MULTIPLE FRAME LIVESTOCK SURVEYS

AN EVALUATION OF ALTERNATIVE METHODS

OF OVERLAP DETERMINATION

Frederic A. Vogel
Raymond R. Bosecker
Dwight A. Rockwell

Sample Survey Research Branch
Research Division
Statistical Reporting Service
U.S. Department of Agriculture
Washington, D.C.

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INTRODUCTION

Multiple frame sampling methodology is a powerful sampling tool used as the basis for nearly all major probability surveys conducted by SRS. The theory involved in multiple frame sampling is fairly simple and straightforward. However, the execution of a multiple frame survey is very difficult. Multiple frame surveys are subject to all operational problems that plague single frame surveys; however by their very design, problems unique to multiple frame surveys also occur. These problems arise from the basic assumptions involved in multiple frame sampling:

a. Every element of the survey population must be included in at least one of the frames.
b. It must be possible to determine for every selected sample unit whether or not it belongs to any other sample frame, i.e., the overlap between frames must be determined.

The first assumption is satisfied by using the area sampling frame. The latter assumption leads to one of the most critical aspects of a multiple frame survey. Sometime during the survey process it is necessary to determine for each sample unit whether it could have been selected from another frame also being used. Since the area frame is conceptually a complete frame, the overlap between the two frames is identified by determining whether each farm operation found in the area frame sample could also have been selected from the list frame. The need to determine the overlap between the sample frames affects many of the survey procedures.

The purpose of this study was to evaluate some of these survey procedures to determine if they are adequate to handle problems encountered and to identify possible improvements.

MULTIPLE FRAME SURVEY CONCEPTS

It is important that one has a good understanding of the basic concepts involved before attempting to evaluate survey procedures. Therefore, a discussion of the concepts precedes the examination of the survey procedures.

A multiple frame survey is one relying on the joint use of more than one sample frame. Since it allows the joint use of more than one sample frame, it allows sampling procedures that rely on the most efficient aspects of each frame. To illustrate, consider the two sampling frames used by SRS - the area frame and the list frame.

The area frame is the complete frame or the 100 percent frame. Every farm operator via a sampling unit or segment of land has a chance to be selected from this frame. The frame is generally stratified by land use. Beyond that the only efficient means to improve sampling precision is to increase the sample size. This frame is usually to be completed by personal enumeration.

The list frame, if constructed properly, is more efficient than the area frame. Proper control data permit stratification and varying rates of selection to minimize sampling errors. Less expensive data collection methods such as mail and telephone can also be used. However, the list frame is incomplete; it does not cover the entire population.

Multiple frame sampling allows the joint use of both frames and can utilize the best features of each. The area frame will estimate for the incompleteness of the list frame while the list frame can be used for the operations for which the area frame is not efficient.

One of the difficulties SRS first encountered with multiple frame sampling stemmed from the available sampling frames. To illustrate, the sampling unit from the area frame is a unit of land i.e., a segment while the sampling unit from the list frame is a name. Since one cannot determine overlap between these sample frames by matching names with segment numbers, it was necessary to define reporting units for each sample unit. Then the overlap between the two frames can be determined by matching names associated with the reporting units.

The reporting unit for a name selected from the list is a unit of land. After the reporting unit is established for the farm operation represented by the name, that is, all land operated by that farm operator, then the number of livestock on that land is obtained.

The sampling unit in the area frame is a segment of land selected with a known probability. A reporting unit is the tract which is all land inside the segment under one operation. The land under this operation in the segment is identified by either the name of the person who is the operator or by a farm, partnership, or corporation name. After the reporting unit is defined for land inside the segment all livestock on that land is to be recorded.

In practice, it is assumed that an area of land can be represented by a name. Then in the multiple frame context the overlap of land areas represented by the area and list frames is identified by matching names associated with the land.

To determine overlap between sampling frames, it is necessary to match the name associated with every operation in the area frame sample with names on the entire list frame. This name-matching process is straightforward when individual operations are involved. Either the operator's name is on the list frame or it is not. Problems occur, however, when two or more people are involved in the same operation.

Only about 10 percent or less of the farming operations in most states are some sort of operating arrangement involving several people. Yet these present most of the problems in maintaining the correct probabilities of selection in the multiple frame survey. Difficulty arises when a partnership or corporate operation does not have a farm name but involves two or more people. The problem is in determining whether this operation is also represented by the list frame. The list frame may not have a farm name representing this partnership either. Sometimes one or more of the partners are on the list. This not only affects overlap determination, but may also indicate potential duplication in the list. The question is: Where or how can this operation be reported? Can the entire operation be reported by the list frame?

Problems such as these make it necessary to establish rules and definitions for handling partnership operations. These rules must be such that they cover all situations that can occur in an operational survey, and still allow for unbiased estimators. The rules must also coincide with questionnaire design such that proper data will be collected. The rules involved in the multiple frame survey boil down to a key issue: What can a name selected from a list frame represent?

PROCEDURES TO DEFINE A REPORTING UNIT FOR A SAMPLING UNIT

In practice, it is necessary to make assumptions concerning the reporting unit for a name or an operation. The first assumptions depend upon the definition of the sampling unit. Currently, two definitions are used--the operation and the operator concept. Both are used on the extreme operator list; the operation concept for the JES and the operator concept for the multiple frame survey. The operator concept is also used for the remainder of the multiple frame list. Illustrations 1 and 2 define the operation and operator concepts, respectively.

Briefly, the operation concept involves a livestock operation. The sampling unit (selected name) may not be associated with land. The selected name may represent a livestock owner. The questionnaire asks the respondent to report livestock in the operation, not livestock on land he operates. This concept maximizes the list frame coverage. It minimizes the effects of name or operator changes because the operation data would still be reported regardless of who is the current operator. A problem occurs in the multiple frame context, however, because in the area frame survey, names associated with land are obtained. The area frame survey procedures do not obtain the names of livestock owners. Therefore, it is difficult to determine overlap between area frame tracts and extreme operators. If the extreme operator list is small and one knows a great deal about each extreme operator, it is feasible to determine the location of the operation and whether or not it overlaps with an area frame sample segment. There is a potential, however, that not all extreme operator data are removed from the area frame because of the inability to match names and overlap land areas.

The operator concept used for the list frame is similar to the operator concept used for the area frame. A selected name must represent a land operation. This facilitates a direct name match between names associated with area frame tracts and names on the list frame. The operator concept does require that the list be kept up to date. A name change for an operation means that data will not be reported from the list frame and the operation is in the nonoverlap domain in the area frame. As a result, extreme operator sampling units that involved a change in name are edited to zero. Theoretically there is an area frame tract somewhere which goes from the overlap to the nonoverlap domain. If this is not identified, the multiple frame estimate is biased downward.

In summary, the operation concept and the operator concept are not different with respect to the sampling unit. In either case the sampling unit is a name. The two concepts do differ with respect to the reporting unit. For the operation concept the respondent is asked to report the number of livestock <u>in his livestock operation</u>. For the operator concept the respondent is asked to report the number of livestock located <u>on the land he operates</u>. The operator concept is much more precise for overlap determination. However, the operator concept may be more difficult for a respondent to understand.

ILLUSTRATION 1

O P E R A T I O N C O N C E P T

LIST FRAME CONSIDERATIONS	AREA FRAME CONSIDERATIONS
1. Name selected represents a livestock operation. The name may or may not represent a land operation.	Names from area frame are associated with land. Name either represents a land operator or is the farm name.
2. A landlord or livestock owner who does not operate land may be a sampling unit.	Survey procedures must identify names of persons who do not operate land but that may be on the list.
3. The name associated with the operation may change, but data are retained in the list frame if the operation remains the same.	Usually, only the name associated with the current operation is obtained. To determine overlap, names associated with the previous operation must be determined if a name change occurred.

E F F E C T S O F C O N C E P T

A. The overlap between the sample frames can only be determined by obtaining all names - present and past - associated with livestock on land operations. Then all names must be matched with the list. Overlap determination is difficult.

B. The list coverage is maximized. All effort is made to retain data on the list frame.

ILLUSTRATION 2

O P E R A T O R C O N C E P T

List Frame Considerations	Area Frame Considerations
1. Name must represent a land operator. All livestock on land operated are reported.	Name associated with the area frame reporting unit represents a land operation. All livestock on the land are reported.
2. Landlords and livestock owners are not sampling units.	Name of operator of land on which livestock are located must be on list before area reporting unit overlaps the list. Landlord or livestock owner is not a farm operator.
3. If a change in name associated with an operation occurs, the sample unit is coded to be out of business.	Overlap determined by matching name associated with the current land operation with the list. Area operation overlaps the list only if current operator is on the list.

E F F E C T S O F C O N C E P T

A. The overlap between the sample frames is determined by matching names. Both sets of names represent a land operation. Overlap determination is simplified.

B. Emphasizes need to keep list frame up-to-date, especially changes in operations. Otherwise coverage of list frame decreases.

C. Data collection may be more difficult. The operator is asked to report livestock on land he operates regardless of who owns the livestock.

PROCEDURES TO DETERMINE OVERLAP BETWEEN FRAMES

Many different methods can be used for determining overlap between the area and list frames using the operator concept. They differ in the method used to associate a name with a unit of land; thus data collection procedures also differ. Each is also accompanied by a procedure to handle duplication within the list frame. However, all procedures are the same if we are working with an individual operation that is not duplicated in the list.

Current Partial Nonoverlap Procedure (Alternative I)

This procedure was implemented for the December 1971 Multiple Frame Surveys. The primary purpose was to minimize the effects of partnership operations on the sampling errors. Data to be shown later indicate that it did minimize sampling errors. This procedure relied on some basic assumptions:

a. Each partner in a partnership will report for the entire operation whether contacted through the area or list sampling frames.
b. Each partner will also report his individual operation if there is one.
c. Each partner will correctly identify all of the other partners.
d. Each partner whose name appears in the list frame will be identified.

