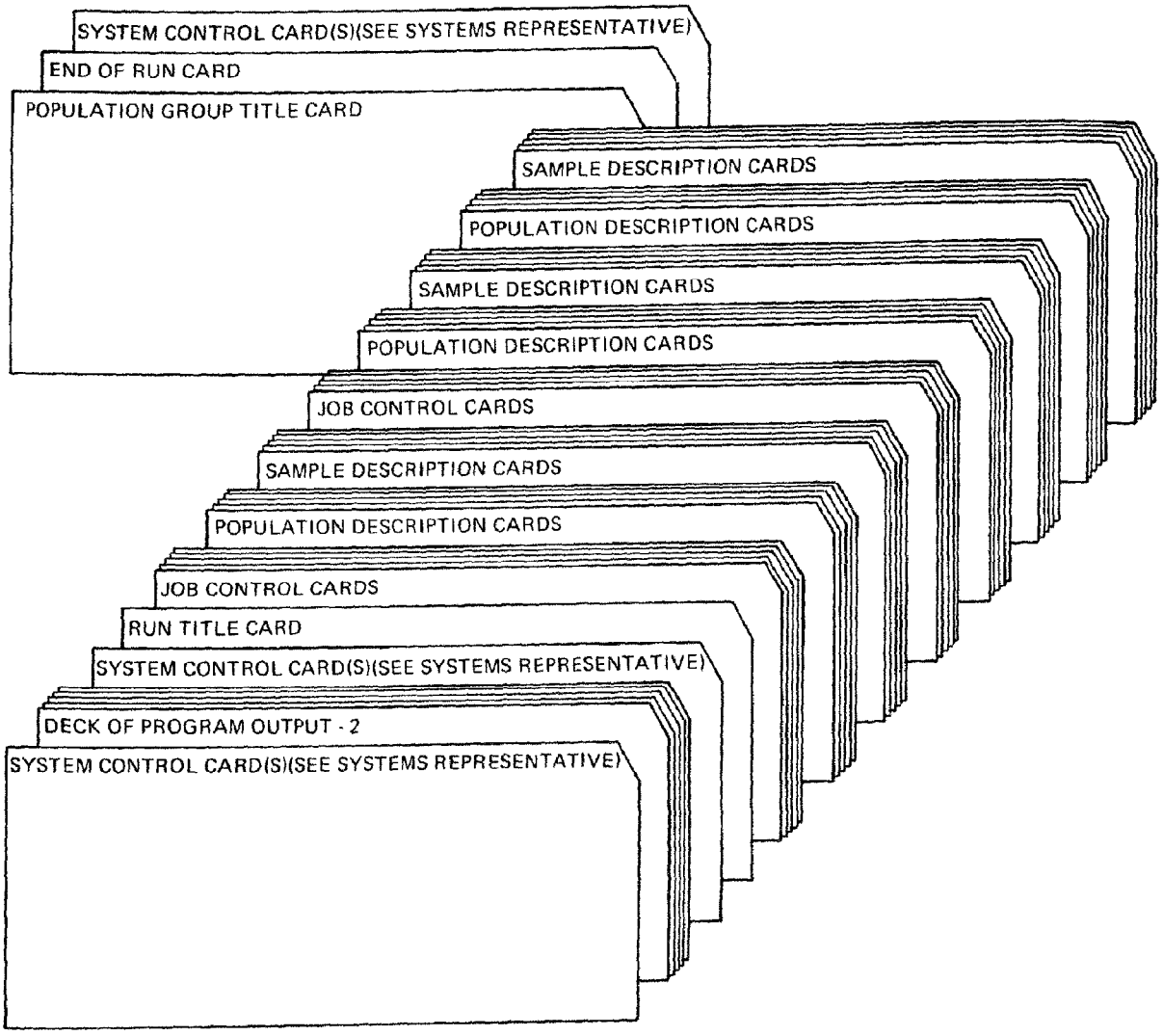

Figure 21.--The Job Control Deck setup, illustrating the kinds of cards that are necessary and the order in which they must be arranged. The example is for a run that contains two jobs, the first requiring statistics for one population, and the second requiring statistics for two populations and the sum of the two groups.

In addition to these requirements, the input data must have been produced in TABLE-2 under an output option that is consistent with the processing option to be used in OUTPUT-2. The necessary relationships are:

OUTPUT-2 processing option	TABLE-2 output option	Sample summary table contains
1	1 or 2	Sample sums or means.
2	3 or 5	Sample means and their variances.
3	3 or 5	Sample means and their variances.
4	3 or 5	Sample means and their variances
5	4	Sample means, their variances, and covariances of individual means with grand means within the table.
6	4	Sample means their variances, and covariances of individual means with grand means within the table.

