

Identifying Sources of Survey Errors: the 2007 Classification Error Survey for the United States Census of Agriculture

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Abstract

For the 2002 Census of Agriculture (COA), the number of operations misclassified (either as farms or non-farms) in the COA was estimated. Operations in NASS's June Agricultural Survey (JAS) and the COA were matched and their answers compared. Misclassification estimates were based on the assumption that the JAS was *truth*. The misclassification rate was small but it was clear that the JAS assumption was not always justified. The 2007 Classification Error Survey focused on understanding why operations reported differently in the JAS and COA, rather than estimating misclassification. Operations in the 2007 COA and JAS were matched but neither report was assumed as *truth*. Instead, operations were reinterviewed and respondents asked to resolve discrepancies. More errors were found in the JAS than in the COA, and were related to respondents, enumerators and NASS procedures. A multipart solution will be required to address them.

Key Words: Reporting Errors, Classification Errors, Reinterviews, Record Linkage

1. Introduction

The Census of Agriculture (COA), is conducted every five years (for years ending in 2 and 7) by the USDA's National Agricultural Statistics Service (NASS). The COA is a complete count of United States (U.S.) farms and ranches and the people who operate them. For census purposes, a farm is defined as a place from which \$1000 or more of agricultural products were produced and sold, or normally would have been sold, during the census year. The census collects data on land use and ownership, operator characteristics, production practices, income and expenditures and many other characteristics. The outcome, when compared to earlier censuses, helps to measure trends and new developments in the agricultural sector of our nation's economy. Census forms are mailed to all known and potential agricultural operations in the U.S beginning in December and data is collected primarily by mail return over the next several months. The census provides the only source of uniform, comprehensive agricultural data for every county in the nation.

In addition to a Census of Agriculture, NASS conducts an area frame based survey each June, which collects information about U.S. crops, livestock, grain storage capacity, and type and size of farms and is used to produce current commodity acreage estimates. The area frame is a theoretically complete sampling frame with every acre of land having a known chance of selection. As such, it can be used both as a stand-alone frame and to measure errors in a list. The June Agricultural Survey (JAS) samples designated land areas (segments) which field enumerators visit and collect data on all agricultural activity

occurring within the segments. A typical segment is about one square mile, which is equivalent to 640 acres. Each segment is outlined on an aerial photo which is provided to the appropriate field enumerator. Each segment is divided into tracts of land, each representing a unique land operating arrangement. Each tract is then screened to determine whether it is part of an agricultural operation. This may include both land inside and outside the tract. Agricultural operators are interviewed and information about the tract's land inside the segment and its entire operation is collected. Data is collected with in person interviews over the course of approximately two weeks beginning June 1st.

The JAS can be used to estimate the number of farms not on the census mail list or coverage error, as well as the number of farms misclassified. This report discusses misclassification errors. Following each census, an evaluation is conducted to measure misclassification of farms on the census mail list. Each record on the census is either in-scope (IS), i.e. a farm, or out-of- scope (OS) i.e. a non-farm. Classification errors on the census consist of undercount due to farms incorrectly classified as OS, overcount due to non-farms incorrectly classified as IS, and overcount due to farms occurring on the list more than once.

Prior to the 1997 Census of Agriculture, a list based reinterview sample of census respondents in a Classification Error Survey (CES) was used to measure classification errors on the census. Separately, the NASS area frame survey served to measure incompleteness of the census mail list, which is by far the largest component of coverage inaccuracies on the census.

Following the 1997 Census, a real-time Classification Error Study was conducted for the eleven western states of Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming, which comprise the West Census Region. This was done to evaluate the feasibility of using the NASS area frame both to measure misclassification errors and to replace the Classification Error Survey reinterview approach that was being used. The 1997 Classification Error Study results indicated a net undercount of 27,971 farms for those eleven states. While the standard error of this estimate is not available to determine statistical significance, even if statistically significant, it represents a relatively small portion of the overall number of farms. Recommendations were to replace the Classification Error Survey reinterview approach with the Classification Error Study using the area frame (Johnson, 2000).

