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# SAMPLING AND THE INDEPENDENT AUDITOR (AN EMPIRICAL STUDY OF THE STATISTICAL SAMPLING METHODS USED BY CERTIFIED PUBLIC ACCOUNTING FIRMS OF THE UNITED STATES IN PERFORMING THEIR INDEPENDENT AUDIT FUNCTION)

A DISSERTATION

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JOSEPH J. JOSEPH, JR.

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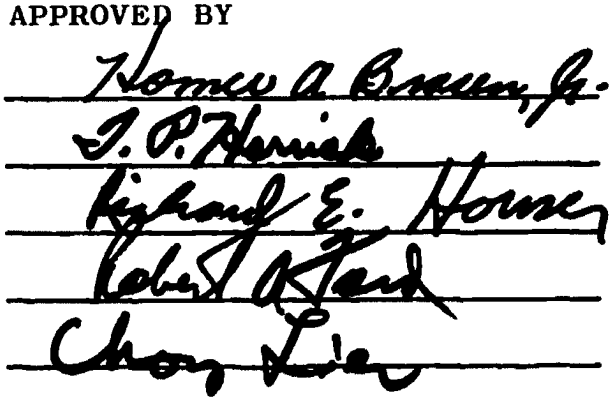
SAMPLING AND THE INDEPENDENT AUDITOR

(AN EMPIRICAL STUDY OF THE STATISTICAL SAMPLING METHODS USED BY CERTIFIED PUBLIC ACCOUNTING FIRMS OF THE UNITED STATES IN PERFORMING THEIR INDEPENDENT AUDIT FUNCTION)

APPROVED BY



DISSERTATION COMMITTEE

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The author accepts full responsibility for any errors or omissions in the study.

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## ABSTRACT

Very little empirical data or information was available about the extent to which independent auditors used statistical sampling to gather and analyze audit evidence, and that which was available was very superficial. If objective decisions were going to be made about the use of statistical sampling methods as employed by independent auditors, a verified benchmark was necessary. The problem was that no verified benchmark existed. More specifically there was no information available about the process surrounding the decision to use statistical sampling; attitudes and experience toward setting levles of confidence and precision; how extensive was the use of statistical sampling training and aids; experience surrounding the use of statistical sampling; and how extensive was the use of statistical sampling.

The purpose of the study was to empirically determine the status of statistical sampling's use to quantify and incorporate the risks that an auditor accepted in forming his opinion. For the study, the population sampled was defined as all offices of certified public accounting firms in the United States with two or more certified members. The scope of the study was limited to those facts obtained from reviewing available literature; by interviewing audit staff members of various CPA firms located in Norman and Oklahoma City, Oklahoma; and from mailing a questionnaire to offices of CPA firms throughout the United States.

Some of the more important findings included:

(1) Even though 93.6 percent of the offices of large firms used statistical sampling at some time during the previous year, the level of application on all of their audits was only 43.7 percent. For offices of small firms the percentages were much lower: the proportion of those who used statistical sampling was 66.4 percent and the level of application was only 17.7 percent.

(2) As the audit staff size increased, both the initial and final decisions to use statistical sampling were made at lower levels of authority.

(3) Establishment of profession-wide guidelines for statistical accuracy was rejected by a ten percent margin, even though offices of small firms favored them by three-to-one.

(4) Problems encountered when applying statistical sampling were as likely to be experienced in defining the error as in interpreting test results.

(5) The audit areas where statistical sampling was most likely to be applied were receivable confirmation, followed by purchase or voucher test and inventory determination.

(6) The method of statistical sample selection to some extent dictated the type of problems encountered when applying statistical sampling.

(7) The audit area to which statistical sampling was being applied to some extent dictated the method of statistical sample selection.

(8) The most important factors in determining the level of use of statistical sampling were whether the firm had a statistical sampling training course, followed by the level of authority for the initial decision to use statistical sampling and whether a response came from the office of a small or large firm.

(9) The lower the level of the initial decision to use statistical sampling on an audit, the higher the level of use.

(10) Not only were offices of large firms more likely to use statistical sampling, but the level of use of statistical sampling on all of their audits was twice as high as for offices of small firms.

(11) The use of statistical sampling was employed to estimate attributes by a margin of about four-to-one over variables.

(12) Many offices of small firms indicated that they did not use statistical sampling because of the small size of the CPA firm, small size of audits, small number of audits done, and the training inadequacy of the firm's staff members.

(13) Offices of small firms were likely to use statistical sampling for sample selection, while offices of large firms generally used statistical sampling for sample selection and for statistical inference.

According to their comments, some offices of small firms apparently looked upon the use of statistical sampling as a panacea for avoiding or limiting legal liability from possible lawsuits. Offices of large firms expressed their apprehension about accepting the use of statistical sampling, because of the disadvantages when placed in the hands of inadequately trained personnel. They pointed to the fact that lack of statistical expertise might increase or even lead to possible liability when challenged by expert statisticians in court.

# SAMPLING AND THE INDEPENDENT AUDITOR (AN EMPIRICAL STUDY OF THE STATISTICAL SAMPLING METHODS USED BY CERTIFIED PUBLIC ACCOUNTING FIRMS OF THE UNITED STATES IN PERFORMING THEIR INDEPENDENT AUDIT FUNCTION)

## CHAPTER I

## INTRODUCTION

The environment of the auditing profession has been described as:

> a time of prosperity and a time of peril. Each year (auditors have) posted new highs in billings and earnings, but at the same time they reportedly (have been) subjected to an unprecedented number of lawsuits.[1]

A staff reporter for The Wall Street Journal opined that nearly one hundred lawsuits were pending against auditors in the late 1966.[2] More recently an associate editor of Fortune reported that as many claims for damages were filed against auditors in 1968 as in the previous twelve years.[3] The increased volume of suits filed has frequently involved the auditing profession's more prestigious firms.[4] These events have led auditors to seek auditing procedures that would avoid or limit their liability in performing their primary objective.

The primary objective of an examination of financial statements by the independent auditor is to enable him to express an opinion as to the fairness of the statements, their compliance with generally accepted accounting principles, and the consistency of these principles with prior periods. Auditors generally base their opinions about the fairness of the presentation of financial statements on conclusions formed as a result of gathering evidence through the use of samples or tests.

Although the auditor has historically relied upon judgmental sampling to gather accounting data, the advantages of statistical sampling have received serious consideration by the auditing profession in recent years. The unique feature that makes statistical sampling more attractive than judgmental sampling is the ability to objectively determine and state the precision at some level of confidence about the audit area or element under examination. The auditor is placed in a much better position to formulate and defend his opinion because his conclusions have been reached through objective means.

A frequently suggested solution to prevent or limit potential liability is for the auditor to use statistical sampling on his audit. Reiling and Taussig further suggest that:

> Auditors should not express an opinion on financial statements without qualifications as to the level of confidence for the estimated amounts in those statements. Financial reporting would be greatly improved if a (statistical) probability approach were applied to the financial statements. Confidence limits should be published for the principal items along with their expected values. . . . Many lawsuits would be avoided if auditors would simply indicate that they were not certifying to deterministic facts, but rather are expressing an opinion on estimates from a probability distribution. A caveat should be included in the auditor's opinion putting the reader on notice of the stochastic nature of the quantities covered by the report.[5]

## Other Work in the Area

Considerable work has been done in developing normative statistical sampling methods for application to auditing. Yet, a review of the literature produced only one study which attempted to determine the current use of statistical sampling in auditing. In 1971 an article by Ross, Hoyt, and Shaw entitled "The Use of Statistical Sampling in Auditing--An Empirical Study" was published in The Ohio CPA.[6] Essentially, their study was designed to determine (1) the factors that led to the use of statistical sampling; (2) the factors that affected an individual's level of statistical sampling knowledge; and (3) the level of statistical sampling that would be employed in the future.

Both their study and this one had four areas in common. Both studies were designed to determine the

audit areas in which statistical sampling was used. Ross, Hoyt, and Shaw found that statistical sampling was used most often for accounts receivable confirmation, followed by inventory testing, purchase or voucher tests, accounts payable confirmation, and sales and receipts tests. The determination of the level of the future use of statistical sampling in auditing was also an objective of both studies. The conclusion of Ross, Hoyt, and Shaw was that the use of statistical sampling would be increased. Both studies were designed to determine whether the respondent considered statistical sampling a valid audit tool. Results of the Ross, Hoyt, and Shaw study revealed that statistical sampling was considered to be a valid audit tool. Additionally, each study dealt with the extent to which statistical sampling was used in auditing. Ross, Hoyt, and Shaw concluded that statistical sampling was not widely used.

The Ross, Hoyt, and Shaw study was of limited usefulness for a number of reasons. Their study was limited geographically to the state of Ohio, the sample was small, the sample was confined to the individual CPA certificate holder, and the useful response rate was very low. Additionally, in the areas of similarity of the two studies no attempt was made to determine

(1) the relative importance of the audit areas where statistical sampling was used; (2) the margin by which statistical sampling was considered to be a valid audit tool; (3) what the level of statistical sampling should be in the future; and (4) how extensive the use of statistical sampling was in quantitative terms.