4. Messages Printed During Execution

The messages listed below are those printed by the program during execution.

Other messages also may appear in the printed summary of the run. They will be produced by the operating system under which this program is being executed. For the meaning and consequences of any message not found in the list below, see your computer systems representative.

MAIN Messages

1. THE JOB CONTROL CARD IS INCORRECT.

The message prints if JOB is not punched in the first three columns of the card or if any of the coded options are incorrect.

2. THE TABLE SELECT CARD IS INCORRECT.

The first six columns of the card must contain the word, TABLES.

3. THE TABLE SCALE FACTOR CARD IS INCORRECT.

The first six columns of the card must contain the word, SCALES.

4. AN INPUT IDENTIFICATION CARD IS INCORRECT.

The first 12 columns of the card must contain the words, INPUT IDENT.

5. AN EXPANSION FACTOR CARD IS INCORRECT.

The first 12 columns of the card must contain the words, EXPAN FACTOR, and the value of the expansion factor must be greater than zero.

6. A POPULATION TABLE TOTALS CARD IS INCORRECT.

The first 12 columns of the card must contain the words, TABLE TOTALS. This card is needed when using sampling option 4.

7. A STRATUM WEIGHTS CARD IS INCORRECT.

The first 12 columns of the card must contain the words, STRATUM WTS.

8. A STRATUM TABLE TOTALS CARD IS INCORRECT.

The first 12 columns of the card must contain the words, TABLE TOTALS. This card is needed when using sampling option 5.

SUBR2 Message

9. DIMENSIONED SPACE OF XXXXXX HAS BEEN EXCEEDED. INCREASE THE DIMENSION OF ARRAY XIMP TO XXXXXX OR REDUCE THE SIZE AND/OR NUMBER OF TABLES.

The total storage requirement needed to produce the desired output table set has exceeded the dimensioned value.

SUBR5 Message

10. . THE TABLE NAMED AAAA HAS ITS LABELS MISSING OR OUT OF ORDER.

The table name on the TABLE TITLE CARD does not correspond with a table name on the input file. The table is missing from the deck or has been bypassed when searching for previous tables.

SUBR8 Messages

11. RATIO TABLES END CARD MISSING - OR - ATTEMPT TO DEFINE MORE THAN XXX RATIO TABLES. INCREASE DIMENSION LRMAX IF NECESSARY

The RATIO TABLE DEFINITION CARDS must be terminated by an END OF RATIO TABLES CARD.

12. TABLE NAMED AAAA CANNOT BE FOUND FOR RATIO TABLE. AAAA=AAAA/AAAA.

The dividend or divisor table name is mispunched or the table was not selected on the TABLE SELECT CARD.

13. TABLES AAAA AND AAAA DO NOT HAVE THE SAME DIMENSIONS TO COMPUTE RATIO TABLE AAAA=AAAA/AAAA.

The dividend and divisor tables must have the same number of rows and columns.

LABELS Messages

14. SUBROUTINE LABELS CAN ONLY HANDLE XXXX TABLE LABEL SETS.

Variable MAXSET in SUBROUTINE LABELS must be increased.

15. THE NAME AAAA HAS ALREADY BEEN USED FOR SET NUMBER XXXX.

Each table label set must have a unique name.

16. NOT ENOUGH ROOM TO STORE TABLE LABEL SET NUMBER XXXX NAME=AAAA.

Increase dimension LTOTAL or reduce the number of label sets.

17. TABLE LABEL SET AAAA HAS NOT BEEN DEFINED.

A TABLE LABEL SET REFERENCE CARD named a set that was not defined by any TABLE LABEL SET DEFINITION CARD.

C. OUTPUT-2 MODIFICATION OF DIMENSIONED SPACE

OUTPUT-2 carries restrictions on both the dimensions and the overall size of problem that can be handled in a single-processing run. These restrictions are a result of the manner in which dimensioned space has been allocated (table 2) and the total space available in a given operating system. The program has been written so that all modifications of dimensioned space can be made in the main program called OUTPUT. No other parts of the program need be touched for this purpose. The use of dimensioned space and the means of changing dimensions are discussed in detail in the following section.