After the 2002 Census of Agriculture, the Classification Error Study using an area frame approach was conducted in the 48 coterminous states. This was a quantitative study and its main objective was to determine the relative size and likelihood of classification errors to warrant future studies. The underlying basis for the analysis and all quantitative results was an assumption that the area frame survey classification was correct. Census records were matched to Area Frame records and differences in scope of the operations between the two surveys were identified. Results of the 2002 study showed a net misclassification overcount of 51,345 farms for the U.S. The classification error was small and was not used to adjust census numbers. The eleven states from the 1997 study were also compared in 2002 and results indicated a statistically insignificant net overcount of 5,438 farms.

The results of the 2002 study indicated that although the Classification Error Study comprised a small portion of the overall coverage number, it needed to be addressed

further. The 2002 Classification Error Study found an overall misclassification overcount of farms, while in the 1997 Classification Error Study there was a net misclassification undercount of farms. Due to this inconsistency from census to census, it was recommended the study be conducted again in 2007 with a focus on addressing reasons for discrepancies between June and the census instead of a quantitative measure of the errors (Abreu, 2007).

2. Background of the 2007 Classification Error Survey (CES)

For any given year the farm versus non-farm classification for operations should generally agree between the JAS and the census for that year. However, many operations do not report consistently between them and the reasons for these discrepancies cannot be determined from the questionnaires alone. Some discrepancies are due to legitimate changes in acres operated between June and the end of the year, though these are relatively rare. More frequently, the discrepancies are the result of misclassification of the operation in either the JAS or the census. This may be due to how the forms were processed, because it was not clear what should be reported on a questionnaire, because only part of the operation was included, or due to some other reporting error.

Because classification error is not used to adjust census numbers, more benefits can be gained from examining *why* errors occur rather than from estimating the amount of classification error. For 2007, the primary purpose of the CES was to identify reasons for the discrepancies between the two sources, both true and spurious differences. Recommendations from the 2007 Council on Food, Agriculture, and Resource Economics (C-FARE)'s independent evaluation of the Census of Agriculture suggested this type of analysis. In regard to possible classification errors, the panel suggested investigating potential coverage issues arising from new (birth) and exiting (death) farms following the 2007 JAS but before the 2007 Census of Agriculture. The frequency of such births is one of the issues that were examined in the CES.

In the 2007 CES, discrepancies between the 2007 Census of Agriculture and the 2007 JAS were examined. The CES was a qualitative examination of why errors occur, both classification and reporting errors. Data from both the 2007 Census of Agriculture and the 2007 JAS was compared for a sample of operations. In cases where they did not agree, respondents were reinterviewed. Reinterviews have been used in the past by NASS to examine potential problems in survey reporting (Hanuschak et. al., 1991). Reconciliation interviews at other organizations have also proved beneficial in identifying reasons for discrepancies due to comprehension, recall, encoding, response options, or other problems (Morton et. al., 2008). In the 2007 CES reinterviews, respondents were asked to review their questionnaires and resolve discrepancies, if possible. The census collects data for 2007 with no reference to a specific date. The JAS, on the other hand, asks for data as of June 1st. The focus of the reinterviews was on operations in both the JAS and COA classified as in-scope on one and out-of-scope on the other. In addition, operations with large acreage discrepancies between June 2007 and the COA were also reinterviewed. Findings related to operations reporting large acreage discrepancies are discussed elsewhere (Abreu, Dickey and McCarthy, 2009) and are not included in this paper.

The objectives of this study were to examine 1) if the change in scope and acreage was legitimate, 2) if respondents were reporting incorrectly and 3) if the forms were processed

correctly in both cases. If the intent of the forms and how to report is unclear to respondents, improvements to these forms and processing procedures for the next census may be necessary. The information could help improve the quality of the data and/or reduce analyst review and editing.