## The Problem

Very little empirical data or information was available in 1972 about the extent to which independent auditors used statistical sampling to gather and analyze audit evidence, and that which was available was very superficial. If objective decisions were going to be made about the use of statistical sampling methods as employed by independent auditors, a verified benchmark was necessary. The problem was that no verified benchmark existed. More specifically, there was no information available about the process surrounding the decision to use statistical sampling; attitudes and experience toward setting levels of confidence and precision; how extensive was the use of statistical sampling training and aids; experience surrounding the use of statistical sampling; and how extensive was the use of statistical sampling.

## Need for the Study

The primary need for the study was to establish a verified benchmark so that practitioners and academicians

could more objectively:

1. decide if the current level of application of statistical sampling needed to be changed;
2. decide if certified public accounting firms were adequately employing statistical sampling;
3. have available a point of reference for trend analysis for similar studies to be done in the future; and
4. decide if changes needed to be made in teaching and training methods currently employed.

## Purpose of the Study

The purpose of the study was to empirically determine the status of statistical sampling's use to quantify and incorporate the risks that an auditor accepted in forming his opinion. In order to investigate the current use, five areas of interest were chosen as the basis for the development of specific questions that appeared on the questionnaire used in the study. The five areas included:

1. the process surrounding the decision to use statistical sampling;
2. level of confidence and precision;
3. statistical sampling training and aids;
4. application experience; and
5. level of application.

Additionally, questions were included on the questionnaire to determine the characteristics of the respondents and to allow respondents to make additional comments.

## Scope and Method of Investigation

For the purpose of the study, the population sampled was defined as all offices of certified public accounting firms in the United States with two or more certified members. The scope of the study was limited to those facts obtained from reviewing available literature; by interviewing audit staff members of various CPA firms located in Norman and Oklahoma City, Oklahoma; and from mailing a questionnaire to a sample of offices of CPA firms throughout the United States. The methods used to analyze the primary data included single frequency and correlation analysis.

## Organization of Study

Chapter I covers the current environmental climate of the auditing profession and how the auditor has been continually faced with the potential legal liability associated with his opinion. The importance of statistical sampling in avoiding or limiting the auditor's liability, other empirical work in the area of statistical sampling's application to auditing, the problem of the lack of knowledge about the current use of statistical sampling, the need for the study, the purpose of the study, scope and method of investigation, and organization of study are also covered.

Chapters II and III are presented primarily to provide an overall perspective and orientation for those readers who are unfamiliar with the historical development

of the use of statistical sampling in auditing and with the sampling methods available today. Those already familiar with statistical sampling methods may not wish to read Chapter III. Chapter IV contains a summary of the methodology used in the research for the study. Summaries of single frequency and correlation analysis of the data along with the related implications are presented in Chapters V and VI, respectively. Chapter VII is devoted to summarizing the major conclusions of the study and providing recommendations concerning future research. Since the nature of statistical sampling is somewhat technical, a glossary of terms used in the presentation of the study is included for the convenience of the reader in Appendix A.

## FOOTNOTES

[1]Henry B. Reiling and Russell A. Taussig, "Recent Liability Cases--Implications for Accountants," The Journal of Accountancy, Vol. 130 (September, 1970), p. 39.

[2]Lee Berton, "CPAs Under Fire," The Wall Street Journal, Vol. 43 (November 15, 1966), p. 13.

[3]Arthur M. Louis, "The Accountants Are Changing the Rules," Fortune, Vol. 77 (June 15, 1968), p. 177.

[4]Reiling and Taussig, op. cit.

[5]Ibid., pp. 44-45.

[6]Timothy Ross, Hugh Hoyt, and Herb Shaw, "The Use of Statistical Sampling in Auditing--An Empirical Study," The Ohio CPA, Winter, 1971, pp. 5-13.

# CHAPTER II

## A BRIEF HISTORY OF SOME OF THE MORE IMPORTANT INFLUENCES SURROUNDING THE DEVELOPMENT OF STATISTICAL SAMPLING USED BY INDEPENDENT AUDITORS

Chapter II is presented primarily to provide an overall perspective and orientation for those readers who are unfamiliar with the historical development of the use of statistical sampling in auditing. Some of the more important influences surrounding the historical development of statistical sampling methods used by independent auditors in performing their audit function are traced here. The review presented will cover: Early Development, American Institute of Certified Public Accountants' Influence, American Accounting Association's Influence, and Other Influences.

### Early Development

Changes in audit objectives which took place around 1900 eventually allowed independent auditors to use statistical sampling as an acceptable audit procedure. Previously auditing objectives and techniques were primarily of British origin[1] and characterized by:

1. Detection and prevention of fraud,
2. Detection and prevention of errors, and
3. Detailed, one-hundred percent checks.[2]

With the rapid growth of business, the increase in firm size, and the auditing of these larger firms, the development of auditing objectives and techniques in the United States progressed independently[3] and soon became characterized by:

1. Examination to render an opinion as to the fairness of the financial statements,
2. Detection of fraud only as a minor objective, and
3. Widespread use of sampling procedures as audit tests.[4]

C. A. Moyer pointed out the importance of sampling by his statement that, "The adoption of sampling procedures . . . represents the most important development in auditing during the early 1900's."[5]

After 1900 the use of judgmental sampling for selecting and analyzing audit data increased, but the development and especially the use of statistical sampling in auditing is of more recent origin. Several exceptions exist to the recent development and use of statistical sampling. First, C. R. Rorem noted the relationship between accounting and statistics in 1927. In an article appearing in an early issue of the Accounting Review, Rorem states,

> Accounting and statistics are similar in their use, for both are tools of control. They are also similar in their method, bearing so to speak, a family resemblance, for accounting and statistics may be regarded as offspring of the single parent, quantitative method of analysis.[6]

Undoubtedly, the article provided the impetus for many accountants to search for concrete applications of statistics to the field of accounting.

Second, a few years later in 1933, Lewis A. Carman proposed the first application of statistics to auditing in his now famous article, "The Efficacy of Tests," which appeared in The American Accountant.[7] Lawrence L. Vance, a professor of accounting at the University of California specializing in the application of statistical sampling theory to auditing, felt that Carman's original article was a

> throughgoing effort to apply mathematical probability theory to auditing procedure . . . to determine the sample size necessary to observe one fraudulent entry, given an absolute number of fraudulent entries as a hypothesis. (Carman's approach) uses the formulas for combinations, and through a process of approximation, arrives at sample sizes (expressed) as percentages of finite populations designed to enable the auditor to observe at least one fraudulent entry on varying probability levels upon the hypothesis that some absolute number of fraudulent entries from 1 to 40 existed in the population.[8]

Carman did not attempt any further interpretation of the sample's characteristics in his article.

Prior to 1950 Robert H. Prytherch, Leo Herbert, Jerome Abrams, and William D. Cranstown authored many of the articles about the application of statistical sampling

in auditing.[9] Since the articles were either based upon Carman's original concepts or gave only brief treatment to the application of mathematical probability to statistical sampling, they provided few innovations. An important exception was the work done by the Statistical Research Group of Applied Mathematics Panel of the National Defense Research Committee at Columbia University.[10] The group developed sequential (acceptance) sampling methods along with generated statistical probability tables which made the use of the likelihood ratio as a practical tool much easier.

The first extensive treatise dealing with the application of statistical sampling to auditing appeared as recently as 1950.[11] The object of Lawrence L. Vance's Scientific Method for Auditing was ". . . to make available to the accounting profession some of the techniques developed by statisticians for the interpretation of samples."[12] Vance recognized the need for statistical theory in auditing by stating:

> Almost all auditing work, particularly in the United States, is done on a sampling basis, but no one has bridged the gap between the sister professions of public accounting and statistics to enable auditors to use rigorous statistical reasoning, although the two professions had a parallel development. The present work attempts to serve this need as far as fundamental, readily available statistical concepts are concerned. Its method is to describe the use of probability inferences based upon the binomial distribution; to present sequential sampling as a basis for the general interpretation of auditing samples; to examine the conditions which auditing imposes upon statistical reasoning; to suggest specific procedures which will give auditing the benefit of objective

> statistical devices in the selection and interpretation of auditing samples or tests; to discuss their application; and to illuminate the bases thus provided for the establishment of objective, workable auditing standards.[13]

A couple of years after Vance's work, John Neter was able to report in an Accounting Review article that "Interest in the use of statistical sampling techniques by auditors has grown recently. Articles in the Accounting Review, The Arthur Andersen Chronicle, The Woman C.P.A., and the Journal of the American Statistical Association testify to this development."[14] Several major works have been written by various authors on the applications of statistical sampling to auditing.[15]

## American Institute of Certified Public Accountants' Influence

### Early Influence

The American Institute of Certified Public Accountants influenced the early development of statistical sampling methods primarily through the dissemination of knowledge by the publication of articles on the subject from various articles in The Journal of Accountancy.[16] Although the American Institute of Certified Public Accountants took no formal position on statistical sampling before 1956, the Institute recognized the growing importance of the subject as early as 1949. At that time John Neter was commissioned by The Journal of Accountancy to research

and write an exploratory article to determine whether the application of statistical sampling methods to test-checking could make auditing more useful, more certain, faster, and less costly. The resulting article which appeared in the May, 1949, issue of The Journal of Accountancy:

1. suggests that statistical sampling methods are tools of value to auditors,
2. defines some questions which must be answered and states the nature of further work which must be done before statistical sampling methods can be used in auditing, and
3. concludes with a cautious opinion that these methods may be very useful to the auditor.[17]

John Neter's article invoked widespread interest in statistical sampling as a method of sample selection. Calls for further research were quickly heard. A typical comment was published in the September, 1949, issue of The Journal of Accountancy,

> Reading John Neter's article . . . suggests . . . that this is an area in which some really useful further research can be done (since) most practitioners work almost in the dark as far as any good criteria of the manner in which they should select their samples and as to how much detail of verification they should do. (Further research might develop) a guide to practitioners as to how they should determine the proper composition of a sample and how large the sample should be.[18]

## Committee on Statistical Sampling

By 1956 the American Institute of Certified Public Accountants felt that sufficient exploratory work on statistical sampling methods had been accomplished to establish in that year the Committee on Statistical Sampling. The main objective of the Committee was to consider whether statistical sampling is applicable to audit testing and report any conclusions reached to the Committee on Auditing Procedure.[19] Shortly afterwards the Committee issued a call in The Journal of Accountancy for examples of the use of Statistical Sampling,

> The American Institute's committee on statistical sampling . . . desires to obtain information as to experimentation with these techniques that may have been carried by our readers. In particular, the committee is interested in information regarding experiments that have been conducted by smaller accounting firms or individual practitioners in the audits of small businesses . . . (and in) information as to any use that has been made of statistical techniques in the accounting or internal control procedures of such businesses.[20]

Subsequently the Committee has issued two interim reports and five volumes of An Auditor's Approach to Statistical Sampling.

### The 1962 Interim Report

After pointing out that, "It is a well-established custom of independent auditors to test accounting records in connection with their examination of financial statements," the Committee in the 1962 Interim Report goes on to suggest that, "widespread interest in statistical sampling has led

to the suggestion that statistical techniques might be applied to the test-checking" under certain circumstances.[21] A summary of the conclusions reached by the Committee follows:

1. Statistical sampling methods are useful in some audit tests and are permitted under generally accepted auditing standards.

2. Acknowledgment of the usefulness of statistical sampling methods in some circumstances does not require, in terms of our present knowledge, modification of generally accepted auditing standards to specify the use of statistical sampling in the examination of financial statements by independent auditors.

3. The use of statistical selection is not accompanied by a requirement to use statistical techniques.

4. No obligation is incurred to use statistical sampling methods in all tests of a particular engagement because they are used in one or more tests on that engagement.

5. The use of statistical sampling methods in certain engagements does not require the use of any of these techniques in other engagements.

6. In examining financial statements, the independent auditor should be free to use, or not to use, statistical sampling as a tool in forming his opinion concerning their fairness.

7. Since application of statistical sampling methods requires some knowledge beyond that now normally associated with accountants, a broader education in and knowledge of statistical sampling methods and further research as to its applicability by the profession is desirable.[22]

## The 1964 Interim Report

An influence upon the 1964 Interim Report was Auditing Standards and Procedures issued by the Committee on Auditing Procedure in 1963. The pronouncement contained

the following relevant comments dealing with statistical sampling, and the type and extent of audit-tests:

> In determining the extent of a particular audit test and the method of selecting items to be examined, the auditor might consider using statistical sampling techniques which have been found to be advantageous in certain instances. The use of statistical sampling does not reduce the use of judgment by the auditor but provides certain statistical measurements as to the results of audit tests, which measurements may not otherwise be available.[23]

Pointing to the excerpt from Auditing Standards and Procedures and excerpts from their previous interim report, the Committee on Statistical Sampling made "clear that statistical sampling is not a fundamentally different audit approach, and that its use is permissive rather than mandatory under generally accepted auditing standards."[24]

Believing that interest in the use of statistical sampling methods was increasing, the Committee outlined the purpose of their second interim report, "Relationship of Statistical Sampling and Generally Accepted Auditing Standards," as

> . . . this report is issued to discuss more specifically a way in which statistical precision and reliability can be related to generally accepted auditing standards and to point out some of the factors to be considered by the auditor in deciding what degree or level of each is satisfactory for a particular sample; it is not issued to propose definitive numerical criteria for these measurements nor to discuss their mathematical aspects.[25]

A summary of the more important conclusions reached by the Committee follows:

1. Statistical sampling methods are most directly related to the three standards of field work.

2. Precision and reliability measurements can be useful adapted to the auditor's purposes by relating precision to materiality and the level of confidence to the reasonableness of the basis of his opinion.

3. The competence of evidential matter referred to in the third standard of field work is solely a matter of auditing judgment that is not comprehended in the statistical design and evaluation of an audit sample.

4. Statistical samples applied to test validity or bona fides of accounting data to be evaluated in monetary terms should be designed by specifying reliability levels that vary inversely with the subjective reliance assigned to internal control and to any other auditing procedures or conditions relating to the particular matters to be tested by such samples.

5. Statistical sampling may be applied to test compliance with internal control procedures that leave an audit trail in the form of documentary evidence of compliance.

6. Proper use of statistical sampling methods requires audit planning and supervision as comprehended in the first standard of field work.[26]

## An Auditor's Approach to Statistical Sampling

In order to implement the objectives outlined in their 1964 Interim Report, the Committee on Statistical Sampling of the American Institute of Certified Public Accountants undertook the development of a series of programmed texts. Thus far the Committee has developed and released five volumes, each accompanied by a supplemental section, with the objectives of broadening education in statistical sampling and increasing its applicability in

auditing. "This series of self-study programs uses the programmed instruction method to provide a working knowledge of statistical sampling with (an) emphasis on actual techniques and applications in auditing practice. In addition to a programmed text, each volume includes a supplementary text of summaries, worksheets, examples, and reference materials."[27]

The series, An Auditor's Approach to Statistical Sampling, presently consists of:

1. Volume 1: An Introduction to Statistical Concepts and Estimation of Dollar Values. The volume introduces certain basic statistical concepts and illustrates the practical application of simple random sampling for estimation of variables.

2. Volume 2: Sampling for Attributes. The volume explains how to sample for particular characteristics, such as the frequency of occurrence of certain events and is shown to be particularly applicable to transaction testing and evaluation of internal control.

3. Volume 3: Stratified Random Sampling. The volume covers all phases of stratified random methods and provides exercises to help develop the skills needed to apply them.

4. Volume 4: Discovery Sampling. The volume describes how to design a sample which will estimate the probability of discovering at least one example of a certain population characteristic where the characteristic exists at some specified rate therein.

5. Volume 5: Ratio and Difference Estimation. The volume explains the concepts of ratio and difference estimation and indicates that both can be used with either simple random or stratified random sampling.[28]

## Summary

Until the Committee on Statistical Sampling was established in 1956, the American Institute of Certified Public Accountants had no position on the application of statistical sampling to auditing and their main influence resulted from articles appearing in The Journal of Accountancy. Since formation the Committee has issued two interim reports, one in 1962 and the other in 1964, stating their position on the application of statistical sampling to auditing. Additionally, to aid the education of auditors, five volumes of An Auditor's Approach to Statistical Sampling have been issued since 1967.

## American Accounting Association's Influence

In the development of statistical sampling methods used by independent auditors, the American Accounting Association's influence has been considerably less than that of the American Institute of Certified Public Accountants. Primarily the American Accounting Association's influence has come through articles in The Accounting Review, Monograph Number 6, and to a lesser extent, through two committees of the association.

## The Accounting Review

Since Rorem published "Similarities of Accounting and Statistical Method" in 1927,[29] The Accounting Review has provided a continuing medium for the development of statistical sampling methods. The article has been referred to repeatedly throughout subsequent accounting literature and undoubtedly provided the impetus that

stimulated accountants to make ever increasing efforts to develop useful statistical methods. Before 1950, when there was little development or use of statistical sampling methods by auditors, few articles appeared. As progress was made in the development of statistical sampling methods, the number of articles on the subject appearing in The Accounting Review increased. After the publication of the first extensive thesis dealing with the application of statistical sampling to auditing in 1950, the frequency of articles dealing with the subject that appeared in The Accounting Review increased significantly.

## Monograph Number Six

In 1961, the American Accounting Association published The Philosophy of Auditing by R. K. Mautz and Hussein A. Sharaf as Monograph No. 6.[30] Several areas of the Monograph contain references to the importance or potential importance of statistical sampling in auditing. Initially, the authors suggest the possible need for using statistical sampling in the auditor's customary testing and sampling which he relies upon to form and justify his opinion.