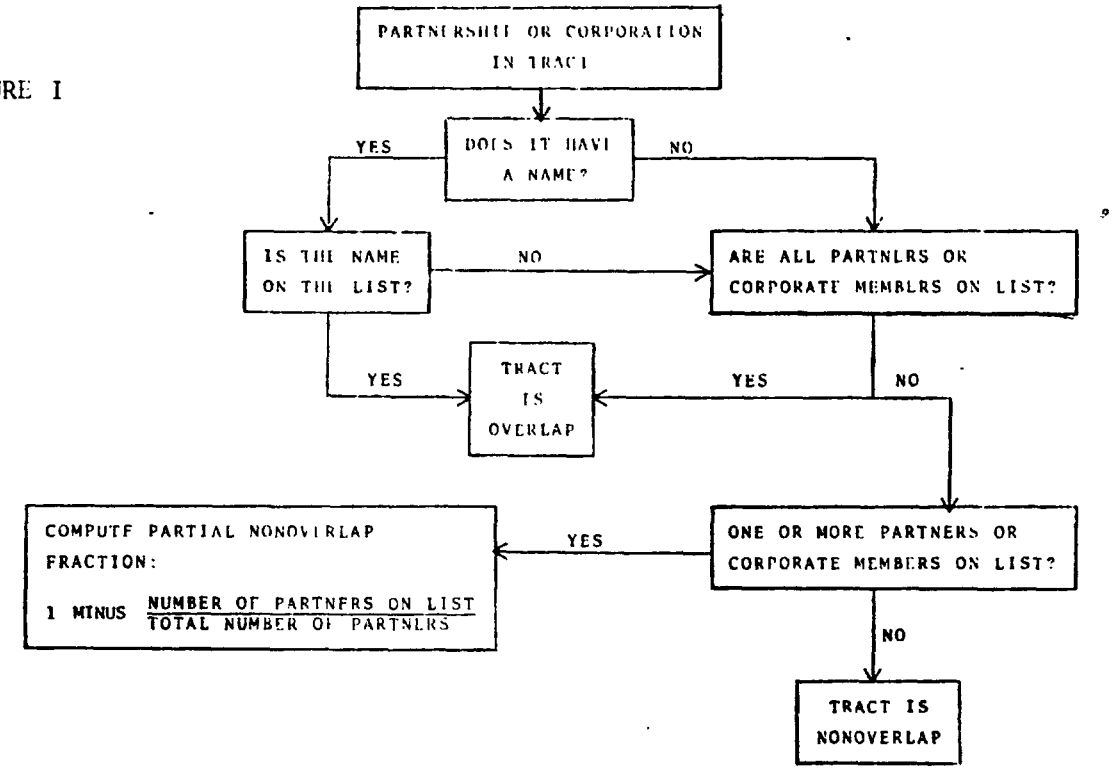
Figure I is a decision diagram used to prorate partnership operations using the partial nonoverlap procedure.[1/] If an area frame tract is a partnership operation, the partnership has a name and the name is on the list, the tract is overlap. If a partnership operation does not have a name, the procedure is to determine if any or all of the partnership or corporate members are on the list. If all members are on the list, the tract is overlap. If only a fraction of the total partners are on the list, a partial nonoverlap fraction is computed. The nonoverlap fraction is one minus the number of partners on the list divided by the total number of partners. This means it is necessary to rely on the assumption that all people listed as partners are in fact partners by our survey rules and definitions.

The procedure for editing data reported by a partnership operation selected from the list frame must be compatible with that used to derive a nonoverlap fraction. For example, consider the case where an individual name is selected from the list and the respondent indicates a partnership arrangement on the questionnaire. If a partnership name is reported by the individual and it is also on the list, then all partnership data are to be removed from the individual's questionnaire since the partnership operation had an independent chance of being selected. If there is no partnership or corporate name, a portion of the partnership data is included on the individual's questionnaire. Since there is more than one chance of selecting the partnership, either in the area or list frame, the proration factor is one divided by the total number of partners, including those on the list and those not on the list. This is necessary because of the way the nonoverlap fraction was computed in the area frame. The nonoverlap fraction plus the proration fraction must equal one. The combination of the two frames will then properly represent the partnership.

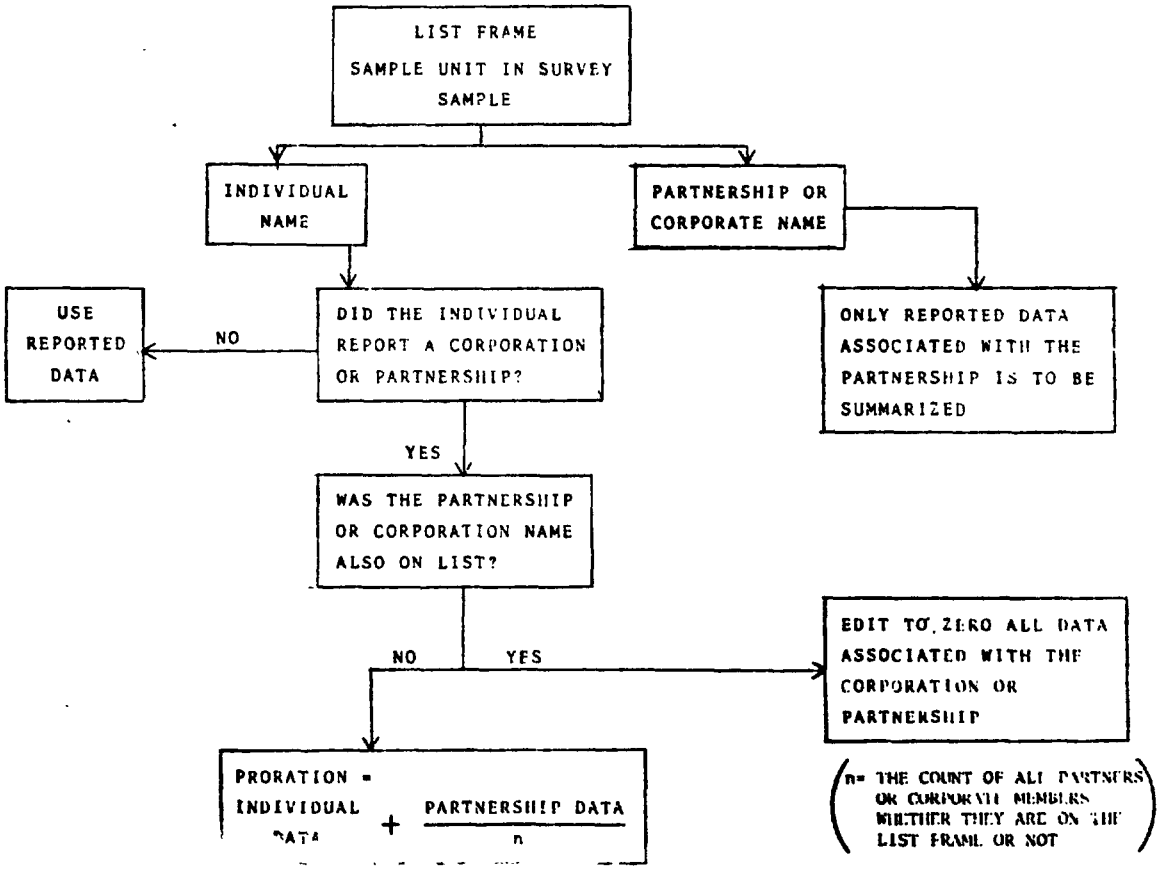
[1/] Sections 3 & 8, Multiple Frame Surveys--Supervising & Editing Manual.

A. Current decision diagram for partial nonoverlap concept applied to area frame.

FIGURE I



B. Current decision diagram for partial nonoverlap concept applied to list frame.



Alternative IIA

This procedure was used prior to the inception of the current partial nonoverlap procedure and relies on the same set of assumptions. It differs only in editing procedures for the partnership operations after the data are collected. The procedures are depicted in Figure II.

Alternative IIA is exactly the same as the current procedure if a partnership or corporation has a name. If an area frame tract is a partnership operation, the partnership has a name and the name is on the list frame, the tract is overlap. The procedures differ when a corporation or partnership does not have a name. If one or more partner's name is on the list, the tract is overlap under Alternative IIA. Only if none of the names of partnership members is on the list does the tract become nonoverlap.

The procedure used to prorate partnership data reported by an individual whose name was selected from the list frame must be compatible with the procedure used to determine if the partnership is overlap when the individual is found in an area frame segment. Under alternative IIA the proration factor applied to list data is one divided by the number of partners who are actually on the list frame, rather than the number of all partners in the partnership. If the partnership operation does not have a name, but an individual selected from the list reports for a partnership or corporation, the procedure is to prorate the data based on the number of times that operation could have been selected from the list. This requires survey statisticians to search their list for the name of every partner reported on the list questionnaire.

Both procedures described so far are theoretically correct.[1/] They differ somewhat in approach and in problems of implementation. Alternative IIA requires all names associated with a partnership reported by an individual selected from the list frame be checked against the list. This does involve extra work; however, it provides an additional check for duplication in the list. If there is a tendency for names of partners that are not valid partners to be reported on a list frame questionnaire, proration effects are minimized by counting only those on the list. The current procedure does not require all names of partners reported in the list sample to be checked against the list. From the standpoint of editing time required, the current procedure is an improvement. However, it is risky because the assumption that all names are those of valid partners may be seriously violated. The section concerning nonsampling errors points out problems incurred in making this assumption.