3. Methodology

For the 2007 CES, additional name, address, and telephone information was collected on both the 2007 JAS and the 2007 Agricultural Coverage Evaluation Survey (ACES) through the addition of three questions to the survey instruments. These questions collected information on landlords, additional addresses, and names (i.e., spouse, partners) which could be related to the operation.

Probabilistic record linkage was used to match this additional information to the names and addresses on the 2007 Census Mail List (CML) for Arizona (AZ), Georgia (GA), Minnesota (MN), New York (NY), and Washington (WA). Probabilistic record linkage is a technique used to identify records that were believed to correspond to a CML record. Records were brought together into link groups which possibly represented the same operation. Each link group was classified into one of three distinct types: definite match, possible match or non-match (Broadbent et. al., 1999). Definite matches consisted of record pairs that with great certainty identified the same operation. Non-matches were singleton area records which did not match any census record. Possible matches were record pairs which required manual review by Field Office (FO) staff for determination of match/non-match status. Non-matches were considered out of scope for the study.

Matched link groups were divided into three groups based on specific characteristics of the JAS and census records and the action they would require. The groups identified were: 1) Classification in agreement with comparable acres (census and JAS both in-scope (IS) or census and out-of-scope (OS) and JAS non-ag); 2) Classification in agreement with acreage differences more than 25 percent; and 3) Classification conflicts (census in-scope and JAS non-ag or census out-of-scope and JAS in-scope). Table 1 presents the breakdown of the records by reinterview status. The table shows the general group description, detailed characteristics of the records, the action that was undertaken, the total number of records in each group and the number in the pool eligible for reinterview.

Table 1: Identifying Groups to Reinterview

Group Description	Characteristics of records	Action	Total	%	Completed Reinterviews
Classification in agreement, acres comparable	Census IS / JAS IS OR Census OS / JAS Non-ag	No Action	1,629	44.40	
Classification in agreement, acres not w/in 25%	Census IS / JAS estimated IS	No Action; assume JAS incorrect	240	6.54	
	Census IS / JAS IS	Reinterview	1,122	30.60	147
Classification Conflict	Data reported on Census, but assigned OS by NASS / JAS IS	FO Review Only	158	4.31	
	Census OS / JAS IS	Reinterview	185	5.05	9
	Census OS / JAS not interviewed, estimated IS	No Action; assume JAS incorrect	53	1.45	
	Census IS / JAS Non-ag	Reinterview	279	7.61	58
	Total			3,666	100

Based on the characteristics of the records within each of the three groups, operations eligible for a reinterview were identified. No reinterview was necessary for records where the census and JAS were both correctly scoped (either as farms or non-farms) and their acreages were comparable (within 25-percent). The groups identified to be reinterviewed were:

- 1) Acreage differences: Census in-scope and JAS in-scope records with acreage differences more than 25 percent;
- 2) Scoping differences: Census records out-of-scope and JAS in-scope; and
- 3) Scoping differences: Census in-scope and JAS out-of-scope.

The last two of these groups are the records which are the focus of this paper. Operations which reported some data on the census but were classified out-of-scope by NASS and were classified as IS on the JAS were reviewed in the field office. No action was taken on any records where the JAS data were estimated. In these cases, the JAS was assumed to be incorrect.

Interviews were conducted between July 7 and August 15, 2008. Because we were asking respondents to reconcile data reported in June 2007, respondents who were contacted for the 2008 JAS were excluded from the scope of the CES to avoid any time period confusion. The 2008 JAS estimated by NASS (refusals and non-contacts) were also excluded. The number of respondents in each category reinterviewed is shown in Table 1.