Table 2.--*Summary of dimensioned space restrictions, and associated program variables and arrays*

Item	Restriction	Variable	Arrays
Maximum number of input tables	40	LOUT	LTABLE, ITAB, TOTAL, TOTVAR, LENGTH
Maximum number of locations available for compilation of output tables	40,000	LTOTAL	XIMP
Maximum number of rows per table	201	NRMAX	RHEAD, LEXTRA
Maximum number of columns per table	101	NCMAX	CHEAD
Maximum number of ratio tables	50	LRMAX	LRATIO
Maximum number of label sets	150	MAXSET (Used only in subroutine LABELS)	Not applicable

1. Number of Input Tables

In OUTPUT-2, up to 40 input tables per data set may be contained in the input data. This is consistent with the number that may be specified in the Job Control Deck for TABLE-2. To change this maximum, the following steps (and only these) must be taken:

a. In the program called OUTPUT, the variable named LOUT must be set equal to the desired maximum value.

b. In the program called OUTPUT, the DIMENSION statement must be changed so that the first dimension of the array ITAB equals the new value of LOUT.

c. In the program called OUTPUT, the DIMENSION statement must be changed so that the dimension of the arrays LTABLE, LSUB2, LSCALE, ITAB, TOTAL, and TOTVAR equals the new value of LOUT.

2. Number of Cells in All Output Tables

In the OUTPUT-2 up to 40,000 locations are available for compiling output tables. To change this maximum, the following steps (and only these) must be taken:

a. In the program called OUTPUT, the variable named LTOTAL must be set equal to the desired maximum value.

b. In the program called OUTPUT, the DIMENSION statement must be changed so that the dimension of the array XIMP equals the new value of LTOTAL.

If the space required for compilation of the output tables specified in the output table selection card exceeds the dimensioned space, a message will be printed during the reading of the Job Control Deck and processing will halt. The space required can be computed as follows:

$$K \sum_{i=1}^{n} r_i c_i + M$$

where M = 0 for options 1,3,4,5,6
M = maximum $(r_i c_i)$ for option 2

Sampling option	Values of K			
	Totals only, No sums	Totals only, Sums	Totals+,[1] No sums	Totals+,[1] Sums
1	2	3	2	3
2	1	2	2	4
3	2	3	4	6
4	2	3	4	6
5	2	3	6	8
6	2	3	6	8

[1]Totals+ meaning that variances or standard error tables also are called for.

n = The total number of output tables requested in the output table selection card.

r_i = The number of rows in the ith output table, including a row of column totals if produced.

c_i = The number of columns in the ith output table, including a column of row totals if produced.

D. OUTPUT-2 PROGRAMING FEATURES

1. File Assignments

Unit	Use
LU1 = 1	File for output of final tables in BCD (LU1 = 10 for Fort Collins version)
LU2 = 2	File for binary input from program TABLE
LU3 = 3	Scratch file for temporary storage of table titles and labels
LU5 = 5	Monitor card reader
LU6 = 6	Monitor line printer
LU7 = 7	Monitor card punch for punching update tables

These logical unit assignments can be changed to fit local conditions by changing the assignments in the main calling program titled OUTPUT.

2. Subprogram Names and Functions

Name	Function
OUTPUT	The main program of the OUTPUT-2.
MAIN	Reads Job Control Decks and calls other subprograms used to compile final output tables. Called from OUTPUT.
SUBR1	Reads a set of stratum tables from unit LU2. Called from MAIN.
SUBR2	Computes storage addresses in array XIMP for all tables and stores the addresses in ITAB and stores number of cells in each table in array LSUB2. Called from MAIN.
SUBR3	Stores the stratum tables in array XIMP. Called from MAIN.
SUBR4	Computes final values for population tables and sums over populations. Called from MAIN.

SUBR5	Reads table titles and labels from unit LU3. Called from MAIN.
SUBR6	Writes the final output tables. Called from MAIN and SUBR8.
SUBR7	Calculates standard errors as percentages of corresponding totals. Called from MAIN.
SUBR8	Reads, decodes, and computes ratio tables. Called from MAIN and SUBR2.
LABELS	Reads the table labels from unit LU5 and writes them on unit LU3. Called from MAIN.
COMMAS	Composes and writes COMMA format output table entries. Called from SUBR6.

3. Important Arrays and Variables

Array	Dimension	Description
LTOTAL	1	The number of storage locations reserved for storage of output tables.
XIMP	LTOTAL	Storage for all output tables.
LOUT	1	The maximum number of input tables for a sampling unit.
LTABLE	LOUT	Storage for information read from the TABLE SELECTION CARD in the Job Control Deck.
LSUB2 (LENGTH in SUB2)	LOUT	A storage array to store the number of cells (rows by columns including subtotals) in each output table.
LSCALE	LOUT	Storage for table scale factors read from the TABLE SCALE FACTOR CARD(S) in the Job Control Deck.
TOTAL	LOUT	Storage for estimates of table totals supplied in the Job Control Deck.
TOTVAR	LOUT	Storage for estimates of variances of table totals (supplied in the Job Control Deck).

