QUESTION ANSWERING STRATEGIES IN AGRICULTURAL SURVEYS

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Introduction and Background

The National Agricultural Statistics Service (NASS) is an agency within the U.S. Department of Agriculture which makes the official estimates of the nation's agriculture. Through 45 state field offices, over 2,000 interviewers gather information on production, supplies, marketing, prices, weather and other agricultural inputs by surveying over 750,000 farmers and ranchers each year. Estimates are produced at both state and national levels. (For more detailed information regarding NASS survey procedures see Scope and Methods of the Statistical Reporting Service, 1983.)

One type of question that often appears in NASS surveys is the inventory question that requests information on how much or how many of an item a respondent has. These questions are important because they are used to estimate supply. These estimates affect prices to producers, processors and eventually the consumer in the supermarket.

This paper will examine two specific inventory questions, Grain Stocks and Cattle on Feed (COF). A typical grain stocks question would appear as, "On December 1, was any WHOLE GRAIN CORN on hand or stored on the total acres operated? How many bushels?" The COF question appears as, "How many CATTLE and CALVES were on feed January 1, 1993 that will be shipped directly from your feedlot to slaughter market?" These questions are asked periodically throughout the year (monthly or quarterly depending on the state and item), so the reference month will change. Interviews are conducted during the first two weeks of the reference month. Although the composition of the sample changes from one reporting period to the next, many operations are contacted more than once during the year.

From previous research, it has been established that record usage for reporting among agricultural respondents is extremely low. (For example (Hood, 1993), only 6% of one sample of operations with less than 1000 head of cattle used records to report inventory.) Therefore, it is assumed that most inventory numbers will have to be mentally derived by the respondent instead of drawn directly from written accounts.

It is also known that operation inventory can range from very small to very large numbers. For the COF operations in the current study, inventory can range from zero head to over 1,000 head. For grain stocks, inventory can range from zero bushels to several hundred thousand bushels.

The current study is an examination of inventory question answering strategies, and attempts to answer several questions.

- Are inventory question answering strategies similar across different item types (grain stocks, COF)? Previous research (for example, Means, Swan, Jobe, Esposito and Loftus, 1989 and Blair and Burton, 1986) has shown that many strategies may be used to answer a single survey question and strategies may differ based on the characteristics of the information requested.
- Are question answering strategies similar across respondent types? For example, will smaller operations use different strategies than larger operations?
- How accurate is the inventory data collected? NASS does not know how accurate each respondent's information is because there is virtually no check data that can be matched back to individual operations to gauge accuracy.
- What may be the potential effect of providing additional information to respondents? Because NASS asks many inventory questions more than once throughout the year, there is often information from previous reports available. This is referred to as Historic Data (HD) and can be provided to respondents in later reporting periods while collecting current information. Currently, the effect of using this information on individual reports and aggregated estimates is not clear.

Methods

To answer these questions two studies were conducted. Ninety three cattle feeders in South Dakota and 93 additional Grain and Livestock operations in Ohio representing small, medium and large operations were contacted. Each was asked to participate in a Cognitive Interview which consisted of three parts.

The first part of each interview was a verbal protocol exercise in which the respondent was asked to think aloud and explicitly report how they were deriving their answer as they answered the target inventory question. This was followed by an additional series of questions which examined specific areas of question comprehension. The final part of the interview consisted of additional questions examining the effect of providing HD and asking them to recall their HD.

With the respondent's consent, most of the interviews were tape recorded. This paper will concentrate on the verbal protocol portion of the interviews. (For a complete report of the results of the entire interview, see Stanley (1993a), and Stanley (1993b).)

Following completion of the interviews, the question answering strategies reported in the verbal protocols were classified into types. Direct Retrieval strategies were those in which the respondent had the inventory number directly available in memory and did not have to perform any operations to derive it. (Also included in this group were the few respondents who had small enough inventory numbers to physically count items.)

Anchor and Adjustment strategies were those in which the respondent recalled a base figure and then made adjustments to it to arrive at the inventory number. For example, a respondent stating that they knew how much corn they had harvested and then subtracted from that number the amount they had fed to their livestock since harvest would be classified as using anchor and adjustment. Similarly, a cattle feeder who recalled their total cattle inventory and then subtracted those NOT on feed to arrive at the total number of cattle on feed would also be classified as using this strategy.

Addition of Subgroups were the cases where the respondent added smaller subgroups such as cattle pens or corn bins to arrive at the total inventory.

Use of Related Measure was the cases where knowledge of something other than the inventory was used to infer the inventory number. For example, if the respondent knew the rated volume of a bin and the bins were full, they inferred the total inventory of the bins.

Finally, strategies in which the respondent referred to records, either written or computerized, were classified as Record Usage strategy.