> In the past we have considered the judgment of an experienced practitioner adequate; the new interest in the application of statistical sampling methods to auditing requires that we examine this assumption that experience per se sufficiently qualifies one to judge the adequacy of tests and sample. Perhaps we must understand the laws of inference and probability theory as well. A question exists as to whether there is a minimum audit program required in every case and, if so, what it includes?[31]

In discussing the degree of reliance that auditors place on the theory of probability, Mautz and Sharaf point out that the "development in statistical techniques and in their application have so improved the scientist's ability to draw accurate inferences that objections to their use, providing the application is in accordance with accepted principles of statistical inference, are seldom accepted as valid."[32] The authors then go on to conclude that,

> Auditing is like other applications of scientific thinking in its reliance on probability theory (,) . . . exemplified by the use of the term "opinion" in describing the auditor's final over-all judgment with respect to the financial statements examined. . . . it must be admitted that as yet auditing has not found ways of improving its use of probability theory through statistical applications to the same extent that other fields have. Thus this remains one of the areas in auditing in which additional experience is necessary.[33]

## Committees

More recently the American Accounting Association has organized two committees to investigate various aspects of the field of auditing. The first committee, Committee on Auditing Concepts, was organized in 1969 and charged to (a) investigate the role and function of auditing, and (b) make recommendations for research projects, examine the problems of evidence, and issue a position paper on the scope of auditing by accountants.[34] Shortly afterwards, in 1971, the Auditing Education Committee was organized and charged to survey existing auditing concepts, literature,

and practice with a view to determining the proper scope, content, and implementation of auditing theory and methodology in the accounting curriculum at both the graduate and undergraduate levels.[35] To date, no final report has been published by either committee; however, each will undoubtedly consider the place of statistical sampling in auditing.

## Influence of Others

Although most of the development of statistical sampling methods available today in auditing was accomplished through individual effort, the Committee on Statistical Sampling of the American Institute of Certified Public Accountants, and to a lesser extent the American Accounting Association, other groups and organizations have been influential. Noteworthy among these included the Securities and Exchange Commission, New York State Society of Certified Public Accountants, the Federal Government Accountants Association, the Institute of Internal Auditors, Certified Public Accounting firms, and certain foreign sources. Some of the more important contributions of these groups are discussed below.

An organization which has been a factor in the development of auditing in the United States since 1933 has been the Securities and Exchange Commission (SEC). Even though the Commission has been granted broad powers by Congress to prescribe detailed steps to be followed by the independent accountant in his examination for the purpose

of certifying financial statements, with two exceptions the Commission has not used those powers. Instead the SEC has generally been content to provide an indirect influence, allowing the public accounting profession to lead the way in auditing progress. However, Rappaport is quick to point out in his book, SEC: Accounting Practice and Procedure, that "the Commission, on the other hand, has not hesitated to criticize any practice that may be generally accepted within the profession, but is, in the Commission's view, faulty."[36]

One of the major exceptions to the Commission's indirect influence has been to set up specific auditing standards in its "General Instructions with Respect to Form X-17A-5." The Commission enumerates in some detail the minimum audit requirements applicable to the independent public accountant's audit of certain members of national securities exchanges, brokers, and dealers in securities.[37] Thus, the auditor may use statistical sampling methods in his examination only if they meet or exceed the Commission's minimum audit requirements.

The other major exception to the Commission's indirect influence relates to investment companies registered with the SEC under the Investment Company Act of 1940. The act requires that a physical examination and comparison with the books be made of all securities on hand, in vault, in box, or otherwise in physical possession of the

broker.[38] The procedure clearly forbids the use of any statistical sampling methods. The Commission generally has allowed the unrestricted use of statistical sampling methods in auditing as deemed appropriate by the independent accountant with the exceptions noted above.

The New York Society of Certified Public Accountants has been the most influential of all state societies through their publication, The New York CPA, now The CPA, in the development of statistical methods used in auditing. Since 1948 many articles explaining and advocating the application of statistical sampling to auditing have been published by such noted authors as Abrams, Arkin, Neter, Hill, and Trueblood.[39]

In recent years the Federal Government Accountants Asscciation has become more influential in the development of statistical sampling methods in auditing through their publication, The Federal Accountant.[40] They have particularly been influential in developing the application of statistical sampling methods in auditing by the use of the computer. In 1967 The Federal Accountant published a special supplement entitled Sampling Techniques and Regression Analysis for Accounting and Auditing Information: A Practical Approach, which was the basis for the development of workshops to give practical hands-on experience with statistical sampling computer problems for its membership at the chapter level.[41]

Another organization which has been a factor in the development of the application of statistical sampling to auditing is the Institute of Internal Auditors. Primarily the influence has been a result of two special sampling manuals published by the Institute.

In 1967 the Institute of Internal Auditors published The Sampling Manual for Auditors[42] which covered the basic fundamental concepts of applying statistical sampling methods to auditing. Then in 1970 the Institute published a Supplement to the Sampling Manual for Auditors[43] which was essentially a self-contained unit for difference and ratio estimates with related computer applications. Both manuals have been widely used as staff training aides on sampling techniques for industry as well as CPA firms.

The desire to increase efficiency of collection and validity of audit evidence and to decrease the potential liability from possible lawsuits has led to the acceptance of statistical sampling as an audit tool by many certified public accounting firms, especially the larger ones. The acceptance of statistical sampling by these firms is evidenced by articles in firm publications,[44] firm training manuals, and firm training courses dealing with the application of statistical sampling methods to auditing. Since 1961 Haskins and Sells has been a leader in the use of statistical sampling methods in auditing; they have a firm-wide policy which requires justification for failure to use statistical sampling techniques on any audit.

As clients' accounting data has become more computerized and as computers have become more readily available to accounting firms, the use of statistical sampling on audits has become more widespread. Often the only way to efficiently retrieve data, short of a total printout, is to use statistical sampling. Additionally, in many cases the only efficient way for the auditor to summarize voluminous data is to use statistical sampling. Realization of the advantages of closely integrating statistical sampling in the use of computers has led many of the larger accounting firms to develop many specialized statistical sampling programs to retrieve and analyze accounting data in their audits.[45]

Since the United States has led in the development of auditing objectives and techniques since 1900, foreign influences have not been very great. Primarily their function has been to promulgate rather than innovate auditing objectives and techniques throughout the world.[46]

## Summary

As the auditing objectives shifted around 1900 from detection and prevention of fraud to expression of an opinion on the fairness of financial statements, auditing procedures changed from detailed one hundred percent checking to widespread use of sampling procedures as audit tests. The shift in objectives made possible the introductory use of statistical sampling on an audit. However, the

increasing use of statistical sampling as an audit tool has only become more widespread as auditors have increased their desire to determine the risks they have been accepting.

Most of the early influence in the development of statistical sampling as an audit tool came primarily through individual effort. Then in the early 1950's the AICPA became the first major organization to become interested in the use of statistical sampling as an audit tool. Significant organized strides in development began making headway afterwards, with the AICPA becoming the most influential. Essentially the AICPA's position has been one which has allowed and encouraged, but not required, the use of statistical sampling for audit tests under generally accepted auditing standards. The influence of certified public accounting firms is second to that of the AICPA. Other organizations have been less influential.

The inclusion of the chapter is for the benefit of those who may be unfamiliar with some of the more important influences surrounding the development of statistical sampling in auditing. The presentation was not intended to be an exhaustive, detailed, historical study; but only a brief history for orientation purposes.

## FOOTNOTES

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[6]C. R. Rorem, "Similarities of Accounting and Statistical Method," Accounting Review, Vol. 2 (March, 1927), pp. 10-18.

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[16]A few of the more important articles appearing in The Journal of Accountancy that dealt with statistical sampling and auditing before John Neter's article appeared in 1949 would certainly include the following: Robert H. Prytherch, "How Much Test Checking Is Enough?" The Journal of Accountancy, Vol. 74 (December, 1942), pp. 525-30; and William D. Cranstoun, "A New Look at Basic Auditing Techniques," The Journal of Accountancy, Vol. 86 (October, 1948), pp. 274-83.

[17]John Neter, "An Investigation of the Usefulness of Statistical Sampling Methods in Auditing," The Journal of Accountancy, Vol. 87 (May, 1949), p. 390.

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[23]Committee on Auditing Procedures, American Institute of Certified Public Accountants, Auditing Standards and Procedures (New York: American Institute of Certified Public Accountants, Inc., 1963), p. 37.

[24]Committee on Statistical Sampling, American Institute of Certified Public Accountants, "Relationship of Statistical Sampling to Generally Accepted Auditing Standards," The Journal of Accountancy, Vol. 118 (July, 1964), p. 56.

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[31]Ibid., p. 3.

[32]Ibid., p. 33.

[33]Ibid.

[34]"American Accounting Association Committees--1969-70," The Accounting Review, Vol. 45 (January, 1970), p. 190.

[35]"Committees 1971-72," The Accounting Review, Vol. 47 (January, 1972), p. 182.

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[41]National Educational Committee, Federal Government Accountants Association, "Sampling Techniques and Regression Analysis for Accounting and Auditing Information: A Practical Approach," The Federal Accountant, Vol. 16 (November, 1967), pp. 1-102.

