Appendix B: ARMS Coverage and Statistical Measures

Nearly 8,800 farm and ranch operators in the 48 contiguous States provided useable data for the Agricultural Resource Management Study (formerly called the Farm Costs and Returns Survey) during February and March of 1996 for the 1995 calendar year. The sample is drawn from two types of sources, one called a list frame and the other an area frame. The list frame is a list of known operators of farms stratified (sorted into groups) by farm size and other attributes. The list frame contains larger, more specialized operations. Maintaining a current list for smaller operations is difficult. Thus, an area frame is used to compensate for any incompleteness in the list frame. The area frame sample consists of land segments located within the 48 contiguous States stratified by land use. Rigorous procedures are followed to prevent the inclusion of any one operator in both sample frames.

The ARMS is a probability-based survey, where each respondent represents a number of farms of similar size and type. Thus, the sample data can be expanded by using appropriate weights to represent all farms in the 48 contiguous States. Estimates based on the expanded sample differ from what would have occurred if a complete enumeration had been taken. These differences result from nonsampling and sampling errors [*5*].

Nonsampling errors can be attributed to such sources as questionnaire design and data processing. Sampling errors may be related to sample selection, estimation, or nonresponse adjustment procedures. Although nonsampling errors cannot be measured directly, sampling error can be measured statistically.

One measure of sampling error is the relative standard error (RSE), a measure of relative dispersion of the data. The RSE, also called the coefficient of variation (CV) when computed for means, is calculated by dividing the standard error of the estimate by the estimate itself and multiplying the result by 100.

The standard error is a measure of variation within the sample. The standard error itself can be used to calculate a range of values around an estimate (such as a mean), which is likely to include the 'true' value for the population from which the sample is drawn with a given degree of confidence. This range of values is called the confidence interval. For example, while the national average acres operated in 1995 was estimated at 434 acres, the 95-percent confidence interval was 402 to 466. This means that, given the variation of the data in our sample, we are 95 percent confident that if we had data for every farm in the 48 contiguous States, the mean acres operated would lie between 402 acres and 466 acres.

Dividing the standard error of the mean by the mean itself eliminates the units of denomination (such as dollars or bushels) and eliminates the effects of scale (such as dollars or millions of dollars). Thus, the RSE is expressed as a percentage of the mean, allowing us to compare the relative dispersion of the data across items of different denominations and, at the same time, to infer the reliability of the estimate.

The higher the RSE, the less well the estimate represents individual items in the sample. For example, a sample of two items weighted equally with values of 0 and 100 has a mean of 50, as does a sample of two items with values of 48 and 52. However, the RSE of the first sample is high compared with the second sample, confirming a common-sense observation that a value of 50 does not represent 0 or 100 as well as it represents 48 or 52. Estimates with RSE's exceeding 25 percent are generally used with caution.

Because of space limitations, RSE's are not published in the tables, but estimates with RSE's higher than 25 percent are identified. One asterisk (*) preceding an estimate indicates an RSE greater than 25 percent but no more than 50 percent, while 2 asterisks (**) indicate an RSE greater than 50 percent but no more than 75 percent. Estimates with RSE's greater than 75 percent are not printed and are denoted with an "r."

We use the t-statistic to evaluate whether or not observed differences between means are statistically significant. Although t-statistics are not published in this report, the text generally makes comparisons between groups only when estimates are different at the 5-percent level of significance. This means that if we calculated a large number of sample means and the associated t-statistics, there is a 5-percent chance that the t-statistic would lead us to conclude that the means are different when they actually are not.

The relationship between the RSE and the t-statistic is, in general, the higher the RSE's, the lower the t-statistic and the less likely the means are different. This can be seen from the formula:

$$t = (\text{Mean}_A - \text{Mean}_B) / (\text{RSE}_A^{\ 2} + \text{RSE}_B^{\ 2})^{0.5}$$

When the t-statistic is less than 1.96, the difference between means is not significant at the 5-percent level of significance.

Survey data are also influenced by nonsampling errors. In order to minimize nonsampling errors, data are collected by personal interview and data collection procedures are made uniform and consistent across the Nation by extensively training and supervising data collectors [*13*]. Efforts are also undertaken to minimize other types of potential nonsampling errors by extensive editing of the data [*14*]. Questionnaires are edited by hand in NASS State offices and by NASS computerized routines in Washington, DC.

NASS personnel in Washington, DC, combine the data collected in the various States and use the reported information to construct farm size, geographic location, and production specialty variables for each farm operation, as well as the survey expansion factors used as weights. ERS constructs additional variables to classify farms and to summarize expenses, income, assets, debt, and other items related to farming.