4-1984

Audit Sampling: Statistical Versus Nonstatistical

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AUDIT SAMPLING: STATISTICAL VERSUS NONSTATISTICAL

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An Independent Study

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of the

University of North Dakota

in partial fulfillment of the requirements

for the degree of

Master of Accountancy

Grand Forks, North Dakota

April
1984

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

CHAPTER I

INTRODUCTION

"Audit sampling is the application of an audit procedure to less than 100 percent of the items within an account balance or class of transactions for the purpose of evaluating some characteristic of the balance or class."[1] Auditors developed effective audit sampling as a means of reducing the costs and time spent on audit engagements.

There are a variety of reasons for an auditor to use sampling and testing procedures on an audit engagement. These reasons include: (1) to conclude whether a population is acceptable; (2) to assure the accuracy of conclusions reached on any area of the financial records; (3) to serve as a basis for an audit decision regarding the fairness of the presentation of the financial statements; and (4) to expedite the audit operation.[2]

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[1] American Institute of Certified Public Accountants (AICPA), AICPA Professional Standards (Chicago: Commerce Clearing House, Inc., 1982), AU Section 350.01.

[2] Arthur W. Holmes and Wayne S. Overmyer, Basic Auditing, 5th ed. (Homewood, Illinois: R. D. Irwin, 1976), p. 134.

Audit sampling is classified as statistical or nonstatistical. Either method is effective when properly applied. Statement on Auditing Standards (SAS) 39, the current official pronouncement on audit sampling, provides guidelines for statistical and nonstatistical sampling. Auditors had a harder time adjusting to SAS 39 than originally anticipated, so the Auditing Standards Board decided to delay the implementation of SAS 39 from June 25, 1982, until June 25, 1983.[3]

This paper will analyze the two general approaches to audit sampling: nonstatistical and statistical. The development of audit sampling, the testing of a sample versus the testing of the entire population, and the sampling tests being used today will also be examined. Trends in audit sampling are discussed in Appendix I, and Appendix II contains a glossary of the sampling terminology used in this study.

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[3]John C. Burton, Russell E. Palmer, and Robert S. Kay, Handbook of Accounting and Auditing--1983-1984 Update (Boston: Warren, Gorham and Lamont, 1983), p. 14-2.

CHAPTER II

DEVELOPMENT OF SAMPLING AND CURRENT AUDIT TESTS

Development of Present Day Audit Sampling

Evolution of Sampling

Prior to the beginning of the twentieth century, auditors had been testing the entire population for any necessary audit tests of account balances and classes of transactions. With the rapid increase in the size of American businesses around the turn of the century, a need was created for testing selected items from these accounts and classes.[1] This was the beginning of audit sampling. During the first decades of this century, an auditor's use of sampling had no relation to the effectiveness of a company's internal accounting control.[2] Sampling has been refined over the years and is now almost a necessity in the expanded area of auditing.

In 1955 several Certified Public Accountants (CPAs) were asked to identify the extent of audit sampling necessary for an audit presented as

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[1] American Institute of Certified Public Accountants (AICPA), Audit and Accounting Guide: Audit Sampling (New York: AICPA, 1983), p. 5.

[2] Ibid.

a case study. From this study, the American Institute of Accountants, which later became the American Institute of Certified Public Accountants (AICPA), published "A Case Study of the Extent of Audit Samples." The conclusion reached from this study was that although the CPAs had similar views regarding the necessity of sampling items in the financial statements, no clear pattern existed.[3]

A substantial interest in using statistical sampling in auditing developed during the 1950's. The first pronouncement on statistical sampling, "Statistical Sampling and the Independent Auditor," was issued in 1962 by the AICPA's Committee on Statistical Sampling.[4] Several other statements were issued on statistical sampling in the 1960's and the 1970's, but it was not until the issuance of SAS 39 (Audit Sampling) in 1981 that guidance was specifically provided for nonstatistical sampling as well as for statistical sampling.[5] SAS 1 contained the previous statement on audit sampling in Sections 320 A, "Relationship of Statistical Sampling to Generally Accepted Auditing Standards," and 320 B, "Precision and Reliability for Statistical Sampling in Auditing." The statistical nature of this statement is quite evident in these titles.

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[3] Ibid., p. 6.

[4] Ibid.

[5] Ibid., pp. 6-7.

Provisions by SAS 39

SAS 39 replaced some of the terminology in sections 320 A and 320 B and also introduced some new terms. The reason for this change was to provide fewer technical terms, since SAS 39 applies to both statistical and nonstatistical sampling. "Tolerable error" and "allowance for sampling error" were introduced by SAS 39 to replace "precision," and "tolerable risk" is now used instead of "reliability." "Risk of incorrect acceptance" and "risk of overreliance on internal accounting control" replaced "beta risk," while "alpha risk" was deleted for "risk of incorrect rejection" and "risk of underreliance on internal accounting control." Under SAS 39, there is also the probability of "sampling risk" and "nonsampling risk" within the "ultimate risk" framework.

Sample Testing Versus Population Testing

Determining Whether to Sample

The auditor must decide whether to test a sample drawn from the population or whether the entire population should be tested. The third standard of field work of Generally Accepted Auditing Standards (GAAS) states that "sufficient competent evidential matter is to be obtained through inspection, observation, inquiries and confirmations to afford a reasonable basis for an opinion regarding the financial statements under examination."[6] This standard allows auditors to use their judgment in

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[6]AICPA, AICPA Professional Standards, AU Section 150.02

determining whether to test samples or to test the entire population, as long as the auditor obtains "sufficient competent evidential matter." (Evidential matter acquired in a sample is competent if it is representative of the population.) SAS 39 does not specify when an auditor should sample or when the entire population should be tested, but only provides guidelines to follow after the auditor decides to sample.

Defining the population may be a first step in deciding whether to sample. The population definition may include an estimate of its size, the location of the population, the arrangement of data, and the cost to obtain the necessary data.[7] Once the population is defined, the auditor can decide if sampling procedures should be used. Influencing factors may be the comparison of sampling costs to the benefits received and the degree of confidence a sample will offer. If the costs exceed the benefits of sampling or if little confidence can be placed in the sample results, the auditor should test the entire population.[8]

Determining Sample Size

When determining the sample size, the auditor must keep in mind that the sample should be a reflection of the entire population. The size of a sample is a matter of professional judgment and no general rule can

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[7] Institute of Internal Auditors, Sampling for Modern Auditors (Alamonte Springs, Florida, 1977), p. 11-6.

[8] Ibid., p. 11-5.

apply to all situations.[9] The sample size is influenced by such factors as the nature of the population, the sampling objectives, and the audit objectives.[10] The population's size should not materially influence the sample size.

Sample size may be reduced by stratification. A stratified sample is one in which the sample items are separated into homogeneous groups based on such characteristics as book value or the nature of internal accounting controls over the various items.[11] One must be careful to maintain the efficiency of the sample. Too small a sample results in not meeting the planned objectives and too large a sample causes the auditor to examine more items than necessary.[12] Either way leads to sample inefficiency.