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[44]Many articles describing the application of statistical sampling to auditing have appeared in such firm publications as: The Arthur Andersen Chronicle, Haskins and Sells Selected Papers, Lybrand Journal, and Price-Waterhouse Review.

[45]Some examples of such specialized statistical programs include: Ernst & Ernst Auditronic 16 System and Haskins and Sells Auditape System.

[46]Foreign sources of influence of importance include such publications as: Canadian Chartered Accountant, Accountancy (England), Chartered Accountant in Australia, Accountant (England), Accountants' Journal (New Zealand), and Australian Accountant.

# CHAPTER III

## SAMPLING METHODS AVAILABLE TODAY

Chapter III is presented primarily to provide an overall perspective and orientation for those readers who are unfamiliar with the statistical sampling methods available today for auditing application. As shown in the preceding chapter, auditing has evolved into a sampling process generally described as testing or test-checking. A brief review of the statistical sampling methods available to the independent auditor for sampling and evaluating audit evidence is presented here. The review will cover both nonprobability and probability sampling.

### Nonprobability Sampling

Nonprobability (judgment) sampling is a method of sample selection in which there is no objective assignment of probabilities to individual sample units. For such a sample, no measure of sample reliability may be objectively determined. Essentially, the auditor using judgmental sampling (a) determines the sample size, (b) selects representative items for the sample, and (c) draws conclusions about the population inferred from the sample results based solely on his expert subjective judgment. Since the

results achieved through judgmental sampling are not based on probability theory, the auditor is unable to objectively evaluate the accuracy of the results and the associated risk of accepting such results as being representative of true population parameters.

Lawrence L. Vance in his Scientific Method for Auditing points out a number of subjective influences that may affect the accept or reject conclusion based on judgment sampling:

a. differences in individual auditor's ability, knowledge, experience, and prejudices;

b. pressure upon the auditor to reduce the client's cost of the audit; and

c. auditor's state of physical and mental health.[1]

Since these influences generally vary among auditors and over time, the whole process of judgmental sampling will produce widely varying results that are frequently unreliable and inconsistent. Thus, the possibility exists that no two auditors will agree on what constitutes a representative nonprobability sample which will produce reliable results for a given population.

Even though the reliability of the results depends upon the auditor's subjective judgment, this does not necessarily mean that judgment sampling is a bad sampling procedure. In some sampling situations judgmental sampling may be acceptable because (a) the results may be reliable,

(b) the procedure is economical, and (c) the auditor may be forced to use this particular method. For example, an auditor checking the inventory of a coal company may select only a sample off the top of a large pile to check the type and quality, since a random sample from inside the pile may be physically impossible. From experience the auditor would know that only coal of the same kind and quality would be stored in one pile. Thus, a small judgment sample selected from the top of the pile would probably be sufficient to provide the necessary information concerning the entire pile of coal.

Although a judgment sample may provide an excellent description of the investigated audit area, there is no way of establishing this fact objectively. Since judgment sampling lacks scientific determination of the required sample size and of objective projection or evaluation of the sample results, many auditors feel judgmental sampling should only be used sparingly and only where statistical sampling cannot be used effectively or would not be economical.

## Probability Sampling

Probability (statistical) sampling is a process where each unit of a sample is drawn with a known probability of being selected. Since statistical sampling is based on widely accepted and mathematically provable

statistical principles, results of such a sample have a number of distinct advantages over nonstatistical sampling results. The greatest advantage is the ability to objectively measure the reliability and level of confidence which can be placed on the results.

Herbert Arkin offers an extensive list of the advantages of statistical sampling in his Handbook for Auditing and Accounting. Some of the more important advantages of statistical sampling offered by him are that statistical sampling:

1. produces objective, defensible results
2. provides an advanced, objective estimation of sample size
3. provides an estimate of sampling error
4. may save time and money
5. results may be combined and evaluated, even though accomplished by different auditors
6. provides a basis for possible objective evaluation of test results.[2]

The primary purpose of statistical sampling is to provide an objective estimate of the characteristics of the population with a means of measuring the reliability of that estimate. Different sampling approaches may be specifically designed to meet the needs of the auditor with respect to the quantity and quality of information required for the decision-making process. A brief

discussion of Classical and Bayesian Sampling Approaches, Sampling Plans, and Methods of Sampling Selection follows.

## Classical and Bayesian Sampling Approaches

Once the auditor has decided to use statistical sampling to gather and evaluate audit evidence, he must then decide whether to use the "Classical" or "Bayesian" sampling approach.

### Classical Sampling Approach

The classical approach focuses only on the objective evidence of a sample. Since the probabilities derived from statistical analyses are valid only when based on repeated observations of past events, extrapolative inference must be based on past information. Generally classical theory does not incorporate the economic consequences of decision making on an audit. Additionally, little consideration is given in the analysis process to the auditor's judgment about situation probabilities in a particular audit area until tests of significance are conducted.

### Bayesian Sampling Approach

In essence, Bayesian sampling theory differs from classical sampling theory in that the auditor's judgment is injected early in the analysis instead of only at the end in the evaluation of results. Very simply, the Bayesian approach states that if you discover a certain event will occur with a certain probability and later you get additional

information about the event which differs from the first, you can estimate the true probability by combining the first probability with the second. Essentially, the Bayesian approach is the classical approach modified by the judgmental probabilities of the auditor.

Supporters of the Bayesian approach contend that auditors are already using the classical approach to supplement their judgments about sufficient, competent evidential matter and internal control.[3] Yet, the auditor has no logical framework within which he can apply both his judgment and sample evidence in a proper mixture relative to the economic consequences of his alternative actions. Thus, Bayesian supporters contend that the proper approach to scientific auditing is to combine the Bayesian statistical approach with economic estimates in a logical framework for decision-making purposes.

## Sampling Plans

In 1960 Lawrence Vance classified the applications of statistical sampling to auditing into three sampling plans. Although many articles and several books have been written about applying statistical sampling to auditing, each application can still be classified into the following categories: (1) estimation sampling, (2) acceptance sampling, and (3) discovery sampling.[4]

## Estimation Sampling

Estimation sampling is a plan that estimates from a sample of the population parameters with set levels of confidence and precision. The estimated population parameter may be either a variable or an attribute.

Estimation sampling for attributes is a sampling plan that estimates the frequency of occurrence of some population characteristics based on a sample. On the other hand, estimation sampling for variables is a sampling plan that estimates numerical amounts, where the amounts may be dollars, pounds, or units. For example, in auditing inventories attribute estimation might be used in determining the number of mechanical errors in accounting for the inventory, while variable estimation might be used in determining the dollar balance.

## Acceptance Sampling

Acceptance sampling provides for control over the quality of data being produced. This control is usually achieved by accepting or rejecting a population based on the number of unacceptable items found in a sample at predetermined levels of confidence and precision.

## Discovery Sampling

Discovery sampling is a special case of acceptance sampling, based on the desire to encounter at least one erroneous characteristic if such a characteristic exists

in the population. Using this plan at some given level of confidence, the population is accepted only if the sample contains none of the populations characteristics sought.

The auditor determines which sampling plan to use by the characteristics of the data to be sampled and the nature of the information needed for decisions about the data. No matter which of these sampling plans is used, the required sample size will always be determined at desired levels of confidence and precision.

## Methods of Sample Selection

Depending upon the sampling objectives and the nature of the sampled population, a statistical sample may be selected by one or more of the available basic sampling methods which follow: (1) simple random sampling, (2) stratified random sampling, (3) systematic sampling, and (4) cluster sampling.[5]

### Simple Random Sampling

Simple random sampling is a method of selecting individual items from a population such that every item has an equal chance of being chosen at each selection. Thus, each unit of the population has essentially an equal probability of being included in the selected sample. In the actual sample selection process, random numbers must be used in order to avoid subjective biases.

Stratified Random Sampling

Stratified random sampling is the process of breaking down a skewed population into non-overlapping homogeneous subpopulations or strata, according to some predetermined criteria, selecting an independent sample from each stratum by simple random sampling, and combining the results from each stratum into a single sample to estimate population parameters. For example, when the auditor is analyzing accounts receivable, he might stratify on the basis of type of customer, age of account balance, or account size. Since auditors often deal with accounting data which is skewed in some manner, they may use stratified random sampling for the following reasons:

1. The statistical precision may be increased under certain conditions by reducing sampling error.
2. Information about the strata parameters may be desired.
3. For physical and administrative reasons data collection may be easier.
4. To obtain unbiased sample results where records or accounts are not of equal importance.
5. To obtain strata that are homogeneous with respect to the population characteristic under consideration, thereby offsetting skewed distributions.[6]

Extreme caution should be exercised by the auditor to insure that stratification is done so that each strata has similar characteristics according to the objectives of the tests.