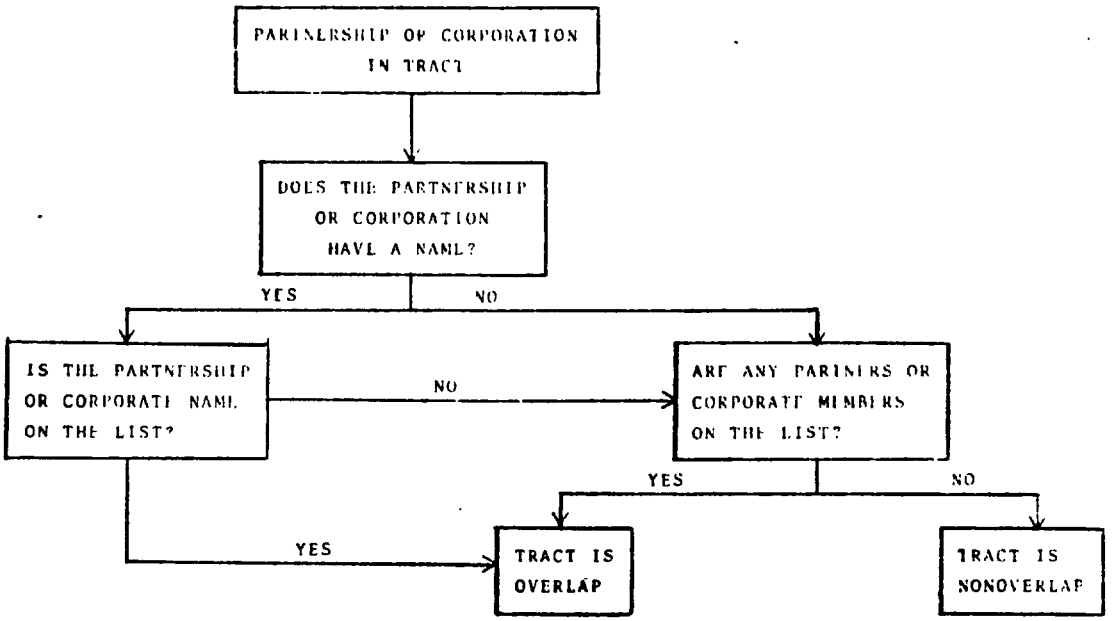
Alternative IIB

This procedure was implemented for the 1975 JES and Multiple Frame Surveys to handle within list duplication. The partial nonoverlap procedure is still used for partnership operations. Figure II shows how alternative IIB could be extended to handle partnership operations. Note that the only difference between alternatives IIA and IIB is in prorating list frame sample data. If the partners are in different strata, all livestock are assigned to the partner is the stratum with the smallest expansion factor. Data for partners

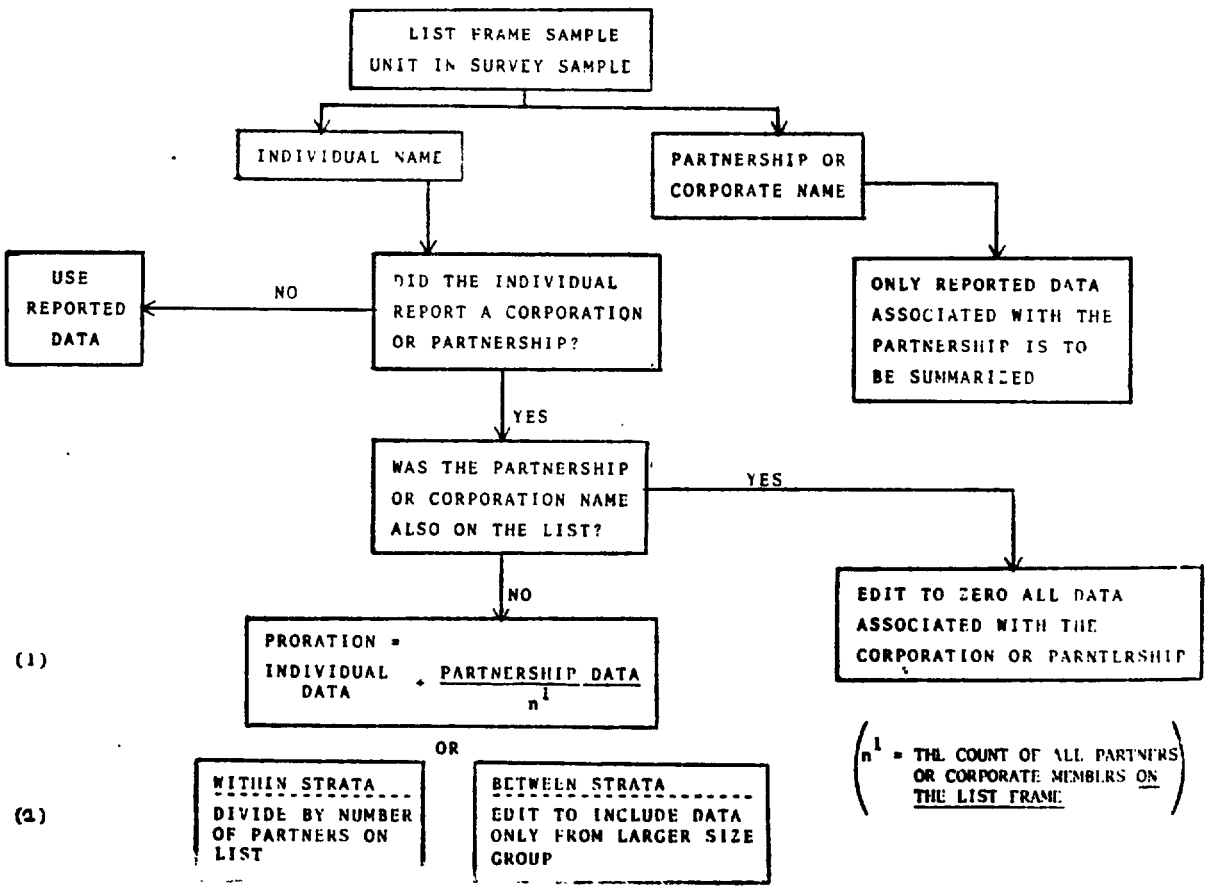
[1/] Vogel, Frederic A., Surveys with Overlapping Frames - Problems in Application, Paper presented at the 1975 Annual Meeting of the American Statistical Association, Atlanta, Georgia.

A. Decision diagram for previous nonoverlap concept applied to area frame.

FIGURE II



B. Decision diagram for previous nonoverlap concept applied to list frame.



in other strata are edited to zero. The nonoverlap determination for area frame tracts is the same for both procedures.

Alternative IIB relies on the basic assumptions required for the partial nonoverlap procedure. The primary reason it was implemented to handle duplication was to be able to obtain estimates for the extreme operator strata that are the same for the JES and MF surveys.

Alternative III

This procedure is depicted in Figure III and relies on the following basic assumptions.

a. An individual's name on the list represents a unique land operation only associated with that name. More specifically, the name Sam Jones can only represent land operated solely by Sam Jones. It cannot represent land operated jointly by Sam Jones and others.
b. If the individual does not have a unique land operation, all reported livestock data will be edited to zero.

The procedure is also theoretically correct. At the outset, it appears to be somewhat easier to understand and implement than the above three procedures. It will increase the size of the nonoverlap domain, however. The procedure does require a much stiffer correspondence between the name of the operation and the name appearing on the list frame. For example, to identify the nonoverlap domain for partnership and corporation tracts, the procedure is as follows: If the partnership or corporation has a name, and the name is on the list frame, then the tract is overlap. If a partnership or corporation does not have a name, the tract is automatically nonoverlap (Individual names listed together would constitute a partnership name.)

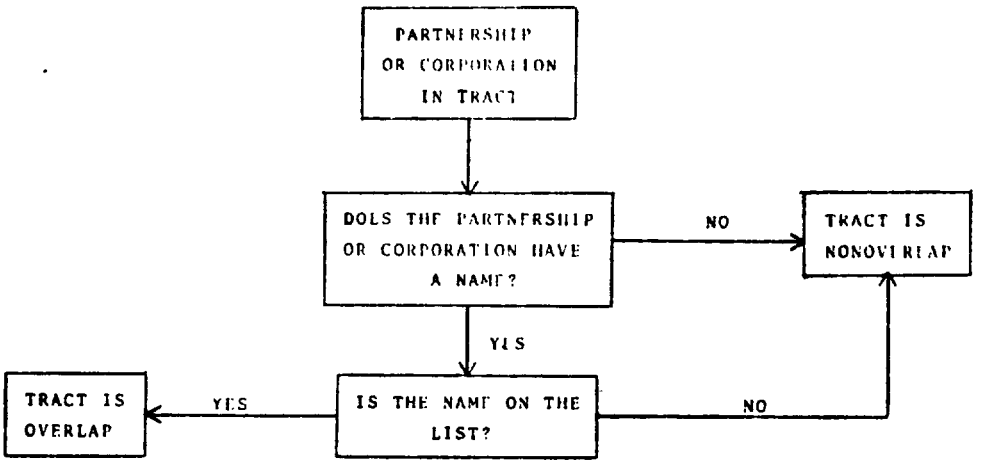
Under certain conditions the editing procedure for list frame sample units using Alternative III will differ from the other alternatives. If a partnership or corporation name is selected from the list, only reported data associated with that partnership are to be summarized. This does not differ from the previous two procedures. In fact the nonoverlap and the list frame procedures for partnerships are the same as for individuals for all alternative methods if the partnership or corporation has a name. However, under alternative III if a list frame sample unit is an individual name and some or all of the reported data are associated with a partnership or corporation, all partnership data would be edited to zero. There is no proration of partnership data under alternative III. This means that all partnership or corporation data must be represented entirely by a single list frame sampling unit (Name) or the partnership will be entirely nonoverlap.

The interest in testing alternative III arose from an earlier analysis of survey concepts.[1/] One recommendation from this study was that a nonoverlap procedure, referred to here as alternative III, be tested against the current partial nonoverlap procedure.