ITAB	LOUT,13	Indexing information for array XIMP, where the second dimension locations are used as follows: 1 = The number of rows in the ith input table. 2 = The number of columns in the ith input table. 3 = The name of the ith input table. 4 = The beginning location in XIMP of the means for the ith input table. 5 = The beginning location in XIMP of the variances for the ith input table. 6 = The beginning location in XIMP of the covariances for the ith input table. 7 = The beginning location in XIMP of the temporary storage for the calculation of final means for the ith input table. 8 = The beginning location in XIMP of the temporary storage for the calculation of final variances for the ith input table. 9 = The beginning location in XIMP of the temporary storage for the calculation of final covariances for the ith input table. 10 = The beginning location in XIMP of the population group sums for the ith input table. 11 = The beginning location in XIMP of the population group variances for the ith input table. 12 = The location in the XIMP temporary storage for calculation of the total for the ith input table. 13 = The location in the XIMP temporary storage for calculation of the variance of the total for the ith input table.
LRATIO	LRMAX,5	1 = Ratio table name 2 = Dividend table name 3 = Divisor table name 4 = Dividend table number 5 = Divisor table number
IDENT	6	Storage for data set identification fields read from the Job Control Deck.
IDNOW	6	Storage for data set identification fields read from binary input tape.

CHEAD	NCMAX,5	Storage array for the column headings of an output table. Space is provided for a heading of five alphameric words (second dimension) for a total of 20 characters for each of up to 101 columns, including row totals (if row totals were produced in TABLE-2).
RHEAD	NRMAX,5	Storage array for the row headings of an output table. Space is provided for a heading of five alphameric words (second dimension) for a total of 20 characters for each of up to 101 rows, including column totals (if column totals were produced in TABLE-2).
LEXTRA	NRMAX	Working storage for row label line skip control.
TITLE	20	Working storage for titles of populations, population groups, and tables.
TAB	39	Working storage for table titles.
ST	20	Working storage for description of type of table produced (totals, variances, etc.).
ISUPRS	80	Storage for population suppression read from the Job Control Deck.
XHTOT	4	Estimated totals heading text.
XHVAR	8	Variance heading text.
XHSE	7	Standard errors heading text.
XHSEP	16	Standard errors as percentages heading text.
X	5	Working storage for update tables.
NTABLE	1	Number of tables read from data input for a data set (NTABLE $\leq$ LOUT).
WT	1	Stratum weight, read from Job Control Deck.

SUMWTS	1	Sum of stratum weights for a population, read from Job Control Deck.
FACTOR	1	Population expansion factor, read from Job Control Deck.
NSTRAT	1	Number of strata to be processed for a population, read from Job Control Deck.
ADJUST	1	Adjustment factor for a stratum, read from Job Control Deck.
NOPT	1	Sampling option ($1 \leq NOPT \leq 6$).
NLIST	1	Job Control Deck listing option. 0 = No listing. 1 = Entire Job Control Deck. 2 = Job Control Deck with exception of table titles and row and column labels.
NJOB	1	Number of populations to be processed in the current job.
NOUT	1	Output option for final tables. 0 = Tape output. 1 = Printer output.
NSUM	1	Option for population group sums. 0 = No sums. 1 = Produce sums for population groups. 2 = Suppress all populations. 3 = Read population suppression control card.
IFMT	1	Output format option. 0 = E format. 1 = F format. 2 = Commas format.
NTOT	1	Option for output of totals. 0 = No output of totals. 1 = Produce tables of totals.
NVAR	1	Option for output of variances. 0 = No output of variances. 1 = Produce tables of variances.

NSE	1	Option for output for standard errors. 0 = No output of standard errors. 1 = Produce tables of standard errors.
NSEP	1	Option for output of standard errors as percentages. 0 = No output of standard errors as percentages. 1 = Produce tables of standard errors as percentages.
NOSE	1	Number of standard errors at which percentages are to be expressed.
NTLE	1	Number of title cards for each table. 0, 1 = 1 TABLE TITLE CARD. 2 = 2 TABLE TITLE CARD.
MTLE	1	Option to print table name. 0 = Do not print table name. 1 = Print table name.
NSCL	1	Option for TABLE SCALE FACTOR CARD. 0 = No TABLE SCALE FACTOR CARD(S). 1 = Read TABLE SCALE FACTOR CARD(S).
NRSP	1	Option for row spacing. 0, 1 = Single space. 2 = Double space.
IDIV	1	Option for ratio tables. 0 = No ratio tables. 1 = Read the list of ratio tables.
NDIVS	1	Counter for number of ratio tables.
NAME	1	Name of an output table punched in columns 1-4 of TABLE TITLE CARD.

E. OUTPUT-2 SUMMARY OF ESTIMATING PROCEDURES

In this section the six processing options available in program OUTPUT are presented in detail.

