The Four Roles of Sampling in Auditing: Representative, Corrective, Protective, and Preventive

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June 1969

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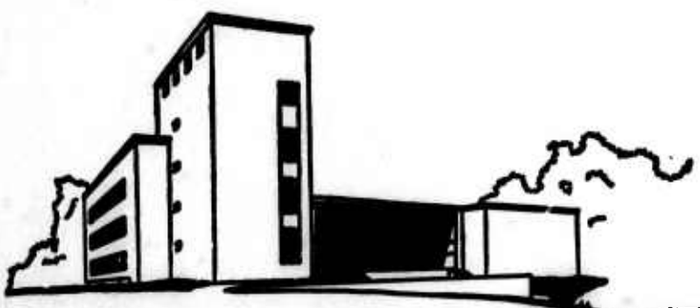

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Abstract

The role of sampling in auditing is reviewed and new objectives are introduced for the sampling process. In addition to the traditional objectives of estimation and acceptance sampling which we label representative sampling, we suggest the following objectives: connective sampling which aims at maximizing the number of errors found in the sample so that these may be corrected, protective sampling which wishes to maximize the dollar value of those items included in the sample, and preventive sampling which attempts to minimize brands by taking random samples in all possible control areas. Ideal samples are developed and a simple example discussed to illustrate each of the sampling objectives.

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In 1960, Professor Lawrence L. Vance reviewed the numerous articles on sampling for accountants and auditors written up to that time. [1/] In this article, he classified the various applications of sampling techniques to accounting into three categories: estimation sampling, acceptance sampling, and discovery sampling. Estimation sampling aims at estimating a population characteristic such as the total inventory dollar value or the proportion of items in error based on a sample taken from a population. The estimate is made with a degree of precision and on a level of confidence specified by the auditor in advance. Acceptance sampling provides a basis for accepting or rejecting a population based on the number of defective items found in a sample taken from the population and is also done on the basis of a pre-arranged level of quality and specified degree of confidence. Discovery sampling is a special case of acceptance sampling in which the population is accepted only if a sample contains no defective items. The auditor's specification of the level of confidence and degree of precision is used in each of these cases to determine the required sample size.

Although a number of interesting articles have been written on the application of sampling to accounting and auditing since 1960 [2/], each can still be classified into one of the three above categories. In other words, the development of sampling theory in accounting and auditing has been basically

confined to classical statistical inference; focusing on estimation and hypothesis testing. More recently, some articles have appeared [3] which suggest the use of Bayesian analysis in sampling for auditors. This approach is a promising one for auditors since it provides a quantification of the auditor's prior experience and judgment and incorporates them into the formal analysis. This has the immediate effect of reducing the large sample sizes which had been required by the purely classical analysis in which no prior knowledge on the part of the auditor is assumed. However, the objective of the articles which utilize the Bayesian analysis is still for estimation and acceptance sampling.

The fact that the development of sampling theory in accounting has been confined to estimation and acceptance sampling (discovery sampling being a special case of the latter) is quite remarkable because the auditor's objectives in sampling are much broader than those aimed at in estimation and acceptance sampling. The purpose of this paper is, therefore, to explore those objectives which have not been fully described but are nonetheless important in performing the auditor's duty.

In classifying the auditor's objectives in sampling, it is often revealing to ask him to describe an ideal sample for a given population. Suppose that an inventory consists of 10,000 items with an average dollar value of $1,000 per item and that 200 items are recorded in error. What is an ideal sample in estimation sampling? Clearly, if the auditor is interested in estimating the average or total inventory dollar value, the ideal sample is one whose average value is exactly equal to $1,000 per item, while if the auditor is interested in estimating the proportion of error items, the ideal sample is one in which

exactly 2% of the sampled items are in error. The same is true with acceptance (and discovery) sampling. An ideal sample here is one in which exactly the same proportion of items are in error as actually the same proportion of items are in error as actually exist in the population. The auditor could then take an appropriate action as if he had observed the entire population rather than just a portion of it.

We may call such sampling, whose objective is to obtain a sample which represents the population as accurately as possible, representative sampling. It is clear that traditional statistical sampling theory falls into this category. However, representative sampling is a broader concept in the sense that it also includes judgment sampling in which the auditor uses his experience to improve the chances of getting a fair representation of the population in the sample.

It is our position that auditors have at least three other objectives when they sample a population. For convenience, we shall name them corrective sampling, protective sampling, and preventive sampling. We shall describe each one of them in some detail and then illustrate how an ideal sample differs under each one of these objectives.