The auditor must remember that the sample should be representative of the population. A sample is representative if it shares similar characteristics with the population. The two requirements for representative selection are: (1) that every unit in the population has an equal chance of being drawn; and (2) that the sample is large enough to be

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[9] "What Is a Sample?" (Auditing Practice Forum), ed. by Victor Z. Brink, The Journal of Accountancy 83 (June 1947):525.

[10] Institute of Internal Auditors, p. 11-3.

[11] AICPA, Audit and Accounting Guide: Audit Sampling, p. 46.

[12] Ibid., p. 55.

typical of the population.[13] The sample should be drawn so that similar results would occur if other samples of the same size were drawn.

Determining the Sample Selection Method

A number of sampling methods can be used in selecting the sample. These methods include random number sampling, systematic sampling, haphazard sampling, and block sampling. Whichever method is used, the auditor must be certain that no items are missing from the population. For example, if the auditor was testing a file drawer of purchase orders, he/she would not obtain a representative sample if an employee had previously removed all questionable purchase orders.

Random number sampling

Random number sampling requires that each item of the population has an equal chance of being drawn. Using random numbers selected from a random number table or selected by a computer, the auditor determines the items to be sampled by matching the numbers obtained to the population sequence.[14]

Systematic sampling

A random starting point is chosen by the auditor in selecting the first item to be sampled under the systematic sampling method. A fixed

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[13]Rodney J. Anderson, The External Audit (Toronto: Pitman, 1977), p. 311.

[14]AICPA, Audit and Accounting Guide: Audit Sampling, p. 28.

interval is used in choosing the rest of the items to be sampled. In order to avoid an existing pattern of errors which may result in an unrepresentative sample, the auditor can choose several random starting points.

Haphazard sampling

A haphazard sample results when the auditor uses his own judgment in choosing a random sample. No specific reason prompts the auditor in selecting the items for the sample.[15] The auditor must be careful not to let his personal bias enter into the selection process, such as selecting or omitting large or small items.

Block sampling

To obtain a block sample, the auditor selects a block of adjacent items from the population, for example, one month's transactions out of a year's transactions. A particular block often will not be indicative of the entire population. Seasonal sales is one example where one month will not be representative of the entire year.

Current Audit Tests

Currently there are three types of audit tests: compliance tests, substantive tests, and dual-purpose tests. This section examines the purpose of each and the relationship between the tests.

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[15]Ibid., p. 29.

Compliance Testing

The reason for compliance testing is to determine if the prescribed internal accounting control procedures are being adhered to within a business. Compliance tests relate to the second field work standard of GAAS. This standard states that "there is to be a proper study and evaluation of the existing internal control as a basis for reliance thereon and for the determination of the resultant extent of the tests to which auditing procedures are to be restricted."[16]

Planning decisions

Factors the auditor needs to consider in planning the sample for a compliance test include the sample's relationship to the objectives of the compliance test, the population characteristics, the maximum rate of deviations allowed, and the allowable risk of overreliance.[17] In evaluating compliance with the prescribed internal accounting control procedures, the auditor needs to establish the maximum rate of deviation, that is, how much leeway he will allow. This maximum rate of deviation is called the tolerable rate. The tolerable rate for all internal accounting control procedures will not be the same, since the tolerable rate depends on the amount of reliance placed on a control.[18] The

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[16]AICPA, AICPA Professional Standards, AU Section 150.02.

[17]Ibid., AU Section 350.31.

[18]Ibid., AU Section 350.33.

establishment of the tolerable rate should be based on the accounting records being tested, any related internal accounting control procedures, and the purpose of the auditor's evaluation.[19] As the reliance placed on internal accounting controls increases, the tolerable rate decreases.

Decisions after testing the sample

The purpose of compliance testing is not to search for errors, but to discover compliance deviations. The deviations in a sample must be projected to the entire population in determining the population's deviation rate. The methods for projecting the deviations differ for nonstatistical sampling and statistical sampling. These projection methods will be discussed in Chapter III, Nonstatistical Sampling, and Chapter IV, Statistical Sampling.

The auditor should use professional judgment in deciding how close the deviation rate can be to the tolerable rate before there exists a real risk of overreliance on internal accounting controls. The auditor also faces the risk of underreliance on internal accounting controls. The greater the tolerable rate and the allowable risks of overreliance and underreliance on internal accounting controls, the smaller the required sample size will be.

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[19] Ibid.

Compliance testing is essential if a prescribed internal accounting control procedure is to be relied on in planning the nature, timing, and extent of substantive tests.[20] Compliance testing and substantive testing vary inversely. If compliance tests do not support the planned reliance on internal accounting controls, the auditor will either have to perform additional compliance testing on other internal accounting controls, or modify the related substantive tests.[21]

Substantive Testing

Substantive tests are used to determine the dollar value of errors in an account balance or class of transactions. Through substantive testing, the auditor gathers evidence on the validity and the proper treatment of transactions and account balances.[22]

Planning decisions

Factors the auditor should consider in planning the sample for a substantive test include the sample's relationship to relevant audit objectives, the population's characteristics, the estimated materiality level, and the allowable risk of incorrect acceptance.[23] In comparing

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[20]AICPA, Audit and Accounting Guide: Audit Sampling, p. 12.

[21]Ibid., p. 40.

[22]Larry P. Bailey, "Impact of SAS-39 on Nonstatistical Sampling," The CPA Journal 52 (June 1982):43.

[23]AICPA, AICPA Professional Standards, AU Section 350.15.

the relationship of the sample to the audit objectives, the auditor needs to decide if the audit procedures he had planned on using will achieve these objectives. These procedures should be applied to each item of the sample.

In evaluating the amount of error that will be allowed before being classified as material, the auditor should consider how much monetary error may exist without causing the financial statements to be materially misstated. This maximum error is known as the tolerable error.

Variation within population items, the risk of incorrect acceptance, the tolerable error, and error expectation are characteristics of a population that need to be considered by the auditor in establishing the sample size.[24] The risk of incorrect acceptance, the risk of incorrect rejection, and the tolerable error vary inversely with the sample size; so as the auditor allows greater risks of incorrect acceptance and rejection and an increase in the tolerable error, the required sample size will decrease.

Decisions after testing the sample

The errors found within the sample are projected to estimate the error for the population. The methods used for projecting the errors discovered through substantive testing will differ for nonstatistical and statistical sampling; therefore, the discussion on the projection methods

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[24] Burton, Palmer, and Kay, Handbook of Accounting and Auditing--1983-1984 Update, p. 14-5.

will be delayed until the respective sampling approaches are examined in Chapters III and IV.

If the estimated error is close to the tolerable error, the auditor faces the risks of incorrect acceptance and incorrect rejection. These risks reflect the possibility that the auditor will come to the wrong conclusion about the sample and the population. Experience and professional judgment should aid the auditor in making this decision. When the estimated error is not close to the tolerable error, the auditor can be quite safe in assuming that the tolerable error for the population will not be exceeded.

In both compliance testing and substantive testing, the auditor should consider the qualitative aspects of the deviations or errors. These aspects include the nature and cause of the deviations or errors and the possible relationship to other phases of the audit.[25] When the projected deviations or errors discovered in a population are greater than the tolerable rate or tolerable error, the auditor can either expand the sample or perform additional audit procedures to determine if the sample is representative of the population.[26] Usually an irregularity will require more research into the possible causes than will an error. The

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[25]Ibid., p. 14-6.