Systematic Sampling

Systematic sampling is the method of selecting every $n^{th}$ individual unit from the population by using a random start. Since bias may be introduced into the sample from a sequentially ordered population, care must be exercised when using this method to select a sample. Bias from sequentially ordered populations can be avoided simply by using several random starts with the use of every $n^{th}$ item after each start. In the absence of sequential bias, systematic sampling gives results comparable to those achieved by using simple random sampling. Some of the more important advantages of using systematic sampling are:

1. Often saves time and money.
2. May reduce sampling error.
3. Ease of drawing sample.
4. Since the sample is spread out more evenly over the population, it is often more representative.
5. Eliminates the need of preparing lists of ordered random numbers.
6. May be used easily where population units are not prenumbered.[7]

Statisticians have several reasons for discouraging the substitution of systematic sampling for simple random sampling. First, many statisticians feel that the disadvantage of possible undetected sequential bias overcomes the advantages from using systematic sampling. Second, recent developments in computers allow for rapid, accurate, and inexpensive production of a list of ordered random numbers. This development overcomes the principal advantage of systematic sampling of cost and time saving which results from not preparing an ordered random number list.

## Cluster Sampling

Cluster sampling is a method of selecting the sample in two or more stages. The first stage involves dividing the population into primary sampling units of which a number of the units are selected randomly. The second stage then is divided into secondary sampling units of which an appropriate number of them are randomly selected. The process can be continued until the desired elementary sampling unit level is reached. At this point population parameters can be estimated from the elementary sampling units.

Cluster sampling is particularly desirable for extremely large populations that are geographically scattered, such as large companies with warehouses and retail outlets located throughout the United States. Such populations are extremely difficult to sample with other methods

because of (1) difficulties in defining and listing the entire population, (2) the high cost of surveying scattered sampling units, and (3) mechanical administration of a sampling plan where the units are widely scattered.[8] Even though auditors frequently select a particular period, a single payroll, a specific location, or a single ledger for full or partial testing, this does not constitute a cluster sample because the primary sample unit was not randomly selected.

## Summary

The sampling methods available to independent auditors for selecting and evaluating audit evidence have been presented here for orientation purposes for the benefit of those who may be unfamiliar with them. Both nonprobability and probability sampling were covered giving particular attention to the advantages and disadvantages of each. Classical and Bayesian sampling, sampling plans, and methods of sample selection were all contrasted in the section on probability sampling. The presentation was not intended to be exhaustive, but only to be a brief survey for orientation purposes.

## FOOTNOTES

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[2]Herbert Arkin, Handbook of Sampling for Auditing and Accounting (New York: McGraw-Hill Book Company, Inc., 1963), pp. 9-12.

[3]James E. Sorensen, "Bayesian Analysis in Auditing," The Accounting Review, Vol. 44 (July, 1969), p. 561.

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[5]Taro Yamane, Elementary Sampling Theory (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1967), p. 2.

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[7]Ibid., pp. 159-61.

[8]Ibid., p. 186.

# CHAPTER IV

# METHODOLOGY OF RESEARCH

As discussed in Chapter I, the primary objective of the study was to gather empirical evidence in order to establish the current status of the statistical sampling methods used by independent auditors to gather and analyze audit data for forming and stating an opinion about the fairness of the financial statements. The purpose of this chapter is to report the methodology used in conducting the study. Areas covered are Survey Description, Questionnaire Design and Testing, Sample Design, Circularization Procedures, Survey Responses, Limitations of Survey and Methodology, and Methodology of Data Analysis.

## Survey Description

Because of temporal and financial limitations, the most efficient approach for collecting data about the current status of the use of statistical sampling was to use a mail questionnaire. The use of a questionnaire to make status studies of current practices and to conduct opinion polls for determining attitudes is a well established practice. The use of a questionnaire requires the

following assumptions about the respondent:

1. He is a competent source of data.
2. He will provide the data willingly.
3. He has the ability to understand questions.
4. He has answered the questions in the form intended and with integrity.[1]

The above assumptions appear acceptable as applying to respondents from CPA firms, since these respondents are generally highly competent individuals and appear to have no reason to withhold truthful information, especially because of the confidential conditions under which the information was gathered. In order to achieve the primary objective of the study, five areas of interest were the basis for the development of specific questions on the questionnaire. The five areas included:

1. the process surrounding the decision to use statistical sampling,
2. level of confidence and precision,
3. statistical sampling training and aides,
4. application experience, and
5. level of application.

Additionally, questions were included on the questionnaire to determine the characteristics of the respondents and to allow respondents to make additional comments.

## Questionnaire Design and Testing

The questionnaire used was the result of a two-stage development process. The first stage consisted of reviewing topical literature and interviewing five local CPA firms, from which an initial test questionnaire was prepared. The questionnaire was then distributed on a test basis to ten CPA firms in Oklahoma City and Norman, Oklahoma. To insure maximum feedback, one week later the initial test questionnaire was picked up personally. The test respondents were interviewed then to determine what adjustments they thought would make the questionnaire more meaningful. Based upon the process described above, a final questionnaire was drafted.

The final revised questionnaire, which was mailed to selected CPA firms in the sample, was one legal page in length and contained twenty-three basic questions. The cover letter was printed on the opposite side of the paper from the questionnaire and appeared on the front when folded. (See Appendix B for a copy of the questionnaire and accompanying cover letters.)

To test the validity of questionnaire responses, a commonly employed technique is to include questions which solicit similar information at widely separated places on the questionnaire. Questions 1 and 19 which covered whether statistical sampling was considered to be a valid audit tool and respondent opinion concerning the level of

use of statistical sampling in auditing were designed to employ this technique. The fact that at least 94.5 percent of the time logically consistent answers were made to the two questions and that a moderate correlation measure existed between the two implied that the questionnaire responses could be accepted as valid.

## Sample Design

### Definition of Population

The population sampled for the study was defined as all offices of CPA firms in the United States having two or more certified members. Where a firm consisted of more than one office, each office was considered separately as an elementary sampling unit. The population excludes the individual practitioner based on the assumption that an individual practitioner generally conducts few audits, and those audits that he does conduct are small in size. Therefore, the influence of the individual practitioner on audit procedures and techniques was considered to be minimal.

After excluding the individual practitioner, the remaining firms were stratified into two subpopulations according to division lines frequently described by the AICPA in their published literature.[2] The division of

the population resulted in two relatively homogeneous groups according to total membership in the AICPA: one containing the offices of the top 25 firms and the other containing all offices of the remaining firms. The assumption was made here that total audit staff size, audit billings, and influence upon the auditing profession were directly related to total membership in the AICPA. Hereafter, the first subpopulation will be referred to as offices of large firms and the second subpopulation will be referred to as offices of small firms.

## Construction of Population

Accounting Firms and Practitioners: 1968,[3] published by the AICPA, was the basis for constructing the mailing list of the population. Since the publication was incomplete and somewhat outdated, information obtained directly from individual state boards of public accountancy was used to update it and fill in the gaps. As a result, the total population size was determined to be approximately 6,400 based upon the updated list as described above. The population consisted of approximately 5,700 offices of small firms and 700 offices of large firms.

## Calculation of Sample Size

Since one of the main areas of interest of the study was to determine the percentage of CPA firms which used statistical sampling to gather and analyze audit data, the calculation of the sample size was based upon estimating this attribute. Plus or minus three percent precision and 95 percent level of confidence were considered sufficient for calculating the sample size to afford a reasonable basis for conclusions to be drawn about the percentage of CPA firms which used statistical sampling to gather and analyze audit data. Using the statistical accuracy mentioned above, the sample size was calculated to be 618 good responses for the population size of approximately 6,400.

Since similar studies had achieved a response rate of about 70 percent,[4] the sample size was adjusted upward to arrive at a required total mailing of 883 = (618/.7). According to the 1971 Report of Council to the Membership of the AICPA, 41.1 percent of the total practicing membership of the Institute is associated with offices of small firms and 38.6 percent is associated with offices of large firms.[5] Taking the combination of these two groups as a population, offices of small firms comprised 52 percent and offices of large firms accounted for 48 percent.

Allocating the total sample size of 883 between the two subpopulations resulted in selecting 459 offices of small firms and 424 offices of large firms.

### Sample Selection

After stratification of the defined population, the two subpopulations were numbered; i.e., the offices of small firms were numbered from 1 to 5,700 and the offices of large firms were numbered from 1 to 700. Two sets of random numbers were then generated, ordered, and used for selecting the sample from each subpopulation.

### Circularization Procedures

Since identifying the data source is necessary for verification purposes in all scientific investigations, a four-digit number system was developed and then encoded with obscure pin holes along the center fold of each questionnaire to be mailed. The encoding specifically identified each questionnaire. The ability to identify the questionnaire allowed for a second mailing to those not responding to the first mailing, for follow-ups in case of returned incomplete questionnaires, and for cross-checking respondent data against known accepted sources. The questionnaire, the cover letter, and an addressed, stamped return envelope were all inserted into another envelope

and mailed to the partner-in-charge of the selected offices on January 15, 1972.

Of the questionnaires received during the following weeks, thirty-nine were returned due to incorrect or incomplete addresses. These questionnaires were remailed after correct addresses were obtained from the telephone company.

Three weeks later on February 5, 1972, when the response rate was approximately fifty percent, a second mailing of the questionnaire was made to those offices which had not responded. The second mailing contained a new cover letter (see Appendix B for a copy) emphasizing that each office had been singled out from all accounting firms to participate in the study and that their individual response was vital to get good and accurate results from which to determine the current status of statistical sampling's use in auditing. An important note was included at the bottom of the new cover letter which requested that if the particular office did not use statistical sampling, they should respond only to questions 1, 2, 3, 19, 20, 22, and 23.