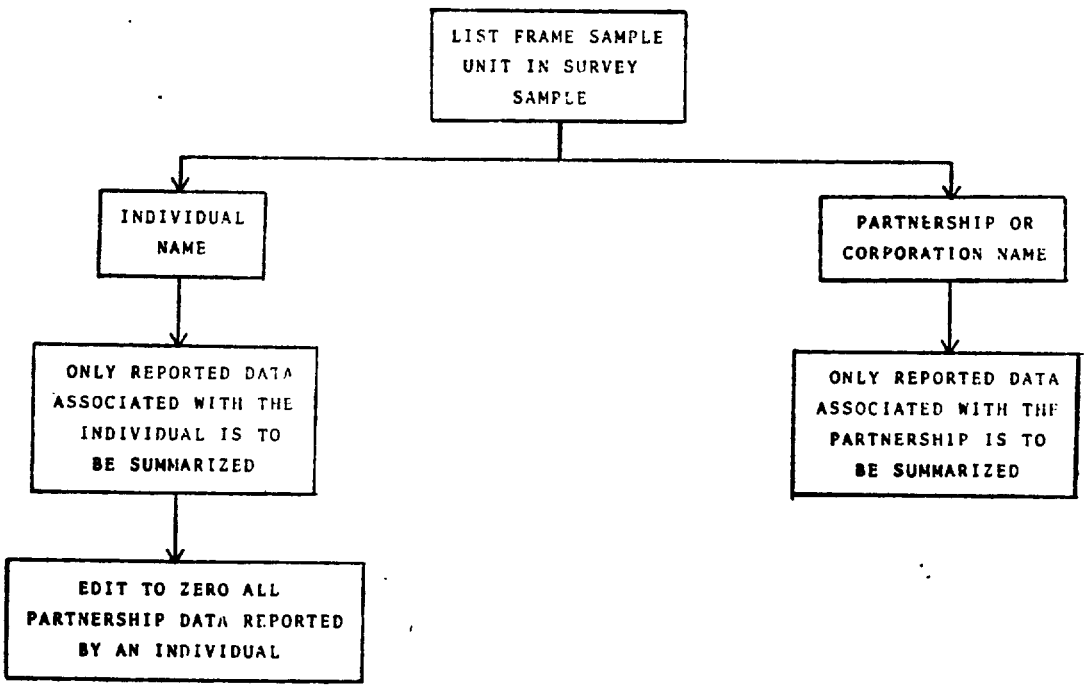
1/ Raymond R. Bosecker and William F. Kelly, "Summary of Results from Nebraska Survey Concept Study," Sampling Studies Section, Sample Survey Research Branch, Research Division, Statistical Reporting Service, U.S. Department of Agriculture, 1975.

A. Decision diagram for alternative nonoverlap concept applied to area frame.

FIGURE III



B. Decision diagram for alternative nonoverlap concept applied to the list frame.



AN ANALYSIS OF SURVEY DATA

Procedure

In the previous section four alternative methods, including the current procedure, for determining overlap between the area and list frames were described. Each is theoretically correct. However, it is desirable to gain some insight into how these methods compare in ease of application and in survey results. Also of interest is the degree of nonsampling error associated with the current procedure that could be reduced using an alternative method.

To compare the current procedure and alternative methods for determining overlap using the operator concept, June Enumerative and Multiple Frame livestock data were used for six states. Data from the June 1974 surveys were used for Iowa, Kentucky and Illinois; June 1975 survey data were used for Idaho, Minnesota and Ohio. States to be included in this analysis were selected on the basis of manpower availability and the desire to include different areas of the country.

Following the regular survey period, each June Enumerative and Multiple Frame livestock questionnaire that represented a partnership operation was re-edited in these states. Members of the Livestock and Data collection Branches and the Methods staff participated along with Research personnel in this phase of the project. Re-editing was not necessary for individual operations since for these there is no difference among the alternatives. Each partnership questionnaire was edited by four different methods:

1) Alternative I, the current procedure (a second look),
2) Alternative IIA,
3) Alternative IIB, and
4) Alternative III.

The number of cattle or hogs to be summarized using each procedure was recorded on listing sheets for each partnership operation. Also recorded was whether or not each partnership had a partnership name and whether or not the name was in the list frame.

This information was keypunched and matched against the edited data tapes that had been used to summarize the original survey results. Survey estimates of total cattle and total hogs and their respective estimated sampling errors were subsequently obtained in five different ways:

1) Estimates were obtained using data from the original edited tapes. A comparison between this result and the original survey result provided assurance that the correct tapes and summarization procedure were being used.
2) Estimates were obtained using the original data as amended by the second look using the current procedure. A comparison between the second look results and the original results was used as an indication of nonsampling errors that occurred using the current procedure.
3) Estimates were obtained using alternative IIA. This procedure was used to provide an indication of changes in survey estimate levels and sampling errors that occurred when the current procedure was adopted in favor of alternative IIA in December 1971.

4) Alternative IIB was used for comparative purposes. Although not of primary interest, alternative IIB would be an alternative for implementation if it proved desirable to use it.
5) Finally, estimates were obtained using alternative III. The second look was used for comparison with alternative III since it was most comparable with alternative III with respect to time of application (following the regular survey) and personnel doing the editing.

In addition to survey estimates by alternative procedures, the contribution of partnership operations to sample size and survey estimates was determined for each of the six states. Also of interest was the effect on area frame survey estimate levels and relative sampling errors that might be expected if the operator concept were adopted instead of the operation concept for extreme operators. Data were collected and summarized using the operator concept to obtain an indication of this effect.

Comparison of Survey Results from Alternative Procedures

Although each nonoverlap procedure being discussed is theoretically correct, survey estimates and associated sampling errors can vary among procedures for any given survey. Table A shows the percent each alternative procedure survey estimate of total hogs and total cattle, respectively, is of the current procedure for each of the six states in the analysis. Also shown are the sampling errors for each procedure. Details of these results are shown in Tables 1-11 of the appendix. Alternative IIB could not be used in Ohio, since the entire list frame was not stratified in that state for the 1975 Multiple Frame surveys. Also, Idaho does not have a Multiple Frame hog survey. Survey estimates using the current procedure were based on the results of the second look.

Survey estimates of total cattle on a state-by-state basis did not vary substantially among the different procedures. Differences between alternative III and the current procedure compare quite favorably in absolute size with those between alternative IIA and the current procedure. This comparison seems a reasonable one to make since the differences between alternative IIA and the current procedure provide some indication of changes in level that occurred when the current procedure was adopted.

Similar comparisons between total hog estimates are not quite as favorable, particularly for Iowa and Kentucky. The absolute change in level using alternative III in Iowa is considerably larger than that of the other alternatives. For Kentucky the survey estimate using alternative III is substantially different from the current procedure; however, the difference is not as striking when compared with the change in level associated with alternative IIA.

Comparisons of six state totals for cattle and five state totals for hogs show the current and three alternative procedures provide very similar results. This suggests that not only in theory but also in practice these different procedures can be expected to yield very similar results on a regional basis and more certainly on a national basis.

Relative sampling errors associated with alternative III were consistently larger than those associated with the current procedure. With the exception of the Kentucky hog estimates, the relative sampling errors for alternative III were also larger than those for alternatives IIA and IIB.

Table A--Multiple frame survey cattle and hog estimates based on alternative nonoverlap procedures as a percent of estimates from the current procedure - Illinois, Iowa and Kentucky, June 1974 and Idaho, Minnesota and Ohio, June 1975 [1/]

Procedure	Illinois	Iowa	Kentucky	Idaho	Minn	Ohio	Total
	(%)	(%)	(%)	(%)	(%)	(%)	(%)
			Cattle and Calves				
Current	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	(3.6)	(3.3)	(3.6)	(3.5)	(3.8)	(6.7)	(1.7)
Alt. IIA	100.7	99.3	100.5	100.8	98.1	100.3	99.7
	(3.5)	(3.3)	(3.6)	(3.4)	(3.6)	(6.7)	(1.6)
Alt. IIB	101.1	98.9	100.3	101.1	98.2	--	99.6
	(3.5)	(3.3)	(3.6)	(3.4)	(3.6)		(1.6)
Alt. III	99.3	101.3	100.7	99.3	100.7	101.2	100.6
	(3.9)	(3.7)	(3.8)	(4.0)	(4.4)	(6.9)	(1.8)
			Hogs and Pigs				
Current	100.0	100.0	100.0	--	100.0	100.0	100.0
	(6.6)	(3.6)	(8.1)		(6.4)	(7.0)	(2.7)
Alt. IIA	100.1	98.5	104.0	--	102.3	98.4	99.6
	(6.4)	(3.6)	(9.0)		(6.3)	(6.4)	(2.7)
Alt. IIB	100.4	98.6	103.7	--	102.4	--	99.8
	(6.4)	(3.6)	(9.0)		(6.3)		(2.8)
Alt. III	98.5	105.3	94.1	--	98.1	99.6	101.9
	(7.1)	(4.3)	(8.2)		(6.6)	(9.0)	(3.1)

[1/] Survey estimates for the current procedure are after the second look. Relative sampling errors are shown in parenthesis.

Ease of Applying Nonoverlap Procedures

Based on the experience gained from re-editing data from the six states, alternative III is the preferable procedure from the standpoint of ease of application. Alternative III requires no proration of partnership data in either the area or list frame. Each area frame tract is either completely overlap or completely nonoverlap. For each partnership tract there are at most two names (a combination of individual names or a partnership name) to match against the list frame. Accordingly, the number of livestock reported by a list frame sampling unit is used in its entirety if it is for the sample name selected (individual or partnership) or it is edited to zero if the reported data is not for the sample name.

A comparison among the remaining procedures (current, alternative IIA, and alternative IIB) does not lead to any definite conclusions. Generally, alternatives IIA and IIB require more time than the current procedure when editing list frame questionnaires. The current procedure does not require looking for each partner's name in the list as do alternatives IIA and IIB. Conversely, the current procedure does involve the use of partial nonoverlap area frame tracts, whereas under alternatives IIA and IIB, an area tract is completely overlap or nonoverlap.

Operation vs. Operator Concept

The results of using the operator concept for extreme operators in conjunction with the area frame estimates are shown in Tables 1-11 of the appendix. These results as compared with the operation concept are summarized in Table B.

Alternative III was used in applying the operator concept. The results are encouraging since the changes in level using the operator concept were relatively small, the largest change being 1.5% for Minnesota hogs. Also, the relative sampling errors were virtually unchanged. These results might suggest that area frame estimates will usually be slightly smaller using the operator concept. Six of the eight individual state survey estimates showed a slight decline. However, it is probably premature to take this as conclusive evidence.

Table B--June Enumerative survey cattle and hog estimates based on editing extreme operators with the operator concept as a percent of estimates based on the current operation concept - Illinois and Kentucky, June 1974 and Minnesota and Ohio, June 1975 [1/]

Procedure	Illinois	Kentucky	Minn.	Ohio	Total
	(%)	(%)	(%)	(%)	(%)
		Cattle and Calves			
Operation	100.0	100.0	100.0	100.0	100.0
	(8.3)	(6.0)	(6.0)	(6.8)	(3.4)
Operator	100.0	100.4	99.5	99.8	99.9
	(8.3)	(6.0)	(6.0)	(6.8)	(3.4)
		Hogs and Pigs			
Operation	100.0	100.0	100.0	100.0	100.0
	(11.9)	(12.2)	(11.2)	(20.3)	(7.5)
Operator	99.8	99.9	98.5	98.6	99.3
	(12.0)	(12.2)	(11.3)	(20.6)	(7.6)

[1/] The operator concept was implemented using alternative III. Relative sampling errors are shown in parenthesis.