[26]Carl S. Warren, Stephen V. N. Yates, and George R. Zuber, "Audit Sampling: A Practical Approach," The Journal of Accountancy 153 (January 1982):70.

auditor should not change the definition of either an error or the population after he has finished sampling.

Dual-Purpose Testing

The auditor may decide to draw dual-purpose samples from the population. A dual-purpose sample is a sample designed for both compliance testing and substantive testing.

In determining the dual-purpose sample size, the auditor should consider the size of samples that would have been required if compliance and substantive testing were performed separately. The larger sample size should be the size chosen for the dual-purpose sample.[27] The auditor would perform the same separate procedures that would have been performed if compliance testing and substantive testing were performed on separate samples. These procedures were discussed earlier in this chapter under the respective titles.

Miscellaneous Sampling Considerations

The purpose of audit sampling is to evaluate the characteristics of an account balance or class of transactions; so the items selected in a sample should be tested with appropriate audit procedures: inspection, confirmation, observation, inquiry, analysis, comparison and

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[27]AICPA, AICPA Professional Standards, AU Section 350.43.

calculation.[28] Even when the auditor decides to sample, key items with large dollar values will usually require a one hundred percent evaluation. The auditor must use professional judgment and experience in determining which items, if any, fit in this category.

Documentation is essential if an auditor is to maintain quality control over sampling. The audit objectives, the definition of the population, the sample size, the sample selection method, the list of selected items, a summary of audit work performed, an error analysis, and the conclusions reached from the audit should be documented in the working papers.[29]

Once the auditor has decided to sample, he/she must determine which approach to sampling is appropriate: nonstatistical or statistical. Either method can provide sufficient evidential matter when properly applied, so the auditor must make a decision based on a variety of other factors. The decision as to whether the auditor should use nonstatistical or statistical sampling will be examined in the next two chapters.

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[28] Donald H. Taylor and William G. Glezen, Auditing--Integrated Concepts and Procedures (New York: John Wiley & Sons, Inc., 1979), pp. 138-139.

[29] Abraham D. Akresh, "Statistical Sampling in Public Accounting," The CPA Journal 50 (July 1980):25.

CHAPTER III

NONSTATISTICAL SAMPLING

Judgmental sampling, as nonstatistical sampling was previously called, was being performed before the issuance of SAS 39, but the official statements were not supplying the necessary guidelines for its use. The name of this sampling approach was changed to nonstatistical sampling, because the auditor is also required to use professional judgment in applying statistical sampling procedures.

Nonstatistical sampling can be defined as "a sampling technique for which the auditor considers sampling risk in evaluating an audit sample without using statistical theory to measure that risk."[1] Auditors rely on their professional judgment and experience in evaluating the nonstatistical sample results.

Nonstatistical Sampling Decision Process

The nonstatistical sampling process involves a number of steps and decisions. The decision process in audit sampling (illustrated in Figure 1, page 26), consists of the following steps:[2]

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[1]AICPA, Audit and Accounting Guide: Audit Sampling, p. 128.

[2]Warren, Yates, and Zuber, p. 63.

1. Specify the audit objectives.
2. Consider those factors that determine the audit scope.
3. Determine the materiality of the account balance or class of transactions in relation to the financial statements.
4. Decide whether tests of details should be performed.
5. Decide whether the entire population should be tested.
6. Identify key items.
7. Determine if an examination of only key items is sufficient.
8. Decide if you need to sample or if you only need to perform analytical review procedures.
9. Determine the size of the sample.
10. Select the items for sampling.
11. Examine the selected items.
12. Evaluate the sample results.
13. Reach an overall conclusion.

Preliminary Considerations

The auditor must identify the objectives of the audit and relate these objectives to the type of testing he plans on performing.[3] An objective in compliance testing would be to determine the deviations from pertinent internal accounting control procedures. The search for possible errors in an account balance or class of transactions could be

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[3] Ibid., p. 62.

an objective in substantive testing. A determination of audit objectives is important, as this will indicate the direction the auditor plans to go, what he/she plans to achieve through the audit, and the necessary audit procedures to be performed. These audit procedures are not influenced by the auditor's decision to sample or to test one hundred percent.

Materiality and risk are considered when determining the audit scope.[4] The type of business and the nature of items being audited will be indicators as to the probable risks involved. For example, an auditor may reach the conclusion that a highly technical business involves more risk than a less technical business. The materiality factor influences the auditor's decision in developing the tolerable rate for compliance testing and the tolerable error for substantive testing.

Several factors should be considered in determining the materiality level of an account balance or class of transactions in relation to the financial statements: (1) if the tolerable error is greater than the account balance, substantive testing probably will not be necessary; and (2) a number of immaterial balances could be material when aggregated,[5] so the auditor must consider the possible effect when account balances and classes of transactions are combined.

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[4] Ibid., p. 63.

[5] Ibid., p. 64.

Extent of Testing

If the account balance or class of transactions is material, the auditor's next decision would be to determine if a test of details is necessary or if only analytical review procedures are required.[6] Analytical review procedures would probably suffice in an area where the risk is relatively low.

Upon determining that the possible risk requires a test of details, the auditor must decide whether or not the entire population needs to be examined. Whenever only a portion of the population is tested, risk exists.[7] A one hundred percent examination is necessary when the auditor cannot accept any sampling risk.

The next step involves identifying key items when the entire population does not need to be tested. Large book values and special risks would probably indicate key items. Audit judgment is required, but when the book value of a single item is greater than the tolerable error for the account balance or class of transactions, this item usually would be considered a key item.[8] When the selected key items constitute a significant part of the account or class, the auditor may decide not to test any remaining items. However, if the auditor decides that these

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[6] Ibid.

[7] Ibid.

[8] Ibid., p. 65.

remaining items require further testing, he/she needs to determine if analytical review procedures would be sufficient or if a sample is necessary.

The Sampling Process

Once the auditor has determined that sampling will be necessary, the sample size must be estimated. As was mentioned in the previous chapter on compliance and substantive testing, sample size is influenced by the tolerable error, the tolerable rate, the expected number of errors, and the reliance placed on internal accounting controls and other audit procedures. All of these influencing factors, except the expected number of errors, have an inverse effect on the sample size.[9] Figure 2 (page 27) illustrates these relationships. In determining a nonstatistical sample size, the auditor may find it helpful to consider a similar sample size using a statistical approach, but SAS 39 does not require the auditor to do so.

After determining the sample size, the auditor is ready to select the sample. Four methods for drawing a sample were discussed in Chapter II. Any of these methods is appropriate for nonstatistical sampling. When the auditor wishes to obtain a sample that is representative of the population, the most preferable method is random number sampling, whereas the least desirable is block sampling.

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[9] Ibid., p. 68.