## Survey Response

The respondents in the survey were allowed three months to receive, complete, and return the questionnaires. On April 17, 1972, the cut-off date, a total of 709 questionnaires had been received. Of the 709, forty responses contained no useful information, because too few questions

had been answered. The remaining 669 good responses, representing an overall response rate of 75.8 percent, exceeded the 618 previously calculated as necessary to reach statistically sound conclusions. Table 1 contains a detailed breakdown of returned responses, unusable responses, and good responses for offices of small and large firms.

Table 2 indicates that the distribution of the responses to the offices of small and large firms did not differ greatly from the distribution of questionnaires as originally mailed. Thus, responses to the questionnaire in each subpopulation suggest that they were reasonably representative of the population.

Some possible reasons for the achieved response rates would certainly include the nature of the population, the quality of the questionnaire, the current interest in statistical sampling in auditing due to the environmental climate, and a second mailing. The overall response rate seems to be in line with similar studies of the offices of accounting firms.[6]

Two characteristics of the respondents were sought on the questionnaire. Question 2 inquired about the total number of auditing staff members, including partners, employed in their office. About 85 percent of the offices of small firms had fewer than twenty auditing staff members,

TABLE 1

A SUMMARY OF RESPONSES IN RELATION TO THE ORIGINAL MAILING

| Categories | Offices of Small Firms | | Offices of Large Firms | | Total Offices | |
|---|---|---|---|---|---|---|
| | Total | Percent | Total | Percent | Total | Percent |
| Original Mailing | 424 | 100.0 | 459 | 100.0 | 883 | 100.0 |
| Returned Responses | 319 | 75.2 | 390 | 84.9 | 709 | 80.3 |
| Unusable Responses | 27 | 6.4 | 13 | 2.8 | 40 | 4.5 |
| Good Responses | 292 | 68.8 | 377 | 82.1 | 669 | 75.8 |

TABLE 2

A SUMMARY OF THE DISTRIBUTION OF RESPONSES BETWEEN OFFICES OF SMALL AND LARGE FIRMS
(Expressed as Percentages)

| Offices | Original Mailing | Returned Responses | Unusable Responses | Good Responses |
|---|---|---|---|---|
| Offices of Small Firms | 52.0 | 45.0 | 67.5 | 43.5 |
| Offices of Large Firms | 48.0 | 55.0 | 32.5 | 56.5 |
| Totals | 100.0 | 100.0 | 100.0 | 100.0 |

while about 75 percent of the offices of large firms had more than twenty. A summary of the results of the question appear in Table 3. Based on the distribution of the findings as to audit staff size, and the positive, moderate-to-strong correlation between audit staff size and whether a response came from the office of a small or large firm, the stratification used in the sample design was highly homogeneous.

Question 22 of the questionnaire inquired as to the title or position held in the firm by the person filling out the questionnaire. Overwhelmingly, the partner-in-charge of auditing was the most frequent respondent: 74 percent of the time for offices of small firms and 56 percent of the time for offices of large firms. The second most frequent respondents were the partners-in-charge of the offices of small firms 11 percent of the time and the audit managers for the offices of large firms 20 percent of the time. Table 4 summarizes the results of question 22.

Since the partner-in-charge of auditing, generally the most knowledgeable individual about the overall office audit policies and procedures, was also the most frequent respondent, the questionnaire responses were considered highly factual and very reliable. Additionally, as a result of correlating the respondent's position variable with all other variables for questionnaire responses, the respondent's position was found to have little or no apparent effect upon his answers.

TABLE 3

A SUMMARY OF THE DISTRIBUTION OF RESPONDENTS BY TOTAL AUDITING STAFF MEMBERS

| Auditing Staff Members | Offices of Small Firms | | Offices of Large Firms | | Total Offices | |
|---|---|---|---|---|---|---|
| | Total | Percent | Total | Percent | Total | Percent |
| 1 - 5 | 127 | 43.4 | 10 | 2.6 | 137 | 20.4 |
| 6 - 10 | 74 | 25.3 | 28 | 7.4 | 102 | 15.2 |
| 11 - 20 | 47 | 16.1 | 58 | 15.3 | 105 | 15.7 |
| 21 - 30 | 25 | 8.2 | 62 | 16.7 | 87 | 13.0 |
| 31 - 40 | 18 | 6.1 | 26 | 6.9 | 44 | 6.5 |
| 41 - 50 | 0 | 0.0 | 37 | 9.8 | 37 | 5.5 |
| 51 - 100 | 0 | 0.0 | 77 | 20.4 | 77 | 11.5 |
| 101 - 200 | 2 | 0.6 | 57 | 15.1 | 59 | 8.8 |
| Over 200 | 0 | 0.0 | 21 | 5.5 | 21 | 3.1 |
| Totals | 292 | 100.0 | 377 | 100.0 | 669 | 100.0 |

TABLE 4

A SUMMARY OF THE RESPONDENTS TO THE QUESTIONNAIRE
BY TITLE OR POSITION HELD WITHIN THE FIRM

| Title or Position | Offices of Small Firms | | Offices of Large Firms | | Total Offices | |
|---|---|---|---|---|---|---|
| | Total | Percent | Total | Percent | Total | Percent |
| Junior | 0 | 0.0 | 6 | 1.5 | 6 | 0.9 |
| Senior | 11 | 3.7 | 11 | 2.9 | 22 | 3.2 |
| Manager | 20 | 6.8 | 77 | 20.4 | 97 | 14.5 |
| Principal | 0 | 0.0 | 28 | 7.4 | 28 | 4.1 |
| Partner-in-Charge of Auditing | 217 | 74.3 | 212 | 56.2 | 429 | 64.1 |
| Partner-in-Charge of Office | 32 | 10.9 | 22 | 5.8 | 54 | 8.0 |
| Other (Audit Supervisor, Audit Test Specialist) | 12 | 4.1 | 21 | 5.5 | 33 | 4.9 |
| Totals | 292 | 100.0 | 377 | 100.0 | 669 | 100.0 |

## Limitations of Survey Methodology

Several limitations of the survey methodology exist in the study. Some of the more significant limitations include:

1. The population sampled excluded the individual practitioner.
2. The response of each respondent was considered to represent the views of his entire office.
3. Possible respondent bias was present due to improper interpretation of questions and outright misrepresentation of facts.
4. Omission of relevant questions and inability to word questions properly may have caused some questionnaire bias.
5. Even though the population was stratified, the subpopulations were not absolutely homogeneous.

## Methodology of Data Analysis

Two methods were used to analyze the primary data obtained from the questionnaire. Single frequency analysis was used to determine the measure of central tendency (mean) and the variability (standard deviation) of the various variables. Additionally, correlation analysis was used to detect and measure the strength of the interrelationship or association between various variable pairs.[7]

Several limitations of the data analysis are worthy of mention. Since no multi-variate analysis was conducted,

non-linear relationships may have gone undetected. Each firm was considered equally important within the population and within each subpopulation for purposes of data analysis. Since the size of the firm variable produced only eight interrelationships worthy of mention out of a possible 56 when correlated with all other variables, this assumption was not considered to cause material bias.

## Summary

The chapter has presented the methodology used in obtaining and analyzing the empirical data considered appropriate to establish the current status of the use of statistical sampling by the independent auditor. A questionnaire was developed and mailed to a stratified sample of 883 offices of CPA firms throughout the United States. The exclusion of the individual practitioner seemed reasonable since his influence on auditing procedures and techniques was considered to be minimal. The 669 good responses to the questionnaire exceeded the 618 previously calculated as necessary to allow conclusions to be drawn about the level of use of statistical sampling at a preset level of statistical accuracy. Additionally, the response rate was high and in line with similar studies of CPA firms.

The assumptions made about the competency, ability, integrity, and willingness of the respondent from the CPA firm to provide data appeared acceptable. The response validity test suggested that the questionnaire responses

could be accepted as reasonably valid.

Single frequency and correlation analysis of the two questions dealing with characteristics of the respondents indicated that the division of the population produced highly homogeneous subpopulations. Since the partner-in-charge of auditing, generally the most knowledgeable individual about the overall office audit policies and procedures, was also the most frequent respondent, the questionnaire responses were considered highly factual and very reliable. Apparently no material bias resulted from the assumption that the respondent's views represented the view of the entire office, since the most frequent respondent was the partner-in-charge of auditing.

To compensate for the omission of relevant questions on the questionnaire, the final question of the questionnaire invited each respondent to make any additional comments which he wished. A summary of the more important comments is located in Chapter V. Single frequency and correlation analysis were used to analyze the primary data obtained from the questionnaire. As previously discussed, the limitations of data analysis were not considered to be important. The methodology used in obtaining and analyzing empirical data was considered adequate to achieve the stated objectives.

## FOOTNOTES

[1]J. Francis Rummel and Wesley C. Ballaine, Research Methodology in Business (New York: Harper and Row, Inc., 1963), p. 108.