AN EVALUATION OF THE ALTERNATIVE PROCEDURES

The nonsampling errors associated with any procedure for determining overlap between the list and area frames are problems connected with associating a name with a unit of land. We are concerned with errors committed in the process of determining whether a sampling unit is a member of the overlap or the nonoverlap domain.

These problems are often much more serious than one would at first suspect. An estimate from an SRS Multiple Frame survey is formed by adding the area estimate for those not represented by the list, nonoverlap domain, to the list estimate, overlap domain, as an independent stratum. Leaving tracts in the nonoverlap domain which are represented by the list frame results in an error of duplication, while an incorrect classification into the overlap domain is an error of omission. The estimate is too high or too low, respectively, by an unknown amount since these errors are not part of the measured sampling error.

As the survey questionnaires for these six states were being re-edited we observed six major types of nonsampling errors that were made in domain determination. These will be discussed individually in this section. They are:

Incorrect proration of data among partners,
Reporting unit different from sampling unit,
Incorrect editing of extreme operator reports,
Inconsistency in respondent reporting,
Equating range segments with public segments as overlap, and
Failure to link names.

Incorrect Proration of Data Among Partners

Proration is a key element of the current partial overlap procedure. The animals of a given operation in the area frame are allocated equally among the partners and prorated between the overlap and nonoverlap domains according to the proportion of the partner's names that appear on the list frame. Accordingly, livestock on partnership land reported by an individual in the list frame are divided by the total number of partners. This provides several opportunities for error. The types of errors discovered in this study were:

1. Partnership sampled but data are prorated.
   If a partnership name is sampled from the list, the livestock data for that partnership are not to be prorated. But in several cases when the members of the partnership were listed in the operation description section of a list questionnaire, the data were divided by the number of partners given. For example, if the list name sampled is John Brown and George Jones and a report is obtained for the partnership, the sampling unit equals the reporting unit. The partnership data should not be prorated. Occasionally the data were erroneously divided by two.

2. Partnership sampled but more partners are involved.
   Consider an example where William and Walter Smith is the list name and brothers Joe, John, and Jim are also partners but not on the list. The nonoverlap factor and list frame division for this type of situation

have been handled very inconsistently. Nonoverlap factors of 1, 2/5, 2/4, 1/4, and 0 have been used. List data have been observed to be divided by 5, 4, and 2 or left undivided or taken out. For this example, the correct nonoverlap factor would be 1.0 and the list data should be edited to zero. If the area action and list action are inconsistent, then errors of duplication or omission occur.

3. Livestock on individual and partnership land edited incorrectly.
Livestock on partnership land are to be divided by the number of partners and added to the number of livestock on individually operated land. In some cases all animals have been divided. For example, if 360 cattle are reported with 60 head in partnership with 5 members, the report should be edited to 312 head (300 + 60/5 = 312). Occasionally this report would be incorrectly edited to 72 head (360 ÷ 5 = 72). In other cases, none of the partnership cattle is included with an individual's report. For example, 50 head are reported on individually operated land. It is noted on the questionnaire that an additional 200 head are on partnership land, but only the 50 head are divided by the number of partners. All of the 200 additional head have been incorrectly omitted.

   Most of the time, when sufficient information is available, the prorating is done correctly. However, this combination of different reporting units is too frequently a source of nonsampling error.

4. Interpretation of arrangements sometimes differ between frames.
The current list frame questionnaire design makes it possible for a respondent to list partners and the statistician to divide the data when the same operation would be considered individually operated if sampled in the area frame. In the area frame if sons have livestock on their father's farm for 4-H projects, only the father's name is used for overlap determination. On the other hand, if the father reports his sons as partners on a list questionnaire, the data are divided. This is an error of omission.

5. Not enough information available.
Data are sometimes prorated when not enough is known about the operation. An example of this is when "Smith and Sons" is indicated as an operation name with nothing in the operation description section, but the data are arbitrarily divided by three. However, data are sometimes left undivided when a corporate arrangement is indicated without listing the members.

Potential errors 1, 2, and 3 are specifically the result of the prorating activity done under the partial overlap procedure. These problems are less likely to occur under alternatives IIA and IIB and almost certainly will not occur under alternative III. Errors 4 and 5 could be worse under alternative III since all the data could be included or excluded incorrectly. However, with increased emphasis on the sample name and type of operation involved, additional information should be obtained before accepting or rejecting all the data.

Reporting Unit Different From Sampling Unit

When data are accepted on a list questionnaire even though the name has changed from that selected and current nonoverlap determination is being made, an error of duplication has occurred. This new name could already be present on the list. If it is not on the list, the livestock on land associated with the name would be part of the nonoverlap domain. In any event, the report should be edited to zero.

An example of this is when Bob Smith is the name selected but the data reported are for Jack Smith. Another example would be Bob and Tom Smith selected, but Tom is crossed out leaving only Bob's individual operation. For both examples, the reports should be edited to zero.

Another error of this type occurs when the SSO changes the mailing label from an individual name to a partnership name or vice versa based on a previous survey questionnaire and then edits on the new basis for subsequent surveys before a new sample is drawn. For example, Bob Jones lists Tom Jones as a partner in a survey and the data are correctly divided by two. The label is then changed to read Bob and Tom Jones for subsequent surveys and the data are incorrectly left undivided.

These errors should not occur under any of the alternative nonoverlap procedures. Under alternative III, where emphasis is placed on the reporting unit being equal to the sampling unit, this type error should occur less frequently.

Incorrect Editing of Extreme Operator (E.O.) Reports

The current procedure of using an operation concept for the area frame E.O. estimate and an operator concept for the multiple frame estimate is a source of misunderstanding. The area frame E.O. list is not always equivalent to the multiple frame E.O. strata. A partnership name may be on one while an individual name is on the other. There are different rules for editing the E.O. data for the area frame and multiple frame. Often the data are switched from one to the other with no differentiation. Occasionally the editing rules are switched or mixed. A change of name under the operation concept does not alter the livestock data on a list questionnaire, but there would be no way of matching this new name with the E.O. list if it were found in the area frame. This provides an opportunity for duplication. These problems would be alleviated substantially if we were to adopt one operator concept which required one editing procedure and provided one result for both the area frame and multiple frame E.O.'s.

Inconsistency in Respondent Reporting

Alternative III is designed to promote more consistency and uniformity in office procedures for handling sample data. However, if a respondent does not supply a consistent description of this operation each time he reports, then the estimates will not be consistent regardless of the office procedure used. If in the course of a personal enumeration of an area tract, a respondent reports a landlord-renter arrangement while on a mailed questionnaire the same respondent reports a partnership for the same operation, an error has occurred. If in June he indicates a partnership, but in September he does not, then one or the other is wrong if his operation has not changed.

Inconsistent reporting is a problem under any alternative procedure. This problem may be minimized by improvements in questionnaire design and interview techniques.

Equating Range Segments with Public Grazing Segments

The current procedure automatically considers tracts in public grazing segments as overlap. This is done because anyone with cattle on public grazing land is required by law to also have private land. Therefore, all cattle on public

grazing land have the opportunity to be prorated into privately owned tracts. This proration is based on the ratio of private tract acres to total private acres when computing the weighted segment estimate.

If tracts in private range segments are also considered automaticaly overlap, the nonoverlap domain may be understated. All privately owned tracts must be checked for overlap under any alternative.

Failure to Link Names

Matching area frame names against the list is highly dependent upon getting the same name-address information from the respondent to an area frame survey as from the list source. It is desirable to have as few places as possible on the list to check for duplication. Currently, names of partners in the area frame must be checked to see if they are on the list individually or in combination. Each partner or manager may represent the partnership or managed operation as well as his own individual land unless the farm name, partnership name or corporate name are on the list. Under alternative III, names from the area frame would be linked against either an individual name, farm name or a combination of individual names, depending upon how the tract was classified. Individuals and managers represent only their own individually operated land. Joint names, partnership names or corporate names represent joint land arrangements. A farm name may represent either a joint or individual operation, so the farm name may still be duplicated with another name. The main point is that alternative III would simplify the process and thus lead toward a more accurate classification.

Second Look

The second look using the current procedure was used as an indication of nonsampling errors associated with using the current nonoverlap procedure for partnership operations. Second look results are shown in Tables 1-11 of the appendix.

Recognizing that the second look is not performed without error, we feel confident that it was done with less error than the original survey because there was not the time pressure experienced by the survey statistician. Also, the second look was performed with one specific objective in mind: Nonoverlap determination for partnership operations.

Nonsampling errors varied considerably among states and among domains within states. For the list frame, including extreme operators, the errors were mostly in one direction. That is, survey estimates based on the second look were generally below those of the original survey. This seems to reflect the failure to edit out data from some list questionnaires as called for under the current procedure.

These explanations should not be taken as an indication that nonsampling errors associated with using the current procedure on the list questionnaire can be expected to be in one direction. Rather, the results are an indication of the possible magnitude of nonsampling errors in either direction.

In total, the survey estimate attributable to the area frame nonoverlap domain increased after the second look. As with the list frame, these data indicate the possible relative size of nonsampling error in either direction using the current nonoverlap procedure for partnership operations in the area frame.

It is important to note that while the second look corrected for some nonsampling error, the sampling error for the second look is not consistently smaller. In other words, nonsampling errors are not reflected in the estimated sampling errors.

If nonsampling errors can be reduced by adopting alternative III, total error may be reduced even though sampling error can be expected to increase. Unfortunately, survey results do not provide an estimate of total error so the current and alternative procedures cannot be compared directly. We must rely on results of re-editing and subjective evaluation.