Having collected the sample, the auditor can examine the selected items. All of the audit procedures established in the first step should be applied to each item of the sample. If the planned procedures cannot be utilized, the auditor will use alternative procedures. When neither the planned procedures nor alternative procedures can be applied to an item, the auditor may be conservatively wise in assuming an error exists.[10]

Formation of Auditor's Opinion

Now the auditor is ready to evaluate the sample results by projecting the sample deviations or errors to the population. To project the deviations found through compliance testing, one must divide the number of deviations in the sample by the sample size. The resulting number is considered to be the population's deviation rate.[11]

Upon discovering errors through substantive testing, the auditor may use one of the following methods to project these errors: (1) When the auditor expects the amount of the error to be closely related to the size of the item, he/she divides the error discovered in the sample by the percentage of total dollars from the population included in the sample.[12] (2) If the error amount is expected to be about the same for

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[10] Ibid.

[11] Burton, Palmer, and Kay, Handbook of Accounting and Auditing--1983-1984 Update, p. 14-8.

[12] AICPA, Audit and Accounting Guide: Audit Sampling, pp. 61-62.

all items in the population, the auditor estimates the average difference between the audited and the book values of sampled items. This difference is multiplied by the total number of items in the population.[13] Either method will result in an estimated error for the population.

When the auditor is ready to form an opinion regarding the population, sampling risk should be taken into consideration. If the projected errors or deviations are close to the tolerable error or tolerable rate, the auditor must use professional judgment and experience in establishing an acceptable level of errors and deviations. Expanding the sample or performing additional audit procedures should be considered by the auditor.

When to Use Nonstatistical Sampling

Before determining whether the use of nonstatistical sampling is appropriate, the auditor must make some evaluations regarding the population to be examined. The following situations will allow the auditor to use nonstatistical sampling:[14]

1. The auditor has sufficient knowledge of the population, so he/she can reach a reasonably accurate conclusion about the population from the items tested.

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[13] Ibid., p. 62.

[14] John C. Burton, Russell E. Palmer, and Robert S. Kay, Handbook of Accounting and Auditing (Boston: Warren, Gorham and Lamont, 1981), pp. 14-4, 14-5, 14-6.

2. A sample for statistical evaluation would be difficult to obtain. For example, if the population is a drawer containing unnumbered invoices and there is no apparent way of referencing the individual invoices, it would be very difficult to select a statistical sample.
3. The auditor's knowledge of the population will permit him/her to draw a sample subjectively, and this sample results in more audit assurance than a statistically selected sample. A widely diverse population with specific types of items known to be error prone is an example of this situation.

Even if some of these circumstances permit the auditor to apply statistical procedures, the benefits of using a statistical approach must be weighed against the additional costs involved. These costs are discussed under statistical sampling in Chapter IV.

A properly designed nonstatistical sampling approach can be just as effective as a well-designed statistical sampling plan.[15] When the auditor has efficient sampling methods for either a nonstatistical application or a statistical application and the costs of using statistical sampling exceed the resulting benefits, nonstatistical sampling procedures should be used. An auditor's nonstatistical sampling methods can

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[15]AICPA, Audit and Accounting Guide: Audit Sampling, p. 14.

become more efficient once he/she is knowledgeable in statistical sampling concepts and experienced in applying statistical sampling procedures.[16]

Often when using nonstatistical sampling, an auditor may have difficulty explaining how a particular estimate was determined.[17] The proper use of documentation in the working papers, detailing the procedures used, and the reasons for these procedures, can help to justify the auditor's decision.

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[16]Abraham D. Akresh and George Russell Zuber, "Exploring Statistical Sampling," The Journal of Accountancy 151 (February 1981): 50.

[17]Ibid., p. 52.

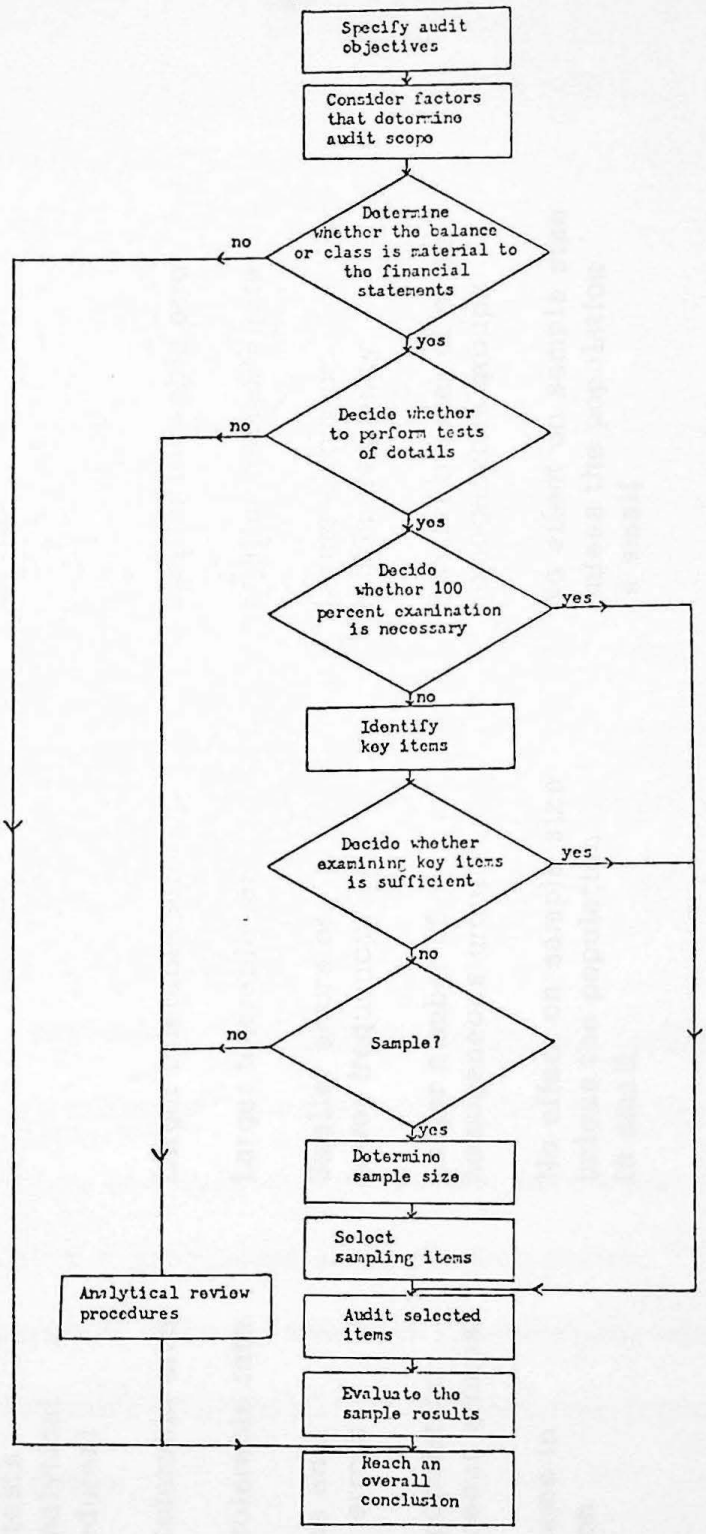

Fig. 1. The decision process in audit sampling

SOURCE: Carl S. Warren, Stephen V. N. Yates, and George R. Zuber, "Audit Sampling: A Practical Approach," The Journal of Accountancy 153 (January 1982):63.