Vector notation is used to make the presentation of computing procedures more compact and easier to read. An input vector, Y^{I}, is a one-dimensional array representing a sampling unit attribute. An output vector, Y^{O}, represents an output table (in general, a two-dimensional array or matrix) summarizing the sampling unit attribute. A final output vector, Y^{F}, represents an estimate of the population attribute corresponding to the sampling unit attribute. Elements of these vectors are represented by y_{i}^{I}, y_{i}^{O}, or y_{i}^{F}.

It must not be inferred from what follows that the arithmetic is the arithmetic of vectors or matrices; though, in general, it is correct vector arithmetic as shown. What is implied is simply the sequential and independent application of the indicated operation to each pair of equivalent elements from the two vectors. In this sense, the procedures will generalize to the case of matrices; otherwise, they will not.

Other notational conventions adopted here are the use of a bar over an attribute symbol ($\overline{Y}$) to symbolize the arithmetic mean of an attribute; and the use of a dot replacing a subscript ($Y_{\cdot jk}$) to indicate the sum over all members of the set represented by the subscript.

OPTION 1.--Process as a 100-percent Sample of the Population

Compute: $Y_{\cdot\cdot}^{F}$

Given: Sets of $Y_{j\cdot}^{O}$; and ns

Where:

j = Subscript for the jth set of sampling units

k = Subscript for the kth sampling unit

$Y_{\cdot\cdot}^{F}$ = A final attribute vector (output table) for a survey unit, containing the sum over the entire population of sampling units of the sampling unit attribute vectors, Y_{jk}^{O}

$Y^{0}_{j\cdot}$ = An attribute vector (output table) that contains the sum over a set of sampling units of the sampling unit attribute vectors, Y^{0}_{jk}, which represent a summary of a sampling unit attribute input vector

ns = The number of sets of sampling units

Procedure: None.

Output:

$$Y^{F}_{..} = \sum_{j=1}^{ns} Y^{0}_{j\cdot}$$

OPTION 2.--Process as a Single Random Sample of the Population

Compute: $Y^{F}_{..}$, $VY^{F}_{..}$, $STY^{F}_{..}$, and $SEY^{F}_{..}$,

Given: $\overline{Y}^{0}_{..}$, $V\overline{Y}^{0}_{..}$, and wt

Where:

j = Subscript for the jth sample stratum or set of sampling units; hence, not applicable in this case of a single set in the survey unit

k = Subscript for the kth sampling unit

$Y^{F}_{..}$ = A final attribute vector (output table) for a survey unit, containing an estimate of the sum over the entire population of sampling units of the sampling unit attribute vectors, Y^{0}_{jk}

$VY^{F}_{..}$ = The variance of $Y^{F}_{..}$

$STY^{F}_{..}$ = The standard error of $Y^{F}_{..}$

$SEY^{F}_{..}$ = The sampling error (in percent) of $Y^{F}_{..}$

$\overline{Y}^{0}_{..}$ = An attribute vector (output table) that contains the arithmetic mean of the sampling unit attribute vectors, Y^{0}_{jk}, which represent a summary of a sampling unit attribute input vector

$\overset{0}{V\overline{Y}}..$ = The variance of $\overset{0}{\overline{Y}}..$

wt = The total number of sampling units in a survey unit population

Output:

$$\overset{F}{Y}.. = \overset{0}{\overline{Y}}..\ wt$$

$$\overset{F}{VY}.. = \overset{0}{V\overline{Y}}..\ wt^2$$

$$\overset{F}{STY}.. = \sqrt{\overset{F}{VY}..}$$

$$\overset{F}{SEY}.. = \frac{\overset{F}{STY}..}{\overset{F}{Y}..}\ 100$$

OPTION 3.--Process as Random Samples from Known Population Strata

Compute: $\overset{F}{Y}..$, $\overset{F}{VY}..$, $\overset{F}{STY}..$, and $\overset{F}{SEY}..$

Given: Sets of $\overset{0}{\overline{Y}}_{j\cdot}$, $\overset{0}{V\overline{Y}}_{j\cdot}$, n_j; and ns, wt

Where:

j = Subscript for the jth sample stratum or set of sampling units

k = Subscript for the kth sampling unit

$\overset{F}{Y}..$ = A final attribute vector (output table) for a survey unit, containing an estimate of the sum over the entire population of sampling units of the sampling unit attribute vectors, $\overset{0}{Y}_{jk}$