Results and Discussion

The reporting strategies used in small, medium and large COF operations are shown in the top of Figure 1. Direct retrieval was the most common strategy used, however, this strategy is not the most prevalent in the large operations. Large operations tend to use more addition of subgroups to arrive at their answers and also use records more often than smaller operations.

The reporting strategies for corn stocks are shown in the bottom of Figure 1. As is the case with COF reporting, records are used to report corn stocks more often in large operations than in medium or small operations. However, there are some substantial differences in the distribution of reporting strategies for COF and corn stocks inventory.

For grain stocks the most prevalent strategies were addition of subgroups and anchor and adjustment. In contrast to the strategies used in COF, overall, relatively few respondents use direct retrieval to report grain stocks inventory. (Although, the trend with more direct retrieval strategies used by small operations still appears here.)

The higher proportion of respondents using anchor and adjustment and addition of subgroups to report corn stocks inventory is fairly consistent across operation size. By comparing the distribution of question answering strategies for COF and grain stocks it is clear that the question answering process is somewhat different for these two items.

Respondents were also asked to rate how accurate they felt the inventory numbers they provided were. Accuracy ratings were much higher for COF than for grain stocks as can be seen in Figure 2. Most respondents reporting COF felt that their answer was the exact number. Few respondents reporting grain stocks inventory felt this way and several even reported that their answer was a guess. Again, this is a clear indication that the question answering process is different for COF and corn stocks.

In addition, respondents in this study were asked how they felt being provided with HD from their previous quarter's report would affect their report for their current inventory. Results for this question were similar for both COF and grain stocks with the overwhelming majority of respondents reporting both

that there would be no affect in regard to the ease of reporting (75.6%, COF and 75.3%, grain stocks) and no affect on the accuracy of their reports (71.4%, COF and 76.3%, grain stocks).

This is not surprising given the question answering strategies reported. The only strategy in which being provided with HD would be useful would be anchoring and adjustment using the HD as the anchor. Since this strategy is not very prevalent, most respondents naturally report that this information would not be useful for them. (Even those respondents reporting anchor and adjustment strategies for corn stocks typically used the end of harvest inventory as the anchor NOT the previous quarter's reported inventory.)

This study has clearly shown that while agricultural inventory items superficially appear similar, to the respondent they represent quite different response tasks. The respondent's question answering strategy differs depending on the particular type of item. Because the nature of the interaction between the respondent and various inventory items is different, what the respondent knows about the inventory and the ease with which it can be reported also differs.

COF operators have an intimate working knowledge of their inventory. Their livelihood depends on the buying and selling of their inventory. In contrast, most agricultural operators use their grain stocks to feed their livestock. Their total inventory is usually the result of their harvest, not buying, of grain. The most the respondent needs to know about the grain is that there is enough to feed the livestock. There is little reason for this operator to keep track of the exact amount that has been subtracted from the inventory or to know what the inventory is in a standard measure (like bushels). This makes the reporting task for an item such as grain stocks much more difficult and the reported numbers much less precise than for an item such as COF.

The inventory reporter's task also changes due to characteristics unique to the respondent, such as the size of their operation. Intuitively, we know that reporting that there are only a few of a particular item is a different task than reporting when there are extremely large numbers of them. This is clearly shown by the results of this study. Also, this study has shown that the utility of additional information (such as HD from previous reports) may be limited.

Taken together, the results of these two studies indicate that question authors and data users should be aware that items that appear similar often represent much different tasks to the respondent.

Because record usage is low, answering inventory questions can be a difficult task for those unable to use direct retrieval. When developing survey materials, the question answering strategies specific to each question should be known. Enumerators should be made aware of the possible question answering strategies and where they may differ so that they will be prepared when dealing with respondents. Other researchers (Jobe and Mingay, 1989) have found that providing memory cues can aid survey recall and reporting, but **only** when the cues are appropriate for the respondent. Prompts specifically designed to aid reporting should be covered in manuals and training materials and should be tailored to each respondent and each question. With the proper information in mind, the enumerator can prompt the respondent with appropriate strategies for question answering.

Providing HD to respondents is only rarely an appropriate memory aid. Therefore, the utility of prior report data should be evaluated against the cost to provide it. Including each respondent's previous inventory information is not a trivial task, therefore, the cost in time, staff and computing resources required to provide it may be too great if it is expected to produce little in increased data quality.

The quality of the data collected may be affected by both the specific subject of the question as well as the characteristics of the respondent. The respondent's task must be understood to ensure the highest quality data.

References

Blair, E. and Burton, S. (1987). Cognitive processes used by survey respondents to answer behavioral frequency questions. *Journal of Consumer Research*, 14, 280-288.

Hood, R. (1992). Analysis of response bias in the January 1992 cattle on feed reinterview pilot study and the July 1992 cattle on feed reinterview study. *SRB Research Report Number SRB-92-09*, USDA, National Agricultural Statistics Service, Washington, D.C.