The magnitude of the nonsampling errors and the relative changes in the estimates when comparing the different procedures become very critical when one recognizes that the different procedures affect only partnership or corporate arrangements. Table C illustrates that a very small percentage of the farms and less than 10 percent of the inventory can be changed considerably by a change in a survey rule. More detailed tables appear in the appendix.

For a majority of the survey estimates, partnerships do account for a larger proportion of the estimate than they do of the sample size. This implies that partnership operations are usually larger than the average of all operations.

There are several factors that account for the variability in contribution of partnerships that have a partnership name in the list frame. Enumerator success in obtaining partnership names for partnership operations in the area frame can vary according to whether or not a name exists and to interview techniques. Furthermore, the proportion of partnership names on the list is directly related to the quality of the list frame.

For most states, partnerships are relatively more important among extreme operators. Also, in most instances extreme operator partnership operations with the partnership name on the list contributed more toward survey estimates than did extreme operations without a partnership name on the list. It is apparent from these results that the contribution of partnership operations to survey estimates is large enough to warrant consideration of alternative procedures for determining their overlap between the list and area frames. An evaluation of these procedures should consider the relative effect on both sampling and nonsampling errors.

Table C--Contribution of partnership and corporate arrangements to area frame, list frame and extreme operator cattle and hog estimates--Iowa, Kentucky and Illinois, June 1974 and Ohio, Minnesota, and Idaho, June 1975.

State	Area Frame 1/		List Frame 2/		Extreme Operators 3/	
	Percent of Sample	Percent of Estimate	Percent of Sample	Percent of Estimate	Percent of Sample	Percent of Estimate
	(%)	(%)	(%)	(%)	(%)	(%)
CATTLE AND CALVES						
Iowa	7.2	11.1	7.6	11.3	28.5	33.3
Kentucky	5.1 4/	11.7 4/	7.0	10.6	6.8	5.2
Illinois	9.6	15.1	6.9	11.6	12.8	22 1
Ohio	7.4	7.2	6.6	9.9	22.6	23.0
Minnesota	10.9	4.4	7.0	10.0	30.8	32.5
Idaho	4.4 5/	6.3 5/	19.2	29.8	36.8	40.2
HOGS AND PIGS						
Iowa	7.2	11.2	6.9	8.8	29.5	25.6
Kentucky	5.1 4/	4.6 4/	5.5	17.6	39.7	43.2
Illinois	9.6	5.2	6.8	11.8	20.9	23.7
Ohio	7.4	3.7	4.0	8.5	37.8	54.4
Minnesota	10.9	2.1	5.8	14.5	23.2	26.5

1/ Agricultural tracts excluding extreme operators.

2/ Excluding extreme operators.

3/ Multiple frame expansion

4/ Agricultural tracts, excluding extreme operators, in segments not rotated in 1974.

5/ Agricultural tracts, excluding extreme operators, in segments not rotated in 1975. Contribution of partnerships in public segments is not included.

SUMMARY AND CONCLUSIONS

An analysis of June Enumerative and Multiple Frame Livestock Survey data from six states was used to compare four alternative procedures, including the current partial nonoverlap procedure, for determining overlap between the area and list frames. The current operation concept used for extreme operators in the area frame estimate was compared with the operator concept.

Comparisons of Multiple Frame Survey estimates of total cattle and total hogs on a state by state basis are not inconsistent with the theoretical proposition that each alternative nonoverlap procedure will yield the same result. When the state estimates are added together, the similarities are even more striking. Therefore, the choice among the alternative procedures should be based on ease of data collection and degree of nonsampling error. Experience gained through this research suggests alternative III is easiest to apply and is least susceptible to nonsampling error; however, the data suggest its use may result in slightly larger sampling error.

This analysis indicates the operator concept, using alternative III, could be applied to the extreme operators in the area frame with essentially no change in the level of the estimates from that obtained using the operation concept. Also, the sampling errors can be expected to show little change. Again, the choice between these two procedures should be made based on ease of application. The operator concept is much easier to apply because under this procedure the reporting unit is land operated, same as for the area frame. Therefore, overlap determination is simplified. Also, if the operator concept were implemented, overlap determination would be the same for extreme operators in both the area frame and the multiple frame livestock surveys.

This study has provided an indication of the possible magnitude of nonsampling errors presently associated with multiple frame livestock surveys. If nonsampling errors can be reduced by adopting alternative III, total error may be reduced even though sampling error may increase.

Some nonsampling errors can be affected only by improved questionnaire design and interview techniques. Although survey concepts have changed over the years, we have not modified our questionnaire design or interview techniques accordingly.

Survey procedures dictate how the data are to be collected. If data cannot be collected to meet the needs of existing procedures, then the procedures must be modified. Also, if data can be collected more accurately or more easily and satisfy the needs of an equally acceptable alternative procedure, the change should be made.

APPENDIX

MULTIPLE FRAME LIVESTOCK SURVEYS - AN EVALUATION OF ALTERNATIVE METHODS OF OVERLAP DETERMINATION

Tables 1-15

Table 1--Area frame and multiple frame cattle survey estimates based on the original survey, second look and alternative nonoverlap procedures Illinois, June 1974.

Survey and procedure	Domain	Direct expansions	Sampling errors	Relative sampling errors
		(000)	(000)	(%)
Area Frame Tract				
E.O. Operation Concept	E.O.	64.6	5.0	7.7
	Overlap	2,209.2	---	---
	Nonoverlap	332.8	---	---
	Total	2,606.6	215.2	8.3
E.O. Operator Concept, Alt. III	E.O.	64.6	5.0	7.7
	Overlap	2,209.2	---	---
	Nonoverlap	332.8	---	---
	Total	2,606.6	215.2	8.3
Multiple Frame				
Original Survey	E.O.	64.6	5.0	7.7
	List	2,817.8	93.6	3.3
	Nonoverlap[1/]	332.8	65.7	19.8
	Total	3,215.2	114.4	3.6
Second Look	E.O.	64.6	5.0	7.7
	List	2,799.5	93.4	3.3
	Nonoverlap[1/]	332.0	65.7	19.8
	Total	3,196.1	114.3	3.6
Alternative IIA	E.O.	64.6	5.0	7.7
	List	2,860.5	95.7	3.4
	Nonoverlap[1/]	292.2	60.0	20.5
	Total	3,217.3	113.0	3.5
Alternative IIB	E.O.	64.7	5.0	7.7
	List	2,873.5	95.9	3.3
	Nonoverlap[1/]	292.2	60.0	20.5
	Total	3,230.3	113.2	3.5
Alternative III	E.O.	64.6	5.0	7.7
	List	2,727.2	93.7	3.4
	Nonoverlap[1/]	381.5	83.1	21.8
	Total	3,173.3	125.3	3.9

[1/] Computed using tract estimator instead of weighted estimator.

Table 2--Area frame and multiple frame hog survey estimates based on the original survey, second look and alternative nonoverlap procedures--Illinois, June 1974.

Survey and Procedure	Domain	Direct expansions	Sampling errors	Relative sampling errors
		(000)	(000)	(%)
Area Frame Tract				
E.O. Operation Concept	E.O.	632.9	44.3	7.0
	Overlap	5,252.6	---	---
	Nonoverlap	906.0	---	---
	Total	6,791.5	811.4	11.9
E.O. Operator Concept, Alt. III	E.O.	572.8	44.6	7.5
	Overlap	5,041.0	---	---
	Nonoverlap	1,161.0	---	---
	Total	6,774.8	813.0	12.0
Multiple Frame				
Original Survey	E.O.	625.5	44.4	7.1
	List	4,788.0	259.1	5.4
	Nonoverlap[1/]	906.0	306.0	33.8
	Total	6,319.5	403.4	6.4
Second Look	E.O.	595.7	43.3	7.3
	List	4,776.1	272.0	5.7
	Nonoverlap[1/]	920.1	306.2	33.3
	Total	6,291.9	411.8	6.6
Alternative IIA	E.O.	600.2	43.1	7.2
	List	4,891.9	275.8	5.6
	Nonoverlap[1/]	806.5	291.5	36.1
	Total	6,298.6	403.6	6.4
Alternative IIB	E.O.	614.5	44.4	7.2
	List	4,898.0	275.8	5.6
	Nonoverlap[1/]	806.5	291.5	36.1
	Total	6,319.0	403.8	6.4
Alternative III	E.O.	572.8	44.6	7.5
	List	4,509.7	256.4	5.7
	Nonoverlap[1/]	1,117.6	355.1	31.8
	Total	6,200.1	440.1	7.1

[1/] Computed using tract estimator instead of weighted estimator.

Table 3--Area frame and multiple frame cattle survey estimates based on the original survey, second look and alternative nonoverlap procedures--Iowa, June 1974

Survey and procedure	Domain	Direct expansions	Sampling errors	Relative sampling errors
		(000)	(000)	(%)
Area Frame Tract				
E.O. Operation Concept	E.O.	272.4	.0	.0
	Overlap	7,404.5	---	---
	Nonoverlap	925.0	---	---
	Total	8,601.9	559.1	6.5
E.O. Operator Concept[2/] Alt. III				
Multiple Frame				
Original Survey	E.O.	267.0	.0	.0
	List	6,172.7	218.9	3.5
	Nonoverlap[1/]	925.0	145.6	15.7
	Total	7,364.7	262.9	3.6
Second Look	E.O.	265.7	.0	.0
	List	6,163.0	218.0	3.5
	Nonoverlap[1/]	831.5	102.5	12.3
	Total	7,260.2	240.9	3.3
Alternative IIA	E.O.	269.5	.0	.0
	List	6,355.7	220.7	3.5
	Nonoverlap[1/]	586.3	85.8	14.6
	Total	7,211.4	236.8	3.3
Alternative IIB	E.O.	269.8	.0	.0
	List	6,323.7	222.7	3.5
	Nonoverlap[1/]	586.3	85.8	14.6
	Total	7,179.8	238.7	3.3
Alternative III	E.O.	262.6	.0	.0
	List	5,907.8	220.6	3.6
	Nonoverlap[1/]	1,183.8	159.4	13.5
	Total	7,354.2	272.2	3.7

1/ Computed using tract estimator instead of weighted estimator

2/ Not available.

Table 4--Area frame and multiple frame hog survey estimates based on the original survey, second look and alternative nonoverlap procedures--Iowa June 1974.