$\overset{F}{VY}.$ = The variance of $\overset{F}{Y}..$

$\overset{F}{STY}..$ = The standard error of $\overset{F}{Y}..$

$\overset{F}{SEY}..$ = The sampling error (in percent) of $\overset{F}{Y}..$

$\overset{0}{\overline{Y}}_{j\cdot}$ = An attribute vector (output table) that contains the arithmetic mean for a stratum of the sampling unit attribute vectors, $\overset{0}{Y}_{jk}$, which represent a summary of a sampling unit attribute input vector

$\overset{0}{V\overline{Y}}_{j\cdot}$ = The variance of $\overset{0}{\overline{Y}}_{j\cdot}$

n_j = The known size of stratum or weight to be applied to the stratum

ns = The number of sample strata in a survey unit

wt = The total number of sampling units in a survey unit population

Procedure:

$$\overset{F}{\overline{Y}}_{..} = \frac{1}{n_{\cdot}} \sum_{j=1}^{ns} n_j \overset{0}{\overline{Y}}_{j\cdot}$$

$$\overset{F}{V\overline{Y}}_{..} = \frac{1}{n_{\cdot}^2} \sum_{j=1}^{ns} n^2_j \overset{0}{V\overline{Y}}_{j\cdot}$$

Output:

$$\overset{F}{Y}_{..} = \overset{F}{\overline{Y}}_{..}\ wt \qquad \overset{F}{VY}_{..} = \overset{F}{V\overline{Y}}_{..}\ wt^2$$

$$\overset{F}{STY}_{..} = \sqrt{\overset{F}{VY}_{..}} \qquad \overset{F}{SEY}_{..} = \frac{\overset{F}{STY}_{..}}{\overset{F}{Y}_{..}} 100$$

OPTION 4.--Process as Random Samples from Population Strata Estimated from a Primary Random Sample

Compute: $\overset{F}{Y}_{..}$, $\overset{F}{VY}_{..}$, $\overset{F}{STY}_{..}$, and $\overset{F}{SEY}_{..}$

(Note: Procedure assumes that samples are <u>not</u> a subset of the primary sample. If samples are a subset, the value of $\overset{F}{V\overline{Y}}$ will be slightly higher than the variance would be from a modified formula.)

Given: Sets of $\overset{0}{\overline{Y}}_{j\cdot}$, $\overset{0}{V\overline{Y}}_{j\cdot}$, n_j; and ns, wt

Where:

j = Subscript for the jth sample stratum or set of sampling units

k = Subscript for the kth sampling unit

$\overset{F}{Y}..$ = A final attribute vector (output table) for a survey unit, containing an estimate of the sum over the entire population of sampling units of the sampling unit attribute vectors, $\overset{0}{Y}_{jk}$

$\overset{F}{VY}..$ = The variance of $\overset{F}{Y}..$

$\overset{F}{STY}..$ = The standard error of $\overset{F}{Y}..$

$\overset{F}{SEY}..$ = The sampling error (in percent) of $\overset{F}{Y}..$

$\overset{0}{\overline{Y}}_{j}.$ = An attribute vector (output table) that contains the arithmetic mean for a stratum of the sampling unit attribute vectors, $\overset{0}{Y}_{jk}$, which represent a summary of a sampling unit attribute input vector.

$\overset{0}{V\overline{Y}}_{j}.$ = The variance of $\overset{0}{\overline{Y}}_{j}.$

n_j = The number of sampling units in the first (photo) sample of a sample stratum

ns = The number of sample strata in a survey unit

wt = The total number of sampling units in a survey unit population

Procedure:

$$\overset{F}{\overline{Y}}.. = \frac{1}{n.} \sum_{j=1}^{ns} n_j \overset{0}{\overline{Y}}_{j}.$$

$$\overset{F}{V\overline{Y}}.. = \left[\frac{1}{n.^2 - n.} \sum_{j=1}^{ns} [(n^2_j - n_j) \overset{0}{V\overline{Y}}_{j}. + n_j \overset{0}{\overline{Y^2}}_{j}.]\right] - \left[\frac{1.0}{n. - 1} \overset{F}{\overline{Y^2}}..\right]$$

Output:

$$\overset{F}{Y}.. = \overset{F}{\overline{Y}}.. \; wt$$

$$\overset{F}{VY}.. = \overset{F}{V\overline{Y}}.. \; wt^2$$

$$\overset{F}{STY}.. = \sqrt{\overset{F}{VY}..}$$

$$\overset{F}{SEY}.. = \frac{\overset{F}{STY}..}{\overset{F}{Y}..} 100$$

OPTION 5.--OPTION 4 Modified to Obtain Stratum Ratios for Application to Independent Estimates of Stratum Means and Variances

Compute: $\overset{F}{Y}..$, $\overset{F}{VY}..$, $\overset{F}{STY}..$, and $\overset{F}{SEY}..$