Factor	Conditions Leading to Smaller Sample Size	Conditions Leading to Larger Sample Size
Reliance on internal accounting controls	Greater reliance on internal accounting controls	Less reliance on internal accounting controls
Reliance on other substantive tests (including analytical review procedures)	Substantial reliance	Little or no reliance
Measure of tolerable error	Larger tolerable error	Smaller tolerable error
Measure of tolerable rate	Larger tolerable rate	Smaller tolerable rate
Expected size and frequency of errors	Smaller errors or lower frequency	Larger errors or higher frequency
Division of population into homogeneous groups	Larger number of homogeneous groups	Smaller number of or no homogeneous groups
Number of items in the population	No effect on sample size unless the population is small	No effect on sample size unless the population is small

Fig. 2. Factors influencing sample size

SOURCE: Carl S. Warren, Stephen V. N. Yates, and George R. Zuber, "Audit Sampling: A Practical Approach," The Journal of Accountancy 153 (January 1982):68.

CHAPTER IV

STATISTICAL SAMPLING

The previous chapter informed the reader that in performing non-statistical sampling, the auditor relies on professional judgment and experience. Statistical sampling requires the use of the laws of probability to measure sampling risk.[1] Statistical sampling does not eliminate the need for the auditor's professional judgment during the sampling process, but helps the auditor apply this judgment in planning a sample, performing tests, evaluating sample results, and relating sample characteristics to the population.

The recently issued Audit and Accounting Guide: Audit Sampling defines statistical sampling as "audit sampling that uses the laws of probability for selecting and evaluating a sample from a population for the purpose of reaching a conclusion about the population."[2] If a sampling process involves only the use of a mathematical evaluation without the use of the laws of probability, the sampling procedure would be nonstatistical in nature.

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[1]AICPA, Audit and Accounting Guide: Audit Sampling, p. 14.

[2]Ibid., p. 130.

Statistical Sampling Decision Process

An auditor performing statistical sampling procedures will make many of the same decisions as in nonstatistical sampling. The objectives of an audit will assist the auditor in determining whether a statistical or a nonstatistical approach is suitable. The auditor will need to decide if a test of the entire population is necessary, or if it will be sufficient to test either a selected sample or key items. The sampling risk the auditor is willing to accept, using a statistical sampling plan, can be measured by the use of a table or a time-sharing computer program.[3] Tables and computers can also assist the auditor in determining the sample size and selecting the items to be sampled.

After examining the sample results, the auditor is ready to evaluate the results and reach an overall conclusion. A statistical sample can help the auditor design an efficient sampling plan, measure the sufficiency of evidential matter, and quantitively evaluate the results.[4]

Statistical Sampling Plans

There are two main classifications of statistical sampling plans: attributes sampling and variables sampling. This section briefly examines each of these. A hybrid between attributes sampling and

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[3] Ibid., p. 39.

[4] AICPA, AICPA Professional Standards, AU Section 350.45.

variables sampling, probability-proportional-to-size sampling, will be studied in more detail.

Attributes Sampling

Attributes sampling is most useful for compliance testing, the testing process used to determine if the prescribed internal accounting controls are being adhered to within the business. The purpose of attributes sampling is to find the rate of occurrence or frequency with which some deviating characteristic (attribute) exists within the population.[5] The auditor is not concerned with the dollar amount of the deviation, but is only testing to see how often a deviation exists. Attributes sampling could be appropriately used for testing the controls on payroll, billing systems, inventory pricing, and depreciation computations.[6]

Variables Sampling

Variables sampling is primarily used for substantive testing. The purpose of variables sampling is to make a decision about a population in terms of a dollar amount.[7] A variation within a population is measured by the standard deviation. The principal use of variables sampling is to

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[5] Akresh, p. 332.

[6] AICPA, Audit and Accounting Guide: Audit Sampling, p. 16.

[7] Ibid., p. 17.

determine the reasonableness of recorded amounts, such as receivables, inventory, and recorded payroll expense.[8]

Probability-Proportional-To-Size Sampling

Probability-proportional-to-size (PPS) sampling uses attributes sampling theory, but the results are stated in dollars rather than as a rate of occurrence.[9] The name for this sampling approach is derived from the concept that each individual dollar within a population has an equal probability of being selected, so accounts with large balances have a greater chance of becoming an item of the sample than accounts with small balances.[10] According to the amount of coverage received in the Audit and Accounting Guide: Audit Sampling, PPS sampling is apparently increasing in popularity.

PPS sampling is appropriate to use when few errors are expected. A major drawback in the use of PPS sampling is that special design considerations will be required if the selected units have a zero balance, a negative balance, or a balance greater than the recorded amount. The advantages of using PPS sampling include the following: (1) the procedure is easy to design and perform; (2) the items are selected in proportion to their dollar amounts, so the sample is automatically stratified; and

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[8] Ibid., p. 16.

[9] Ibid., p. 68.

[10] Ibid., p. 71.

(3) the significant items are automatically selected if their amount is larger than the sampling interval.[11]

Selecting the sample

One method often used in selecting a PPS sample is systematic sampling, a method discussed in Chapter II. Before the auditor can begin selecting the sample, the sampling interval (which will be influenced by the risk of incorrect acceptance and the tolerable error that the auditor is willing to accept)[12] must be identified. A random starting point will determine the first item to be sampled, and then the sampling interval will be used to select every nth dollar thereafter as part of the sample. The recorded amount of the population divided by the sampling interval will equal the sample size.[13]

The entire balance or transaction of which the chosen dollar is a component will be examined by the auditor. This balance or transaction is called a logical unit.[14] Logical units with recorded amounts in excess of the sampling interval have a chance of being selected more than once. If this happens, the repeat selection will be ignored, and the auditor will only consider the logical unit once in evaluating the

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[11] Ibid., pp. 68-69.

[12] Ibid., p. 74.

[13] Ibid.

[14] Ibid., p. 71.

sample results. Consequently, the actual number of units examined may be less than the computed sample size.[15]

When the selection process is performed manually (illustrated in Figure 3, page 39), the auditor could select the sample with the aid of an adding machine in the following manner:[16]

1. Clear the adding machine.
2. Subtract the number chosen as the random starting point.
3. Add the recorded amounts of each succeeding logical unit until the subtotal is positive or zero. The last logical unit added becomes an item to be sampled. Negative account balances should be excluded. The special considerations required for such balances are beyond the scope of this report.
4. Subtract the sampling interval from the accumulated subtotal. The sampling interval must be subtracted as many times as it takes to make the subtotal negative again.
5. Repeat steps three and four, selecting the items which cause the subtotal to equal zero or a positive number, and disregarding repeat selections of a logical unit.

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[15]Ibid., p. 72.

[16]Ibid.

When no logical units remain, the auditor has collected the items to be sampled.

The purpose of this limited illustration was to demonstrate a procedure for selecting a PPS sample. Upon testing the sample, the auditor will project the discovered errors to the population. This process will not be discussed, as it is beyond the scope of this report.