For each contact, field enumerators received a packet containing a copy of the respondent's 2007 JAS Questionnaire, a copy of the respondent's 2007 Census of Agriculture Report Form, and a 2007 Classification Error Survey Questionnaire. Enumerators reviewed the data on the operation's questionnaires before they conducted the CES interview. Enumerators needed to be familiar with what was reported and with any other information on both the JAS and census forms. If it was obvious why there was a discrepancy (for example, the data was reported on both forms, but NASS classified it differently), then the operation was not reinterviewed.

The CES questionnaire was completed through face-to-face interviewing so the respondent could review their JAS and census forms. Showing the respondent their questionnaires helped refresh their memory as there was a substantial time lag between the CES and when the census and JAS were conducted. It was important that the same person who completed the questionnaires was the person reinterviewed for the CES. During the interviews, respondents were asked to review their questionnaires and determine which figure (census or JAS) was correct and to explain the discrepancy. They were also asked to provide detailed comments on what was wrong and why. They were also asked general follow-up questions about reporting acreage.

4. Results

Classification conflicts occurred when census in-scope records matched JAS non-ag records; or census out-of-scope records matched JAS in-scope records. Sixty seven cases (58 and 9 respectively) had scoping differences and were reinterviewed. Of those reinterviewed, 40 stated the census was correct, 10 the JAS was correct, 9 said both were correct, and the remaining 8 said neither was correct. Results are shown in Table 2.

During the 2002 Classification Error Study, the JAS was assumed as truth. However, operations are misclassified in the census, only when their *census* classification is incorrect. If they are classified differently on the census and JAS, but the census is correct, they are not misclassified on the census. Thus, an important aspect of the 2007 CES reinterviews was to ask respondents which source was correct. The results showed that the census report was correct more often than the JAS report (see Table 2), which refutes the assumption used in 2002 that the JAS represented truth. This implies that census misclassification estimates calculated in the 2002 and 1997 CES were most likely significantly overstated. Many of the cases where there were discrepancies between the census and the JAS in those studies were also likely errors on the JAS, NOT misclassification on the census. Of the 67 cases of discrepancies for this study that would have been counted as census misclassifications with the “JAS as truth” assumption, only 15 percent were truly cases of misclassification.

Table 2: Which Source is Correct?

Which Source is Correct?	Number	Percent
Census is correct	40	59.7%
JAS is correct	10	15.0%
Both are correct	9	13.4%
Neither is correct	8	11.9%
Total	67	100.0%

After identifying which source was correct, respondents were asked to provide the reason(s) for the discrepancies. For the cases where the census response was correct, the main reason for the discrepancy was a failure to report agricultural land outside the segment. As a result of this, the operation was made out-of-scope by NASS at the time

of the JAS. There were 16 cases in which JAS segments had been improperly screened, resulting in the survey missing valid farm operations. Some examples of the comments validating this problem were “enumerator only observed tract and coded it non-agricultural” and “996 acres were in my segment in June Ag, all were non-agricultural, respondent was not contacted in June.”

Another very important source of error in the JAS was attributed to different respondents completing the reports (15 cases). During the CES reinterviews, these respondents indicated that a report was answered by a person other than the primary operator. “Ted’s mother did the JAS and did not know the correct answer” and “Wife or help responded” were some of the comments provided by respondents. This is likely a problem due to the relatively short data collection period for the JAS (approximately 2 weeks). If the primary operator cannot be located within this time, reports may be taken from other respondents, if it is felt they are knowledgeable. There were 7 reports of respondents that estimated the acres on the JAS. Again, in a short data collection period, which occurs at a busy time for farmers, respondents may take shortcuts to complete the interviews. Finally, there were 10 reports where the discrepancies were due to exclusion of specific types of land, mainly land enrolled in the government Conservation Reserve Program (CRP) and rented acres. Comments such as “He didn’t consider CRP in June as crop acres” and “Missed reporting CRP in June” indicated that respondents had a difficult time knowing exactly how to report CRP and rented land.