Jobe, J. and Mingay, D. (1989). Cognitive research improves questionnaires. *American Journal of Public Health, 79(8)*, 1053-1055.

Means, B. Swan, G., Jobe, J., Esposito, J. and Loftus, E. (1989). Recall strategies for estimation of smoking levels in health surveys. *American*

Statistical Association, Proceeding of the Section on Survey Research Methods, 421-424.

Stanley, J.S. (1993a). An examination of the cognitive processes involved in answering cattle on feed inventory questions. *Data Collection Branch Staff Report Number 93-01*, USDA, National Agricultural Statistics Service, Washington, D.C.

Stanley, J.S. (1993b). An examination of the cognitive processes involved in answering grain stocks inventory questions. *Data Collection Branch Staff Report Number 93-02*, USDA, National Agricultural Statistics Service, Washington, D.C.

U.S. Department of Agriculture (1983). *Scope and Methods of the Statistical Reporting Service*, Miscellaneous Publication Number 1308, USDA, Washington, D.C.

Figure 1. Inventory Reporting Strategies

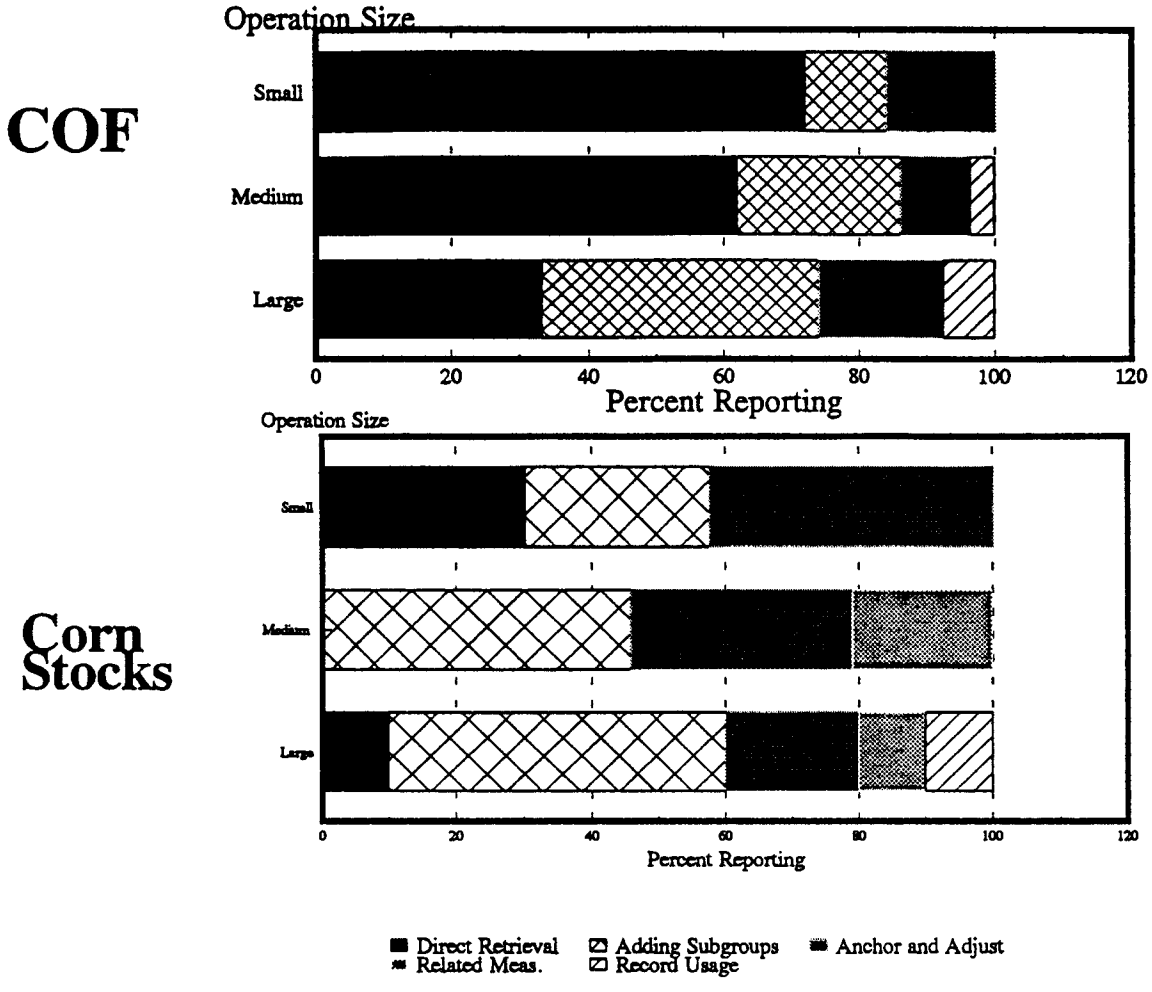

Figure 2. Subjective Accuracy Ratings