Survey and procedure	Domain	Direct expansions	Sampling errors	Relative sampling errors
		(000)	(000)	(%)
Area Frame Tract				
E.O. Operation Concept	E.O.	506.9	26.0	5.1
	Overlap	12,068.8	---	---
	Nonoverlap	2,186.9	---	---
	Total	14,762.6	868.4	6.1
E.O. Operator Concept[2/] Alt. III				
Multiple Frame				
Original Survey	E.O.	458.1	26.5	5.8
	List	10,719.6	371.1	3.5
	Nonoverlap[1/]	2,186.9	302.2	13.8
	Total	13,364.6	479.3	3.6
Second Look	E.O.	460.8	27.2	5.9
	List	10,722.3	372.2	3.5
	Nonoverlap[1/]	2,199.9	302.4	13.7
	Total	13,382.9	480.1	3.6
Alternative IIA	E.O.	476.0	27.1	5.7
	List	10,894.7	380.9	3.5
	Nonoverlap[1/]	1,805.9	289.0	15.8
	Total	13,176.6	477.1	3.6
Alternative IIB	E.O.	485.7	28.0	5.8
	List	10,905.8	381.5	3.5
	Nonoverlap[1/]	1,805.9	289.0	15.8
	Total	13,197.3	477.6	3.6
Alternative III	E.O.	443.8	28.0	6.3
	List	10,376.5	371.6	3.6
	Nonoverlap[1/]	3,271.6	476.5	14.6
	Total	14,091.9	604.9	4.3

[1/] Computed using tract estimator instead of weighted estimator

[2/] Not available.

Table 5--Area frame and multiple frame cattle survey estimates based on the original survey, second look and alternative nonoverlap procedures--Kentucky, June 1974.

Survey and procedure	Domain	Direct expansions	Sampling errors	Relative sampling errors
		(000)	(000)	(%)
Area Frame Tract				
E.O. Operation Concept	E.O.	134.0	6.3	4.7
	Overlap	2,688.8	---	---
	Nonoverlap	742.3	---	---
	Total	3,565.1	214.4	6.0
E.O. Operator Concept, Alt. III	E.O.	129.8	7.2	5.6
	Overlap	2,688.8	---	---
	Nonoverlap	761.3	---	---
	Total	3,579.9	215.2	6.0
Multiple Frame				
Original Survey	E.O.	133.6	6.9	5.2
	List	3,314.5	118.5	3.6
	Nonoverlap[1/]	742.3	91.4	3.4
	Total	4,190.3	149.8	3.6
Second Look	E.O.	129.8	7.2	5.6
	List	3,234.0	117.7	3.6
	Nonoverlap[1/]	765.1	92.4	12.1
	Total	4,128.9	149.8	3.6
Alternative IIA	E.O.	129.8	7.2	5.6
	List	3,305.8	118.8	3.6
	Nonoverlap[1/]	712.3	90.7	12.7
	Total	4,147.9	149.7	3.6
Alternative IIB	E.O.	129.8	7.2	5.6
	List	3,299.5	119.1	3.6
	Nonoverlap[1/]	712.3	90.7	12.7
	Total	4,141.6	149.9	3.6
Alternative III	E.O.	129.8	7.2	5.6
	List	3,108.5	118.1	3.8
	Nonoverlap[1/]	920.0	107.4	11.7
	Total	4,158.3	159.8	3.8

[1/] Computed using tract estimator instead of weighted estimator.

Table 6--Area frame and multiple frame hog survey estimates based on the original survey, second look and alternative nonoverlap procedures--Kentucky, June 1974.

Survey and procedure	Domain	Direct expansions	Sampling errors	Relative sampling errors
		(000)	(000)	(%)
Area Frame Tract				
E.O. Operation Concept	E.O.	232.3	11.9	5.1
	Overlap	749.6	---	---
	Nonoverlap	298.2	---	---
	Total	1,280.1	156.3	12.2
E.O. Operator Concept, Alt. III	E.O.	231.5	15.4	6.7
	Overlap	749.6	---	---
	Nonoverlap	298.2	---	---
	Total	1,279.3	156.1	12.2
Multiple Frame				
Original Survey	E,O.	233.9	15.2	6.5
	List	803.9	79.3	9.9
	Nonoverlap[1/]	298.2	72.4	24.3
	Total	1,336.0	108.4	8.1
Second Look	E.O.	239.0	15.4	6.4
	List	790.6	78.9	10.0
	Nonoverlap[1/]	302.7	72.5	23.9
	Total	1,332.4	108.1	8.1
Alternative IIA	E.O.	239.0	15.4	6.4
	List	848.5	100.4	11.8
	Nonoverlap[1/]	298.2	72.4	24.3
	Total	1,385.7	124.7	9.0
Alternative IIB	E.O.	240.5	15.4	6.4
	List	843.1	100.3	11.9
	Nonoverlap[1/]	298.2	72.4	24.3
	Total	1,381.8	124.6	9.0
Alternative III	E.O.	231.5	15.4	6.7
	List	713.8	70.3	9.9
	Nonoverlap[1/]	308.7	72.9	23.6
	Total	1,254.1	102.5	8.2

[1/] Computed using tract estimator instead of weighted estimator.

Table 7--Area frame and multiple frame cattle survey estimates based on the original survey, second look and alternative nonoverlap procedures--Idaho, June 1975.

Survey and procedure	Domain	Direct expansions	Sampling errors	Relative sampling errors
		(000)	(000)	(%)
Area Frame Tract				
E.O. Operation Concept	E.O.	576.6	14.1	2.4
	Overlap	1,484.6	---	---
	Nonoverlap	320.2	---	---
	Total	2,381.4	224.9	9.4
E.O. Operator Concept, Alt. III [2/]				
Multiple Frame				
Original Survey	E.O.	569.7	15.7	2.8
	List	1,476.6	50.8	3.4
	Nonoverlap [1/]	320.2	54.3	16.9
	Total	2,366.5	76.0	3.2
Second Look	E.O.	558.1	15.0	2.7
	List	1,449.3	50.1	3.5
	Nonoverlap [1/]	382.6	66.6	17.4
	Total	2,389.9	84.7	3.5
Alternative IIA	E.O.	561.7	14.9	2.7
	List	1,490.5	51.5	3.5
	Nonoverlap [1/]	357.9	60.8	17.0
	Total	2,410.1	81.0	3.4
Alternative IIB	E.O.	560.8	15.0	2.7
	List	1,498.5	52.5	3.5
	Nonoverlap [1/]	357.9	60.8	17.0
	Total	2,417.3	81.7	3.4
Alternative III	E.O.	555.3	15.2	2.7
	List	1,398.9	50.1	3.6
	Nonoverlap [1/]	420.0	79.1	18.8
	Total	2,374.2	94.8	4.0

[1/] Computed using tract estimator instead of weighted estimator.

[2/] Not available.

Table 8--Area frame and multiple frame cattle survey estimates based on the original survey, second look and alternative nonoverlap procedures--Minnesota, June 1975.

Survey and procedure	Domain	Direct expansions	Sampling errors	Relative sampling errors
		(000)	(000)	(%)
Area Frame Tract				
E.O. Operation Concept	E.O.	180.2	8.4	4.7
	Overlap	3,855.4	---	---
	Nonoverlap	907.9	---	---
	Total	4,943.5	295.2	6.0
E.O. Operator Concept, Alt. III	E.O.	153.5	8.4	5.5
	Overlap	3,855.4	---	---
	Nonoverlap	907.9	---	---
	Total	4,916.8	295.2	6.0
Multiple Frame				
Original Survey	E.O.	161.6	8.3	5.1
	List	3,156.9	101.1	3.2
	Nonoverlap[1/]	907.9	124.3	13.7
	Total	4,226.4	160.4	3.8
Second Look	E.O.	162.2	8.3	5.1
	List	3,148.5	101.0	3.2
	Nonoverlap[1/]	905.3	124.3	13.7
	Total	4,216.0	160.4	3.8
Alternative IIA	E.O.	173.5	8.7	5.0
	List	3,226.2	102.6	3.2
	Nonoverlap[1/]	734.9	106.4	14.5
	Total	4,134.7	148.1	3.6
Alternative IIB	E.O.	173.5	8.7	5.0
	List	3,231.8	103.2	3.2
	Nonoverlap[1/]	734.9	106.4	14.5
	Total	4,140.2	148.5	3.6
Alternative III	E.O.	153.5	8.4	5.5
	List	3,057.2	102.1	3.3
	Nonoverlap[1/]	1,033.7	156.1	15.1
	Total	4,244.3	186.7	4.4

[1/] Computed using tract estimator instead of weighted estimator.

Table 9--Area frame and multiple frame hog survey estimates based on the original survey, second look and alternative nonoverlap procedures--Minnesota, June 1975.

Survey and procedure	Domain	Direct expansions	Sampling errors	Relative sampling errors
		(000)	(000)	(%)
Area Frame Tract				
E.O. Operation Concept	E.O.	272.1	18.7	6.9
	Overlap	2,095.7	---	---
	Nonoverlap	450.2	---	---
	Total	2,818.0	314.3	11.2
E.O. Operator Concept, Alt. III	E.O.	229.9	19.8	8.6
	Overlap	2,095.7	---	---
	Nonoverlap	450.2	---	---
	Total	2,775.8	314.4	11.3
Multiple Frame				
Original Survey	E.O.	260.9	19.2	7.4
	List	2,016.7	136.4	6.8
	Nonoverlap[1/]	450.2	100.4	22.3
	Total	2,727.8	170.4	6.2
Second Look	E.O.	241.7	19.1	7.9
	List	1,984.0	135.7	6.8
	Nonoverlap[1/]	445.4	100.0	22.4
	Total	2,671.1	169.8	6.4
Alternative IIA	E.O.	258.0	19.8	7.7
	List	2,068.4	139.0	6.7
	Nonoverlap[1/]	407.2	98.7	24.2
	Total	2,733.6	171.6	6.3
Alternative IIB	E.O.	260.5	19.9	7.6
	List	2,066.6	139.1	6.7
	Nonoverlap[1/]	407.2	98.7	24.2
	Total	2,734.3	171.7	6.3
Alternative III	E.O.	229.9	19.8	8.6
	List	1,895.4	135.3	7.1
	Nonoverlap[1/]	494.9	105.1	21.2
	Total	2,620.2	172.4	6.6

[1/] Computed using tract estimator instead of weighted estimator.