Given: Sets of $\overset{0}{\overline{Y}}_{j\cdot}$, $\overset{0}{V\overline{Y}}_{j\cdot}$, $\overset{0}{C\overline{V}}_{j\cdot}$, $\overline{t}_{\cdot j\cdot}$, $v\overline{t}_{\cdot j\cdot}$, n_j; and ns, wt

Where:

i = Subscript for the ith element of a vector

j = Subscript for the jth sample stratum or set of sampling units

k = Subscript for the kth sampling unit

$\overset{F}{Y}..$ = A final attribute vector (output table) for a survey unit, containing an estimate of the sum over the entire population of sampling units of the sampling unit attribute vectors $\overset{0}{Y}_{jk}$

$\overset{F}{VY}..$ = The variance of $\overset{F}{Y}..$

$\overset{F}{STY}..$ = The standard error of $\overset{F}{Y}..$

$\overset{F}{SEY}..$ = The sampling error (in percent) of $\overset{F}{Y}..$

$\overset{0}{\overline{Y}}_{j\cdot}$ = An attribute vector (output table) that contains the arithmetic mean for a stratum of the sampling unit attribute vectors, $\overset{0}{Y}_{jk}$, which represent a summary of a sampling unit attribute input vector.

$\overset{0}{V\overline{Y}}_{j\cdot}$ = The variance of $\overset{0}{\overline{Y}}_{j\cdot}$

$\overset{0}{C\bar{V}}_{j\cdot}$ = The mean covariance for a stratum of sampling unit attribute vectors, $\overset{0}{Y}_{jk}$, and the sums (totals) of elements in these vectors, $\overset{0}{y}_{\cdot jk}$

$\bar{t}_{\cdot j\cdot}$ = An independent estimate of $\overset{0}{y}_{\cdot j\cdot}$, the arithmetic mean over the entire population of sampling units in a sample stratum, of the sums of the elements of the sampling unit attribute vectors, $\overset{0}{Y}_{jk}$

$v\bar{t}_{\cdot j\cdot}$ = The variance of $t_{\cdot j\cdot}$

n_j = The number of sampling units in the first (photo) sample of a sample stratum

ns = The number of sample strata in a survey unit population

wt = The total number of sampling units in a survey unit population

Procedure:

$$R_{j\cdot} = \frac{\overset{0}{\bar{Y}}_{j\cdot}}{\overset{0}{\bar{y}}_{\cdot j\cdot}} \; ; \quad \overset{F}{\bar{Y}}_{j\cdot} = R_{j\cdot}\, \bar{t}_{\cdot j\cdot} ; \quad \overset{F}{\bar{Y}}_{\cdot\cdot} = \frac{1}{n_\cdot} \sum_{j=1}^{ns} n_j \overset{F}{\bar{Y}}_{j\cdot}$$

$$VR_{j\cdot} = R^2_{j\cdot} \left[\frac{\overset{0}{V\bar{Y}}_{j\cdot}}{\overset{0}{\bar{Y}^2}_{j\cdot}} + \frac{\overset{0}{v\bar{y}}_{\cdot j\cdot}}{\overset{0}{\bar{y}^2}_{\cdot j\cdot}} - 2 \frac{\overset{0}{C\bar{V}}_{j\cdot}}{\overset{0}{\bar{Y}}_{j\cdot}\, \overset{0}{\bar{y}}_{\cdot j\cdot}} \right]$$

$$\overset{F}{V\bar{Y}}_{j\cdot} = \overset{F}{\bar{Y}^2}_{j\cdot} \left[\frac{VR_{j\cdot}}{R^2_{j\cdot}} + \frac{v\bar{t}_{\cdot j\cdot}}{\bar{t}^2_{j}} \right]$$

$$\overset{F}{V\bar{Y}}_{\cdot\cdot} = \left[\frac{1}{n^2_\cdot - n_\cdot} \sum_{j=1}^{ns} \left[(n^2_j - n_j)\, \overset{F}{V\bar{Y}}_{j} + n_j \overset{F}{\bar{Y}^2}_{j\cdot} \right] \right] - \left[\frac{1.0}{n_\cdot - 1} \overset{F}{\bar{Y}^2}_{\cdot\cdot} \right]$$

Output: $\overset{F}{Y}.. = \overset{F}{\overline{Y}}.. \; wt$

$$\overset{F}{VY}.. = \overset{F}{V\overline{Y}}.. \; wt^2$$

$$\overset{F}{STY}.. = \sqrt{\overset{F}{VY}..}$$

$$\overset{F}{SEY}.. = \frac{\overset{F}{STY}..}{\overset{F}{Y}..} \; 100$$

OPTION 6.--OPTION 4 Modified to Obtain Population Ratios for Application to Independent Estimates of Population and Variances