When an auditor takes a sample, often his objective is not just to estimate how many items are in error but rather to find items in error and correct them. From this viewpoint, an ideal sample is one which contains as many error items as possible. Evidence in support of the corrective sampling objective comes from the observation that good auditors always try to take samples from those areas where errors are more likely to occur. They do this not because they believe that they can obtain a fairer representation by doing so but rather because they

are interested in correcting as many errors as they can. Checking items which are not in error is a waste of time for corrective sampling. Thus, if the population has 2% of its items in error, a sample of 100 which contains 2 error items is a poor sample from the viewpoint of correction since one without any auditing skills can, on the average, draw such a sample. (Remember, however, that this is an ideal sample from the viewpoint of representative sampling.) A good auditor, by using his judgment and experience, should be able to draw a sample which contains significantly more error items than a sample drawn randomly from the entire population. An auditor stratifies the population by the estimated proportion of error items, and starts sampling from the stratum which is likely to contain the highest proportion of error items. Checking heavily those transactions in the end or the beginning of a month or a year, those items that have been newly added or dropped, those accounts with unusually high or low values, or those with negative balances is quite common in the procedures of good auditors. These actions can not be justified from the representative sampling viewpoint. They are aimed at correcting the maximum number of error items.

A third type of sampling, protective sampling, is aimed at maximizing the dollar value of those items included in the sample. When a good auditor is asked to take a sample from inventory or receivables records, he invariably includes a disproportionately large number of high-valued items. This action can be explained in part from the representative sampling viewpoint if the variance of high-valued items is greater than low-valued items. One could then improve his estimate by allocating disproportionately more items to the high-valued category. It can also be explained in part from the corrective sampling viewpoint if the chance of an item being in error is greater for high-valued items

than for low-valued items or if the dollar value of errors divided by the number of all items in the category is greater in the high-valued category than in the low-valued category. However, there seems to be an intrinsic attraction to high-valued items since the auditor tends to sample high-valued items even if those high-valued items are less likely to be in error because of the added internal checks on them. Protective sampling explicitly recognizes that the auditor's tendency toward checking high-valued items is one of the objectives of the sampling plan. If an auditor is allowed to take a sample of 100 inventory items out of 10,000 , he feels more secure if he has checked 50% of the total value of inventories than if he has checked only 1%. Contrary to corrective sampling which is, in a sense, an offensive approach against errors and frauds, protective sampling is a defensive approach The auditor recognizes the difficulty of detecting errors and frauds which may occur in only a small fraction of the population and tries to protect himself from a disaster by verifying that at least a relatively significant portion of the population is free from errors and frauds.

The last type of sampling, preventive sampling, is aimed at creating the maximum degree of uncertainty in the mind of auditees as to which items are likely to be audited in the future. An auditor may take a sample from an area not because he wants to do something with the sample, such as in representative, corrective, and protective sampling, but rather because he wants to create the impression in the auditees' mind that the area is not audit-free, in order to prevent the occurrence of frauds in this or related areas in the future. Thus, for this purpose, an auditor tries not to show any patterns in the items he samples. Random sampling is therefore used quite often for this purpose. Note however, that the purpose of random sampling here is quite different from that

used in representative sampling. In representative sampling, random sampling is used so that one can make mathematically supportable statements about the precision and reliability of the estimate. In preventive sampling, random sampling is used to produce a sample without any explicit pattern, so that the auditees can not predict which areas are likely to be sampled in the future.[4/]

Table 1 summarizes the four types of sampling by specifying an ideal sample for each sampling objective.

TABLE 1

Type of Sampling	An Ideal Sample
1. Representative Sampling	One which represents the population characteristic by an exact facsimile.
2. Corrective Sampling	One which contains the maximum number or dollar value of error items.
3. Protective Sampling	One which has the maximum total dollar value.
4. Preventive Sampling	One which creates the maximum degree of uncertainty in the auditees' mind about which items are likely to be included in the future audits.

To show the differences in the approach among the four types of sampling, consider a population of 10,000 accounts receivables which are classified in two dimensions into 5,000 high-valued items and 5,000 low-valued items as well as 5,000 high-error items and 5,000 low-error items. Assume that the error rate is generally small but is expected to be four times as high in the high-error items as in the low-error items. Assume also that the standard

deviation of the high-valued items is the same as the standard deviation of the low-valued items. Finally, assume that there are 2,500 items in each combination of high- and low-valued items and high- and low-error items. The population of 10,000 can thus be stratified as:

Value \ Error Rate	High	Low	Total
High	2500	2500	5000
Low	2500	2500	5000
Total	5000	5000	10000

How should one allocate a sample of 300 items to each of the four categories under each one of the four objectives? For representative sampling,[5/] if one is interested in estimating the average or total dollar value of accounts receivables, 150 samples should be allocated to both high-valued items and low-valued items. If one is interested in estimating the proportion of number of items in error in the total population of 10,000 items, 200 samples should be allocated to high-error items and 100 to low-error items, since the standard deviation of error rate is approximately twice as large in the high-error items as in the low-error items. Of course, in estimating the population proportion of error, the number of error items from the high-error category should be divided by 200 while the number of errors from the low-error category should be divided by 100 , before adding the two error rates together and averaging.