Limited uses of PPS sampling

PPS sampling is designed primarily for the overstatement of errors. If significant understatements occur, the auditor will probably use another test to detect existing understatements. How to deal with understatements is still being researched by professionals within the field.[17]

PPS sampling is limited in its application due to the problems that arise when accounts have abnormal balances or when more than a few errors are expected. Circumstances in which PPS sampling can be useful include investment securities, fixed-asset additions, loans receivables, and account receivables when unapplied credits are insignificant.[18]

The Use of Computers in Statistical Sampling

Back in the 1950's, when a substantial interest in statistical sampling developed, the auditor was required to understand and manually

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[17] Ibid., p. 77.

[18] Ibid., p. 69.

apply complex mathematical formulas. The introduction of computers into the auditing field freed the auditor from performing these complex calculations, but the exorbitant cost of computers made their purchase feasible only by larger firms. With the advent of computer time-sharing programs, practitioners were able to apply statistical sampling procedures economically during an audit.[19] The small portable desk-top computers of today have made it possible for the auditor to bring the computer to the engagement site.

The advantages of using a computer in the statistical sampling process include:[20]

1. The computer programs overcome the limitations of a table.
2. The computer can perform difficult computations, such as calculating the standard deviation.
3. Programs are flexible in that they may be adapted for different sampling techniques and may be used for single or multiple client locations.
4. The printout from a computer is nontechnical, so it is easily understood. This printout can be included in the working papers as documentation of the sampling procedures used.

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[19]Akresh, p. 22.

[20]AICPA, Audit and Accounting Guide: Audit Sampling, p. 119.

The sampling of accounts receivable balances can illustrate a variety of functions performed by a computer. The computer can total each client's accounts receivable, calculate the standard deviation of the balances, prepare an aging schedule and determine past-due accounts, stratify the balances into homogeneous groups, select sample items for balance and invoice confirmation, and print confirmation requests to be sent out.[21]

When to Use Statistical Sampling

A major concern in using statistical sampling is the additional costs involved; for example, the costs of training auditors in statistical sampling techniques, the costs of designing individual samples to meet the requirements of statistics, and the costs of selecting the items to be tested.[22] When risks can be reduced by using statistical sampling, the auditor must weigh the benefits against the extra costs that will be incurred.

If the auditor determines that the benefits of using statistical sampling exceed the costs, then the application of statistics to the sampling process would be appropriate. The circumstances under which the use of statistical sampling is suitable were listed at the end of the discussion on each sampling plan: attributes sampling, variables

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[21]Akresh and Zuber, p. 55.

[22]AICPA, Audit and Accounting Guide: Audit Sampling, p. 14.

sampling, or probability-proportional-to-size sampling. When a firm uses statistical sampling on an audit examination, all partners and staff responsible for the examination should have a sufficient understanding of statistical sampling to fulfill their professional responsibilities.[23]

There are going to be instances when the additional costs of applying statistical sampling far outweigh the benefits. The use of nonstatistical sampling would be appropriate under these circumstances. An auditor can use a combination of statistical and nonstatistical sampling on the same audit engagement.[24] Some samples may be more conducive to nonstatistical sampling, whereas other samples may require statistical sampling.

The advantages of using statistical sampling include the following: (1) the auditor is forced to carefully plan the sampling approach; (2) the sample results provide an objective basis on which an audit opinion can be formed;[25] (3) an auditor's personal bias is minimized;[26] and (4) a firm's professional appearance may be strengthened with the proficient

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[23]Akresh and Zuber, p. 56.

[24]Anderson, p. 312.

[25]Burton, Palmer, and Kay, Handbook of Accounting and Auditing, p. 14-14.

[26]Hamdi F. Aly and Jack I. Duboff, "Statistical vs Judgement Sampling: An Empirical Study of Auditing the Accounts Receivable of a Small Retail Store," The Accounting Review 46 (January 1971):119.

use of statistical sampling. The firm will be seen by potential clients as one that is knowledgeable in applying modern tools of auditing.[27]

A primary reason for an auditor to use statistical sampling rather than nonstatistical sampling is that the sampling results will be quantified and will be supported by objective evidence. The objective results are available if the auditor must defend the procedures used and the conclusions reached before a court of law, client personnel, or other auditors.[28]

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[27]Akresh and Zuber, p. 52.

[28]Burton, Palmer, and Kay, Handbook of Accounting and Auditing, p. 14-13.

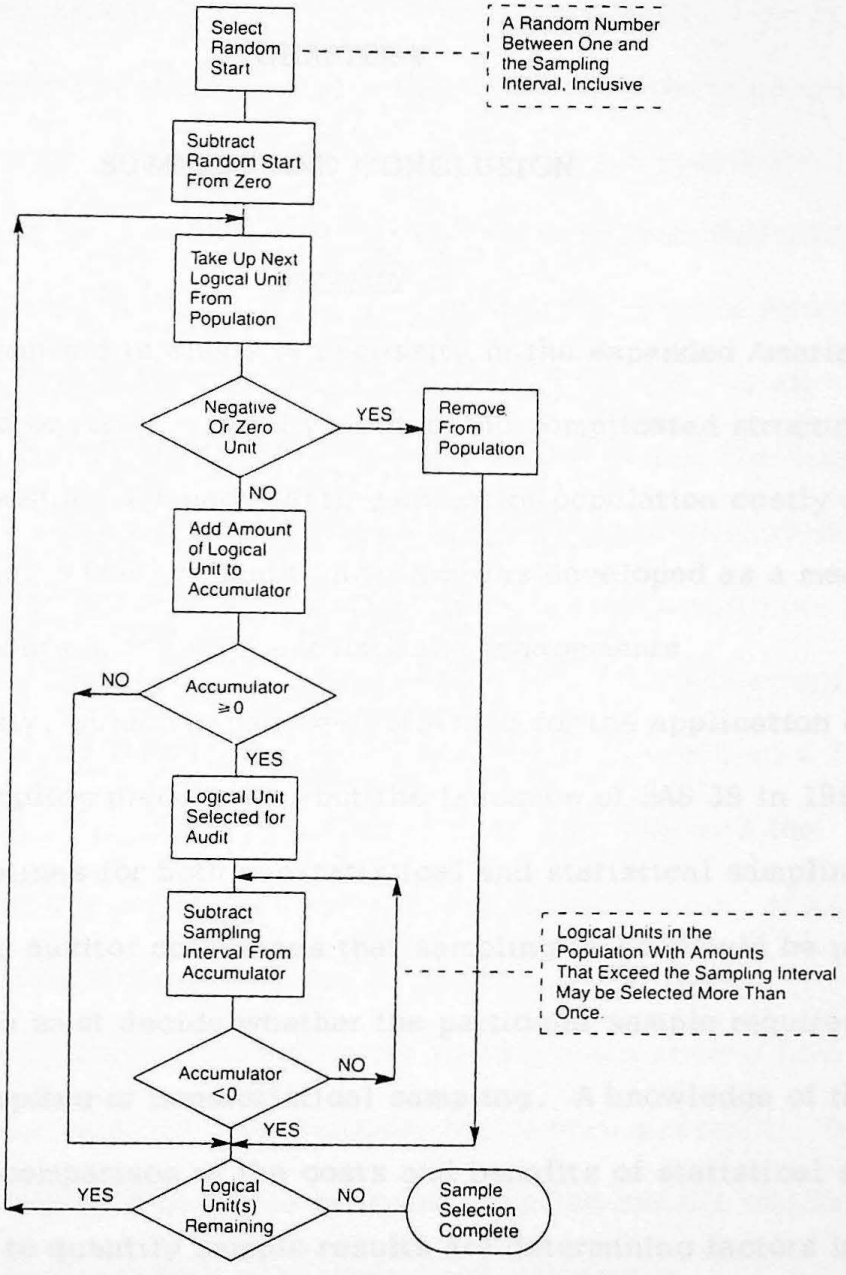

Fig. 3. Probability-proportional-to-size sample selection flowchart

SOURCE: American Institute of Certified Public Accountants (AICPA), Audit and Accounting Guide: Audit Sampling (New York, 1983), p. 73.