Compute: $\overset{F}{Y}..$, $\overset{F}{VY}..$, $\overset{F}{STY}..$, and $\overset{F}{SEY}..$

Given: Sets of $\overset{0}{\overline{Y}}_{j\cdot}$, $\overset{0}{V\overline{Y}}_{j\cdot}$, $\overset{0}{C\overline{V}}_{j\cdot}$, n_j; and $\overline{t}..$, $v\overline{t}..$, ns, wt

Where:

i = Subscript for the ith element of a vector

j = Subscript for the jth sample stratum or set of sampling units

k = Subscript for the kth sampling unit

$\overset{F}{Y}..$ = A final attribute vector (output table) for a survey unit, containing an estimate of the sum over the entire population of sampling units of the sampling unit attribute vectors, $\overset{0}{Y}_{jk}$

$\overset{F}{VY}..$ = The variance of $\overset{F}{Y}..$

$\overset{F}{STY}..$ = The standard error of $\overset{F}{Y}..$

$\overset{F}{SEY}..$ = The sampling error (in percent) of $\overset{F}{Y}..$

$\overset{0}{\overline{Y}}_{j\cdot}$ = An attribute vector (output table) that contains the arithmetic mean for a stratum of the sampling unit attribute vectors, $\overset{0}{Y}_{jk}$, which represent a summary of a sampling unit attribute input vector

$V\overline{Y}^{0}_{j\cdot}$ = The variance of $\overline{Y}^{0}_{j\cdot}$

$C\overline{V}^{0}_{j\cdot}$ = The mean covariance for a stratum of sampling unit attribute vectors, Y^{0}_{jk}, and the sums (totals) of elements in these vectors, $y^{0}_{\cdot jk}$

n_j = The number of sampling units in the first (photo) sample of a sample stratum

$\overline{t}...$ = An independent estimate of $\overline{y}^{F}...$, the arithmetic mean over the entire population of sampling units, of the sums of the elements of the sampling unit attribute vectors, Y^{0}_{jk}

$v\overline{t}...$ = The variance of $\overline{t}...$

ns = The number of sample strata in a survey unit

wt = The total number of sampling units in a survey unit population

Procedure:
$$\overline{Y}^{F}.. = \frac{1}{n.} \sum_{j=1}^{ns} n_j \overline{Y}^{0}_{j\cdot}; \quad R. = \frac{\overline{Y}^{F}..}{\overline{y}^{F}...}$$

$$V\overline{Y}^{F}.. = \left[\frac{1}{n^2. - n.} \sum_{j=1}^{ns} [(n^2_j - n_j)\, V\overline{Y}^{0}_{j\cdot} + n_j\, \overline{Y^2}^{0}_{j\cdot}]\right] - \left[\frac{1.0}{n. - 1}\ \overline{Y^2}^{F}..\right]$$

$$\overset{F}{C\overline{V}}.. = \left[\frac{1}{n^2. - n.} \sum_{j=1}^{ns} [(n^2_j - n_j)\ \overset{0}{C\overline{V}}_{j.} + n_j\ \overset{0}{\overline{Y}}_{j.}\ \overset{0}{\overline{y}}_{.j.}] \right] -$$

$$\left[\frac{1.0}{n. - 1}\ \overset{F}{\overline{Y}}..\overset{F}{\overline{y}}... \right]$$

$$VR. = R^2. \left[\frac{\overset{F}{V\overline{Y}}..}{\overset{F}{\overline{Y}^2}..} + \frac{\overset{F}{v\overline{y}}...}{\overset{F}{\overline{y}^2}...} - 2\ \frac{\overset{F}{C\overline{V}}..}{\overset{F}{\overline{Y}}..\overset{F}{\overline{y}}...} \right]$$

$$\overset{F}{\overline{Y}}.. = R.\ \overline{t}...$$

$$\overset{F}{V\overline{Y}}.. = \overset{F}{\overline{Y}^2}..\ \left[\frac{VR.}{R^2.} + \frac{v\overline{t}...}{\overline{t}^2...} \right]$$

Output:

$$\overset{F}{Y}.. = \overset{F}{\overline{Y}}..\ wt$$

$$\overset{F}{VY}.. = \overset{F}{V\overline{Y}}..\ wt^2$$

$$\overset{F}{STY}.. = \sqrt{\overset{F}{VY}..}$$

$$\overset{F}{SEY}.. = \frac{\overset{F}{STY}..}{\overset{F}{Y}..}\ 100$$

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Describes a computer software package for use in developing statistical tables from a resource inventory data set. The flexibility of the system in performing user-designated table-making functions also is described. Full instructions for operating the system are included.

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Keywords: Data processing; tables; forest inventory

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