For corrective sampling, all 300 samples should be allocated to high-error items if the correction of the maximum number of items in error is the objective. If it is desired to correct the maximum dollar value of items in error, all 300 samples should be allocated to high-error, high-valued items. For protective sampling, all 300 samples should be allocated to high-valued items. Finally, for preventive sampling, the 300 samples should be allocated randomly to each of the four

categories. In this case, there may be classifications along further dimensions than the dollar value and error rate used here and the auditor may wish to verify that his preventive sample includes at least a few items in each of these sub-classifications.

In selecting a sample in actual audits, auditors appear to have all four objectives in mind. From each observation, the auditor wants to (i) use the result of sampling in his estimate of the population characteristic, (ii) correct the item if it is in error, (iii) increase the dollar value of items that are verified correct, and (iv) increase the uncertainty in the auditees' mind as to the pattern of future audits. How auditors weigh or should weigh these four objectives is an area that needs to be explored.[6/] Just because the accounting literature on sampling has concentrated almost exclusively on representative sampling does not mean that it is the most important objective of the four discussed here.

In fact, the experience of the Lower Manhatten Branch of the Internal Revenue Service which "has abandoned random sampling of accounts because there were too many unproductive returns being audited; instead, examiners scan every return and audit only those that prove the most promising based on predetermined criteria and the overall impression the return makes on the reviewer,"[7/] is not uncommon among those who engage in CPA audits. Such a phenomenon indicates that corrective and protective sampling may perhaps be more important to the auditor than representative sampling.

Therefore, a sample which is poor from the representative sampling viewpoint may be an excellent one from one or more of the other viewpoints. The sampling theory in accounting and auditing should certainly take into account the special nature of the field. For this reason, new developments in sampling

theory for accounting and auditing should appear in the next few years which integrate the various objectives that auditors expect to achieve from their sampling procedures in an audit.

Footnotes

1. Vance, L. L., "A Review of Developments in Statistical Sampling for Accountants," The Accounting Review, Vol. XXXV, No. 1, January, 1960, pp. 19-28.

2. In addition, Cyert, R. M. and H. J. Davidson, Statistical Sampling for Accounting Information, Englewood Cliffs, N.J., Prentice-Hall, Inc., 1962, provides an excellent introduction to the application of classical statistics to accounting and auditing. See also, Trueblood, R. M. and R. M. Cyert, Sampling Techniques in Accounting, Englewood Cliffs, N.J., Prentice-Hall, Inc., 1957 and Vance, L. L. and J. Neter, Statistical Sampling for Auditors and Accountants, New York, John Wiley and Sons, Inc., 1956 for earlier comprehensive studies of the subject.

3. Kraft, W. H., "Statistical Sampling for Auditors: A New Look," Journal of Accountancy, August 1968, pp. 49-56; Tracy, J. A., "Bayesian Statistical Methods in Auditing," The Accounting Review, Vol, XLIV, No. 1, January 1969, pp. 90-98; Soreson, J. E., "Bayesian Analysis in Auditing," The Accounting Review, Vol. XLIV, No. 3, July, 1969, pp. 555-561.

4. For evidence on the psychological function of audits, see Churchill, N. C. and W. W. Cooper, "Effects of Auditing Records: Individual Task Accomplishment and Organization Objectives," Chapter XIV in W. W. Cooper, H. J. Leavitt and M. W. Shelly II, eds., New Perspectives in Organizational Research, New York, John Wiley and Sons, Inc., 1964.

5. For a comprehensive treatment of stratified sampling, see Cochran, William G., Sampling Techniques, 2nd edition, New York, John Wiley and Sons, Inc., 1963.

6. See Ijiri, Y. and R. S. Kaplan, "A Model for Integrating Sampling Objectives in Auditing," Carnegie-Mellon Working Paper WP. 65-68-9.

7. Mogis, R. C. and D. Rogoff, "Statistics Offers a Solution to Tomorrow's Auditing Complexities," The Accounting Review, Vol. XXXVII, No. 4, October 1960, p. 705.

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Sampling						
Auditing						
Stratified Sampling						