CHAPTER V

SUMMARY AND CONCLUSION

Summary

Audit sampling is almost a necessity in the expanded American business world of today. The diversified and complicated structure within these businesses made testing an entire population costly and time consuming. Effective audit sampling was developed as a means of reducing the costs and time spent on audit engagements.

Previously, guidance had been provided for the application of statistical sampling procedures, but the issuance of SAS 39 in 1981 provided guidelines for both nonstatistical and statistical sampling.

Once the auditor determines that sampling tests should be performed, he/she must decide whether the particular sample requires statistical sampling or nonstatistical sampling. A knowledge of the population, a comparison of the costs and benefits of statistical sampling, and an ability to quantify sample results are determining factors in choosing the sampling plan. Either approach requires the use of professional judgment. Having determined the sampling plan, the auditor decides on an appropriate sample size and a representative sampling

method. The audit objectives must be considered by the auditor in making these decisions.

Having made the necessary sampling decisions, the auditor is ready to apply audit sampling tests. To establish the degree of reliance that can be placed on prescribed internal accounting controls, the auditor performs compliance tests. The projected deviations within a population are compared to a predetermined tolerable rate. Since compliance testing and substantive testing vary inversely, the degree of compliance with prescribed internal accounting controls will influence the extent of substantive testing. Substantive tests ascertain the frequency with which errors occur and the dollar value of these errors. The predetermined tolerable error is compared with the projected error for the population. After comparing the projected deviation rate with the tolerable rate and the projected error with the tolerable error, the auditor is able to determine if the population is materially misstated.

In forming an opinion regarding the financial statements as a whole, the auditor must not only consider the sampling results. The auditor's opinion should be based on these sampling results combined with the conclusions reached from other audit procedures.

Conclusion

In this author's opinion, both nonstatistical and statistical sampling have their place in audit sampling today. Either method can be

effective when the sampling plan has been properly designed. If an auditor is sued on an audit which he/she performed, this author is inclined to believe that statistical sampling has a better chance of standing up in a court of law. Statistical sampling is based on judgment along with statistical procedures and evidence, whereas nonstatistical sampling is based only on judgment and experience. This author concludes that the use of statistical sampling is appropriate when the benefits of statistical sampling exceed the additional costs incurred; otherwise, the auditor should use a nonstatistical sampling approach.

APPENDICES

APPENDIX I

TRENDS IN AUDIT SAMPLING

The purpose of this appendix is to examine the current trends in audit sampling. An empirical investigation into CPAs' knowledge, attitudes toward, and usage of statistical sampling in auditing will be reviewed.[1]

The usefulness of the data contained in this appendix is subject to several limitations:

1. The latest survey was conducted in 1979. Since 1979, two important pronouncements have been issued by the AICPA: SAS 39 in 1981 and Audit and Accounting Guide: Audit Sampling in 1983.
2. This study only covers the use of statistical sampling. With the issuance of SAS 39 and Audit and Accounting Guide: Audit Sampling, guidance was provided for non-statistical sampling, as well as statistical sampling.
3. CPAs selected for the survey were limited to members of the Ohio Society of CPAs,[2] so the results may not be indicative of the entire nation.

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[1]Timothy L. Ross, Lawrence Sundby, and Blaine A. Ritts, "Nine Years of Statistical Sampling in Auditing," The Ohio CPA Journal 40 (Winter 1981):41.

[2]Ibid.

In the surveys conducted in 1971, 1975, and 1979, three classifications were used in evaluating the respondents: (1) the type of employment, (2) the length of employment, and (3) the level of position. A profile of the respondents in each of the three surveys is presented in comparative figures in Table 1. The 1979 study shows an increase from 1975 in the number of respondents employed in the auditing field and in "Non-Big 8" firms. Table 1 also shows that a substantial number of respondents have been employed longer and hold higher positions in 1979 than in 1975. It is interesting to note the similarities between the 1979 and 1971 surveys in the classifications of employment categories and length of employment.

Extent of Use

In the 1979 survey, the CPAs were asked "On what percentage of your audits do you estimate that you use statistical (rather than judgmental) sampling procedures?"[3] Table 2 illustrates that "Big 8" firms and employees in higher level positions made more frequest use of statistical sampling procedures on their audits than "Non-Big 8" firms and employees at a lower level. The data in Table 2 also reveals that the use of statistical sampling in 1979 had reached 83%, a relatively

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[3]Ibid., p. 42.

TABLE 1

NUMBER AND PERCENTAGE OF RESPONDENTS

	1979 Survey		1975 Survey		1971 Survey	
	#	%	#	%	#	%
Questionnaires Mailed	300	100	300	100	300	100
Returned Usable Questionnaires	91	30	88	29	67	22
Employment Categories:						
Public Accounting--Auditing	71	78	51	58	48	72
Non-audit Public Accounting and Other	20	22	37	42	19	28
	91	100	88	100	67	100
"Big 8" Firm Employment	35	39	52	59	28	42
"Non-Big 8" Firm Employment	56	61	36	41	39	58
	91	100	88	100	67	100
Length of Employment:						
Less than 5 years	16	18	19	22	2	3
5-8 years	21	23	34	39	22	33
Over 8 years	54	59	35	39	43	64
	91	100	88	100	67	100
Position:						
Entry Level Through Senior	14	15	34	39	19	28
Supervisor or Manager	29	32	31	35	30	45
Principal or Partner	48	53	23	26	18	27
	91	100	88	100	67	100

SOURCE: Timothy L. Ross, Lawrence Sundby, and Blaine A. Ritts, "Nine Years of Statistical Sampling in Auditing," The Ohio CPA Journal 40 (Winter 1981):41.

TABLE 2

STATISTICAL SAMPLING--EXTENT OF USAGE

	Extent of Usage--1979 Only	
	From 33% to 100% of Audits	Never
Overall Response	46%	17%
By Type of Firm:		
"Big 8"	54%	7%
"Non-Big 8"	42%	23%
By Position:		
Entry Level Through Senior	32%	32%
Supervisor or Manager	67%	0%
Principal or Partner	58%	8%

SOURCE: Timothy L. Ross, Lawrence Sundby, and Blaine A. Ritts, "Nine Years of Statistical Sampling in Auditing," The Ohio CPA Journal 40 (Winter 1981):43.

high level of acceptance. However, the auditors indicating usage of statistical sampling employed it on only 30-40% of the audits performed.[4]

Specific Areas of Usage

Statistical sampling can be used in a number of areas being audited. The more common areas of usage are presented in Table 3. A comparison of the 1979 and 1975 figures reveals that the ranking order of areas of usage has remained relatively constant, with only inventory tests and sales and receipts having changed positions.