Table 10--Area frame and multiple frame cattle survey estimates based on the original survey, second look and alternative nonoverlap procedures--Ohio, June 1975.

Survey and procedure	Domain	Direct expansions	Sampling errors	Relative sampling errors
		(000)	(000)	(%)
Area Frame Tract				
E.O. Operation Concept	E.O.	79.5	4.3	5.4
	Overlap	1,629.0	---	---
	Nonoverlap	678.9	---	---
	Total	2,387.4	162.8	6.8
E.O. Operator Concept, Alt. III	E.O.	75.8	4.7	6.2
	Overlap	1,629.0	---	---
	Nonoverlap	678.9	---	---
	Total	2,383.7	162.8	6.8
Multiple Frame				
Original Survey	E.O.	79.5	4.6	5.8
	List	1,915.5	69.6	3.6
	Nonoverlap[1/]	678.9	102.6	15.1
	Total	2,673.9	124.1	4.6
Second Look	E.O.	77.1	4.6	6.0
	List	1,901.8	68.9	3.6
	Nonoverlap[1/]	755.9	168.6	22.3
	Total	2,734.8	182.2	6.7
Alternative IIA	E.O.	77.8	4.7	6.0
	List	1,979.8	79.8	4.0
	Nonoverlap[1/]	684.5	165.7	24.2
	Total	2,742.1	184.0	6.7
Alternative IIB[2/]				
ALternative III	E.O.	75.8	4.7	6.2
	List	1,791.7	66.4	3.7
	Nonoverlap[1/]	901.3	178.2	19.8
	Total	2,768.8	190.3	6.9

[1/] Computed using tract estimator instead of weighted estimator.

[2/] Alternative IIB could not be used since Ohio did not stratify their entire list.

Table 11--Area frame and multiple frame hog survey estimates based on the original survey, second look and alternative nonoverlap procedures--Ohio, June 1975.

Survey and procedure	Domain	Direct expansions	Sampling errors	Relative sampling errors
		(000)	(000)	(%)
Area Frame Tract				
E.O. Operation Concept	E.O.	191.2	19.7	10.3
	Overlap	1,187.9	---	---
	Nonoverlap	204.6	---	---
	Total	1,583.7	320.9	20.3
E.O. Operator Concept, Alt. III	E.O.	168.6	21.0	12.5
	Overlap	1,187.9	---	---
	Nonoverlap	204.6	---	---
	Total	1,561.1	321.0	20.6
Multiple Frame				
Original Survey	E.O.	194.6	21.0	10.8
	List	979.6	60.0	6.1
	Nonoverlap[1/]	204.6	71.9	35.1
	Total	1,378.8	95.9	7.0
Second Look	E.O.	181.0	20.7	11.4
	List	972.2	59.8	6.2
	Nonoverlap[1/]	217.4	72.9	33.6
	Total	1,370.5	95.8	7.0
Alternative IIA	E.O.	186.6	21.1	11.3
	List	1,002.8	61.0	6.1
	Nonoverlap[1/]	158.6	58.3	36.8
	Total	1,348.0	86.9	6.4
Alternative IIB[2/]				
Alternative III	E.O.	168.6	21.0	12.5
	List	922.2	59.8	6.5
	Nonoverlap[1/]	274.3	105.3	38.4
	Total	1,365.1	122.9	9.0

1/ Computed using tract estimator instead of weighted estimator.

2/ Alternative IIB could not be used since Ohio did not stratify their entire list.

Table 12--Contribution of partnership and corporate arrangements to area frame, list frame and extreme operator cattle survey estimates--Iowa, Kentucky and Illinois, June 1974.

STATE AND SURVEY ESTIMATE	TOTAL SAMPLE SIZE	ESTIMATED NO. OF ANIMALS (000)	CONTRIBUTION OF PARTNERSHIPS					
			TOTAL		PART. NAME ON LIST		PART. NAME NOT ON LIST	
			% OF SPL.	% OF EST.	% OF SPL.	% OF EST.	% OF SPL.	% OF EST.
IOWA								
Area Frame 1/	1,646	8,329.5	7.2	11.1	2.4	2.2	4.9	8.9
List Frame 2/	1,180	6,172.6	7.6	11.3	4.0	7.3	3.6	4.0
E.O. 3/	179	267.0	28.5	33.3	23.5	31.6	5.0	1.6
KENTUCKY								
Area Frame 4/	1,454	3,431.1	5.1	11.7	1.2	4.1	3.9	7.6
List Frame 2/	1,775	3,314.5	7.0	10.6	3.0	6.7	4.0	4.0
E.O. 3/	88	133.6	6.8	5.2	6.8	5.2	.0	.0
ILLINOIS								
Area Frame 1/	1,214	2,542.0	9.6	15.1	6.4	5.1	3.1	10.0
List Frame 2/	1,372	2,817.9	6.9	11.6	2.4	3.4	4.4	8.2
E.O. 3/	39	64.6	12.8	22.1	.0	.0	12.8	22.1

1/ Agricultural tracts excluding extreme operators.
2/ Excluding extreme operators
3/ Multiple Frame expansion
4/ Agricultural tracts, excluding extreme operators, in segments not rotated in 1974.

Table 13-Contribution of partnership and corporate arrangements to area frame, list frame and extreme operator hog survey estimates - Iowa, Kentucky and Illinois, June 1974.

STATE AND SURVEY ESTIMATE	TOTAL SAMPLE SIZE	ESTIMATED NO. OF ANIMALS	CONTRIBUTION OF PARTNERSHIPS					
			TOTAL		PART. NAME ON LIST		PART. NAME NOT ON LIST	
			% OF SPL.	% OF EST.	% OF SPL.	% OF EST.	% OF SPL.	% OF EST.
IOWA		(000)						
Area Frame 1/	1,646	14,255.7	7.2	11.2	2.4	1.5	4.9	9.7
List Frame 2/	1,341	10,719.4	6.9	8.8	3.1	5.6	3.9	3.1
E.O. 3/	105	458.1	29.5	25.6	18.1	21.2	11.4	4.4
KENTUCKY								
Area Frame 4/	1,454	1,047.8	5.1	4.6	1.2	.0	3.9	4.6
List Frame 2/	1,744	803.9	5.5	17.6	2.8	6.2	2.7	11.5
E.O. 3/	121	233.9	39.7	43.2	33.9	42.2	5.8	1.0
ILLINOIS								
Area Frame 1/	1,214	6,158.6	9.6	5.2	6.4	4.1	3.1	1.1
List Frame 2/	1,609	4,787.9	6.8	11.8	2.9	4.9	3.9	7.0
E.O. 3/	110	625.6	20.9	23.7	6.4	8.4	14.6	15.3

1/ Agricultural tracts excluding extreme operators.
2/ Excluding extreme operators
3/ Multiple Frame expansion
4/ Agricultural tracts, excluding extreme operators, in segments not rotated in 1974.

Table14--Contribution of partnership and corporate arrangements to area frame, list frame and extreme operator cattle survey estimates - Ohio, Minnesota and Idaho, June 1975.

STATE AND SURVEY ESTIMATE	TOTAL SAMPLE SIZE	ESTIMATED NO. OF ANIMALS (000)	CONTRIBUTION OF PARTNERSHIPS					
			TOTAL		PART. NAME ON LIST		PART. NAME NOT ON LIST	
			% OF SPL.	% OF EST.	% OF SPL.	% OF EST.	% OF SPL.	% OF EST.
OHIO								
Area Frame 1/	1,333	2,307.9	7.4	7.2	1.5	0.4	5.9	6.8
List Frame 2/	1,599	1,915.5	6.6	9.9	1.6	3.4	5.0	6.5
E.O 3/	106	79.5	22.6	23.0	18.9	19.6	3.8	3.4
MINNESOTA								
Area Frame 1/	1,475	4,763.3	10.9	4.4	4.2	0.1	6.7	4.3
List Frame 2/	1,306	3,156.9	7.0	10.0	2.5	3.8	4.4	6.2
E.O 3/	211	161.6	30.8	32.5	12.3	14.3	18.5	18.2
IDAHO								
Area Frame 4/	1,035	1,804.8	4.4	6.3	1.8	0.2	2.6	6.0
List Frame 2/	1,230	1,476.6	19.2	29.8	15.4	25.0	3.8	4.8
E.O. 3/	272	569.7	36.8	40.2	27.6	31.8	9.2	8.5

1/ Agricultural tracts excluding extreme operators.
2/ Excluding extreme operators
3/ Multiple Frame expansion
4/ Agricultural tracts, excluding extreme operators, in segments not rotate in 1975. Contribution of partnerships in public grazing segments is not included.

Table 15.--Contribution of partnership and corporate arrangements to area frame, list frame and extreme operator hog survey estimates - Ohio and Minnesota, June 1975.

STATE AND SURVEY ESTIMATE	TOTAL SAMPLE SIZE	ESTIMATED NO. OF ANIMALS (000)	CONTRIBUTION OF PARTNERSHIPS					
			TOTAL		PART. NAME ON LIST		PART. NAME NOT ON LIST	
			% OF SPL.	% OF EST.	% OF SPL.	% OF EST.	% OF SPL.	% OF EST.
OHIO								
Area Frame 1/	1,333	1,392.5	7.4	3.7	1.5	.0	5.9	3.7
List Frame 2/	1,790	979.6	4.0	8.5	0.7	2.5	3.3	6.0
E.O. 3/	74	194.6	37.8	54.4	24.3	39.9	13.5	14.5
MINNESOTA								
Area Frame 1/	1,475	2,546.0	10.9	2.1	4.2	.0	6.7	2.1
List Frame 2/	1,627	2,016.7	5.8	14.5	3.8	9.3	2.0	5.2
E.O. 3/	99	260.9	23.2	26.5	14.1	17.5	9.1	9.0

1/ Agricultural tracts excluding extreme operators.
2/ Excluding extreme operators
3/ Multiple Frame expansion