In the cases where the JAS was correct, comments such as “They thought they were not a farm as they only grow hay” and “Own/Operate 26 acres, keep horses...No longer board horses so we do not consider ourselves farmers” revealed that respondents were screening themselves out of the census. There were three reports of respondents who did not consider their operations as farms at the time of the census and as a result did not complete the census questionnaire although the instructions did indicate that they should complete the form.

There were only two incidences of discrepancies between the JAS and the census that were indicative of true change in an operation where land was either purchased or sold. Whenever land is purchased it constitutes a true change in an operation, especially if the operator did not own any land at the time of the JAS. Operators that purchased land reported it correctly at the time of the census. However, operators who sold their land after the JAS interview should have reported for the part of the year they were operating and should have included ALL their land in the census questionnaire. Although selling their land constituted a true change in their operation, this case was reported incorrectly. The other cases with discrepancies between JAS and the census were differences attributed to the forms referring to different operations owned by the respondent (four reports) or operations which were out-of-scoped by NASS even though the same information was reported in both cases.

There were also eight cases where neither the census nor the JAS was correct. The key reasons for the discrepancies were that respondents estimated the acreage on both reports or they had difficulty reporting rented land.

In summary, for respondents with scoping differences, the census was correct more often than the JAS. This finding refuted the JAS assumption of truth used in 2002 CES. The results showed that a miniscule number of the cases constituted real changes between the

census and the JAS. In addition, the amount of misclassification in the census is small and the net effect of misclassification on estimates is even smaller. It is much less than would have been estimated using the JAS assumption of truth. The primary reasons for explained differences in scoping were incorrect screening of tract operations in the JAS, respondent errors in estimation of acreage, the use of proxy respondents, and the exclusion of specific types of land (i.e., CRP, woods, rented).

During the reinterviews, respondents were also asked what source they used to report their acreages. Estimation of acres from memory was by far the most common source as shown in Table 3. This finding suggests that some level of error will likely always be present for reports of farm acreage.

Table 3: Source Used to Report Acres on Census Questionnaire

Source Used to Report Acres ¹	Number (n=67)	Percent
I know my acreage	34	50.8%
Tax records	7	10.5%
FSA records	4	6.0%
Operation books	10	14.9%
Other records (ie., deed, GPS #s)	1	1.5%

5. Discussion and Conclusion

The initial objective of the CES was to examine error in the Census of Agriculture, based on the implicit assumption that the survey being used to measure error, the June Agricultural Survey, was itself without error. However, the CES uncovered more errors in the JAS than in the census. This implies that the misclassification error, previously considered minimal, is even smaller than previous estimates would indicate. From this conclusion, and the fact that misclassification errors have not historically been used to adjust census numbers, lead to the recommendation not to use the CES to estimate census misclassification.

However, the errors uncovered in the CES came from several sources and have lead to several recommendations for the JAS. Due to the short data collection period and time of year enumerators are sometimes forced to use proxy respondents in the JAS. However, collecting data from proxy respondents should be minimized as much as possible and enumerator training should emphasize this.

The JAS is used for multiple purposes, and measuring census coverage error and misclassification is not its primary purpose. Therefore major changes to the JAS data collection procedures to improve estimates of the number of farms should be made with caution. Efforts to measure the amount of farms missed in the June Agricultural Survey are already underway. The 2009 JAS will be followed with an additional intensive screening of a subset of estimated and non-agricultural tracts to estimate the number of agricultural operations missed in the JAS. Results of that project may lead to suggest

¹ Respondents were allowed to select multiple answers.

possible changes for the JAS data collection procedures in the future. In addition, capture-recapture estimates will be made to statistically estimate the operations missing from both the census and the JAS.

From the perspective of the examination of survey (or in this case Census) error, one of the most important findings is that you cannot measure error in the census with something else that contains as much or more error. Matching records from two different sources was a valuable process for NASS as it uncovered errors in both of the sources. This will hopefully lead to improvements in both the Census of Agriculture and the JAS.

6. References

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