[4]Ibid., p. 45.

TABLE 3

STATISTICAL SAMPLING--AREAS OF USAGE

	Percentage of Respondents Mentioning Usage		
	1979	1975	1971
Accounts Receivable Confirmations	73%	76%	60%
Purchases, Cash Disbursements, Voucher Tests	63%	73%	27%
Sales and Receipts	56%	55%	16%
Inventory Tests--Prices, Quantities, Accuracy	44%	66%	51%
Inventory Value Estimations	37%	39%	. .[a]
Internal Control	32%	31%	7%
Accounts Payable Confirmations	25%	24%	19%
Additions to Long-Lived Assets	4%	18%	4%

SOURCE: Timothy L. Ross, Lawrence Sundby, and Blaine A. Ritts, "Nine Years of Statistical Sampling in Auditing," The Ohio CPA Journal 40 (Winter 1981):43.

[a]Insufficient 1971 data for this item.

Problem Areas

A list of possible problems and difficulties in applying statistical sampling procedures was included with the surveys sent out to the CPAs. The five problem areas encountered most frequently in 1979 were the same five major problem areas in 1975, as illustrated in Table 4. One significant aspect revealed by Table 4 is that the incidence of problems encountered in the 1979 study is lower in almost every problem area.

TABLE 4

STATISTICAL SAMPLING--PROBLEM AREAS

	Percentage of Respondents Mentioning Problem Area	
	1979	1975
Difficulty of Defining Errors	37%	41%
Time Versus Benefit Trade-off	35%	45%
Problems in Result Evaluation	35%	40%
Adjusting Adequately for Weak Internal Control	25%	31%
Sample-size Problems	23%	33%
Working Paper Detail Requirements Uncertain	17%	15%
Broken Sequences in Document Numbers	15%	25%
Population-size Problems	15%	17%
Convincing Superiors as to its Merit	14%	16%
Confusing Terminology and Disagreements among "Experts"	11%	23%
Substantial Skewness from Large Dollars	10%	13%
Problems of Correspondence	4%	13%
Problems in Using Random Numbers	3%	3%

SOURCE: Timothy L. Ross, Lawrence Sundby, and Blaine A. Ritts, "Nine Years of Statistical Sampling in Auditing," The Ohio CPA Journal 40 (Winter 1981):44.

These results are reasonable to expect, because as knowledge and experience in applying statistical sampling procedures increase, the problems encountered should decrease.[5]

[5] Ibid., p. 43.

APPENDIX II

GLOSSARY[1]

Allowance for sampling risk: A measure of the closeness of a sample estimate to the corresponding population characteristic at a specified sampling risk.

Alpha risk: The chance that the balance will be rejected as being materially in error when such balance is correct.

Analytical review procedures: Substantive tests of financial information made by a study and comparison of relationships among data.

Attribute: Any characteristic that is either present or absent.

Attributes sampling: Statistical sampling that reaches a conclusion about a population in terms of a rate of occurrence.

Audit sampling: The process of applying an audit procedure to less than one hundred percent of the items with an account balance or class of transactions for the purpose of evaluating some characteristic of the balance or class.

Beta risk: The probability that the auditor will accept the account balance as being correct when the balance is materially misstated.

Block sample: A sample consisting of contiguous transactions.

Error: An unintentional mistake.

Expected population deviation rate: An anticipation of the deviation rate in the entire population. It is used in determining an appropriate sample size for an attributes sample.

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[1]Most of these words came from American Institute of Certified Public Accountants (AICPA), Audit and Accounting Guide: Audit Sampling (New York, 1983), pp. 127-130.

Haphazard sample: A sample consisting of sampling units selected without any conscious bias, that is, without any special reason for including or omitting items from the sample. It does not consist of sampling units selected in a careless manner, and is selected in a manner that can be expected to be representative of the population.

Irregularity: An intentional distortion.

Logical unit: The balance or transaction that includes the selected dollar in a probability-proportional-to-size sample.

Nonsampling risk: All aspects of ultimate risk that are not due to sampling.

Nonstatistical sampling: A sampling technique for which the auditor considers sampling risk in evaluating an audit sample without using statistical theory to measure that risk.

Population: The items constituting the account balance or class of transactions of interest. The population excludes individually significant items that the auditor has decided to examine one hundred percent or other items that will be tested separately.

Precision: A range of values, plus or minus, around the sample result.

Probability-proportional-to-size (PPS) sampling: A variables sampling procedure that uses attributes theory to express a conclusion in dollar amounts.

Random sample: A sample selected so that every combination of the same number of items in the population has an equal probability of selection.

Reliability (confidence level): The proportion of precision ranges from all possible similar samples of the same size that would include the actual population value.

Risk of incorrect acceptance: The risk that a sample result shows an account balance is not materially misstated when it is materially misstated.

Risk of incorrect rejection: The risk that a sample result shows an account balance to be materially misstated when it is not.

Risk of overreliance on internal accounting control: The risk that the sample will show the auditor's reliance on the control is warranted when the actual compliance rate does not justify this degree of reliance.

Risk of underreliance on internal accounting control: The risk that the sample does not allow as much reliance on the control as the true rate of compliance supports.

Sample: Items selected from a population to reach a conclusion about the population.

Sampling risk: The risk that the auditor's conclusions based on a sample will be different from the conclusions he would have reached if the entire population were tested. Sampling risk for compliance testing is the risk of overreliance on internal accounting control or the risk of underreliance on internal accounting control. Sampling risk for substantive testing is the risk of incorrect acceptance or the risk of incorrect rejection.

Sampling unit: Any of the individual elements, as defined by the auditor, that constitutes the population.

Standard deviation: A measure of the dispersion among the respective amounts of a particular characteristic as measured for all items in the population for which a sample estimate is developed.

Statistical sampling: Audit sampling that uses the laws of probability for selecting and evaluating a sample drawn from a population for the purpose of reaching a conclusion about the population.

Stratification: Dividing the population into groups of items with similar characteristics.

Systematic sampling: A method of selecting a sample in which every nth item is selected.

Tolerable error: An estimate of the maximum monetary error that may exist for an account balance or class of transactions without causing the financial statements to be materially misstated.

Tolerable rate: The maximum population rate of deviations from a prescribed internal control procedure that the auditor will be willing to accept without altering his planned reliance on the control.

Ultimate risk: The uncertainty that is inherent in applying auditing procedures. Ultimate risk is a combination of two risks: (1) the risk that material errors will occur in the accounting process used in developing the financial statements, and (2) the risk that occurring material errors will not be detected by the auditor. Compliance testing reduces the first risk and the second risk is reduced by substantive testing.

Variables sampling: Statistical sampling that reaches a conclusion on the monetary amounts of a population.

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