[2]Council of the American Institute of Certified Public Accountants, The 70's: A Decade for Decision (New York: American Institute of Certified Public Accountants, Inc., 1971), p. 32, and Letter from American Institute of Certified Public Accountants, New York, January 12, 1972.

[3]American Institute of Certified Public Accountants, Accounting Firms and Practitioners: 1968 (New York: American Institute of Certified Public Accountants, Inc., 1969).

[4]Park E. Leathers and Howard P. Sanders, The Supply of Accounting Graduates and Demand for Public Accounting Recruits: Spring 1971 (New York: American Institute of Certified Public Accountants, Inc., 1971).

[5]Council of the American Institute of Certified Public Accountants, op. cit.

[6]Leathers and Sanders, op. cit.

[7]The methodology of data analysis is discussed in more detail in Chapters V and VI.

# CHAPTER V

# FINDINGS OF EMPIRICAL RESEARCH: SINGLE FREQUENCY ANALYSIS

The findings of empirical research surrounding the use of statistical sampling methods by independent auditors in performing their external audit function will be covered in this chapter. Single frequency analysis was used here to analyze responses to all questions with the exception of questions 2 and 22 which were discussed in the previous chapter. Broad subject areas of the questionnaire provided the division lines for the single frequency analysis.

## Process Surrounding the Decision to Use Statistical Sampling

Questions 4, 5, and 12 were designed to investigate the process surrounding the decision to use statistical sampling on an audit. Question 4 requested each respondent to identify the level of authority at which the decision to use statistical sampling was initially made and finally approved. Results of question 4 are summarized in Table 5. As indicated in the table, the initial decision in offices of small firms was made by the partner-in-charge of auditing

TABLE 5

A SUMMARY INDICATING THE LEVEL OF AUTHORITY AT WHICH THE DECISION TO USE STATISTICAL SAMPLING IS INITIALLY MADE AND FINALLY APPROVED
(Amounts Expressed as Percentages)

| Decision Level | Offices of Small Firms | | Offices of Large Firms | | Total Offices | |
|---|---|---|---|---|---|---|
| | Initial | Final | Initial | Final | Initial | Final |
| Junior | 0.0 | 0.0 | 1.1 | 0.2 | 0.7 | 0.1 |
| Senior | 35.1 | 4.8 | 56.4 | 1.1 | 50.2 | 2.1 |
| Manager | 11.7 | 4.1 | 30.4 | 34.3 | 25.0 | 25.6 |
| Principal | 6.9 | 5.5 | 1.1 | 5.0 | 2.7 | 5.1 |
| Partner-in-Charge of Audit | 40.6 | 80.0 | 2.2 | 54.4 | 13.3 | 61.8 |
| Partner-in-Charge of Office | 5.5 | 5.5 | 0.5 | 1.1 | 1.9 | 2.3 |
| Other | 0.0 | 0.0 | 8.1 | 3.6 | 5.7 | 2.5 |
| Totals | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Total Respondents | 145 | 145 | 358 | 358 | 503 | 503 |

41 percent of the time and by the senior 35 percent of the time; while in offices of large firms the decision was made by the senior 56 percent of the time and by the manager 30 percent of the time. The final decision to approve the use of statistical sampling was made by the partner-in-charge of auditing in 80 percent of the cases for offices of small firms; while for offices of large firms the partner-in-charge of auditing made the decision 54 percent of the time and the manager in large firms made the decision 34 percent of the time.

The initial and final decisions to use statistical sampling were made at lower levels of authority for offices of large firms than similar decisions for offices of small firms. Some reasons for offices of large firms making the decision at lower levels of authority would include: more highly trained and qualified audit staff members, more specialization of audit staff members, and more definitely established audit policies and procedures.

Question 5 requested the respondent to select in order the six most important criteria considered in the decision to use statistical sampling on an audit. In order to determine the overall importance of specific criteria in the decision process, a weighting system was used to differentiate the various levels ranging from six to one depending upon the position of ranked importance, with six assigned to the most important criterion and one assigned

to the least important. The overall importance and rank of each criterion in the decision process are summarized in Table 6.[1]

The criterion in the decision process chosen by offices of all firms as being most important was the population size of the particular audit area under investigation. The second, third, and fourth choices of offices of small firms were client's size, audit evidence validity, and client's business type; while offices of large firms chose audit evidence validity, audit area, and client's size. Considering the relative or weighted importance of the various criteria, offices of small firms considered population size to be about as important as client's size; while offices of large firms ranked population size more than twice as important as client's size. Additionally, offices of large firms ranked population size and audit evidence validity as being of about equal importance, and the two criteria were ranked ahead of all others by approximately a two-to-one margin.

Question 12 was designed to determine the minimum size population for which the respondent would consider using statistical sampling to estimate attributes and variables on an audit under the best circumstances. A summary of question 12 responses is presented in Table 7. The

TABLE 6

A SUMMARY OF THE WEIGHTED IMPORTANCE (RANK) OF THE CRITERIA USED IN DECIDING TO USE STATISTICAL SAMPLING

| Responses | Offices of Small Firms | Offices of Large Firms | Total Offices |
|---|---|---|---|
| Population Size | 347.1 ( 1) | 427.8 ( 1) | 404.2 ( 1) |
| Audit Evidence Validity | 275.1 ( 3) | 383.2 ( 2) | 351.4 ( 2) |
| Client's Size | 343.4 ( 2) | 201.7 ( 4) | 243.1 ( 3) |
| Audit Area | 152.6 ( 7) | 232.1 ( 3) | 208.9 ( 4) |
| Audit Time | 215.1 ( 5) | 199.7 ( 5) | 204.2 ( 5) |
| Auditor's Statistical Expertise | 161.6 ( 6) | 169.4 ( 7) | 167.1 ( 6) |
| Computerization of Client's Records | 135.4 ( 9) | 174.4 ( 6) | 163.1 ( 7) |
| Client's Business Type | 219.6 ( 4) | 102.3 ( 9) | 136.6 ( 8) |
| Numbered Accounts | 151.1 ( 8) | 113.2 ( 8) | 124.4 ( 9) |
| Audit Fee | 81.7 (10) | 43.5 (11) | 54.6 (10) |
| Other | 16.8 (11) | 52.2 (10) | 41.8 (11) |

TABLE 7

A SUMMARY OF RESPONSES INDICATING THE MINIMUM SIZE POPULATION FOR WHICH THE AUDITOR WOULD CONSIDER USING STATISTICAL SAMPLING UNDER THE BEST CIRCUMSTANCES WHEN ESTIMATING ATTRIBUTES AND VARIABLES

| Population Size | Offices of Small Firms | | Offices of Large Firms | | Total Offices | |
|---|---|---|---|---|---|---|
| | Attributes | Variables | Attributes | Variables | Attributes | Variables |
| 0 - 500 | 16.5 | 19.4 | 23.2 | 19.6 | 21.3 | 19.5 |
| 501 - 5,000 | 61.1 | 61.8 | 59.2 | 57.3 | 59.7 | 58.6 |
| 5,001 - 50,000 | 17.9 | 14.3 | 14.9 | 21.0 | 15.8 | 19.1 |
| Over 50,000 | 4.3 | 4.3 | 2.5 | 2.0 | 3.0 | 2.6 |
| Totals | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Total Respondents | 139 | 139 | 348 | 347 | 487 | 486 |

minimum size population range chosen by all offices approximately 60 percent of the time or by about a three-to-one margin for both estimating attributes and variables was the range from 501 to 5,000.

Considering all offices together, the typical respondent indicated that the initial decision to use statistical sampling was made by the senior 50 percent of the time, manager 25 percent of the time, and partner-in-charge of the audit 13 percent of the time. The final approval was made by partner-in-charge of the audit 62 percent of the time and manager 25 percent of the time. The primary criteria used by slightly less than a two-to-one margin over all other criteria in the decision process were population size and audit evidence validity, followed distantly by client size and audit area. The prohibition of competitive bidding by the Code of Professional Ethics of the AICPA apparently explains the complete deemphasis on audit fee as a consideration to use statistical sampling. Overwhelmingly, the minimum population size most frequently chosen by a three-to-one margin, for which the respondent would consider using statistical sampling on an audit under the best circumstances, was the range of 501 to 5,000.

## Confidence Levels and Precision

Questions 14 and 15 were designed to determine the decision process surrounding the setting of levels of confidence and precision, while questions 20 and 21 were

designed to obtain information concerning standardized levels of confidence and precision. Question 14 requested each respondent to indicate the minimum level of confidence and maximum level of precision considered under the best circumstances when applying statistical sampling on an audit. The results of the question are summarized in Table 8. As indicated in the table, the minimum confidence level chosen by over 87 percent of all offices lay between 90 and 95 percent. Offices of small firms generally favored a higher level of confidence than did offices of large firms. The maximum precision level chosen by over 91 percent of all offices ranged between ±2 percent and ±5 percent with ±5 percent chosen by greater than a two-to-one margin. Offices of small firms generally preferred a slightly lower maximum precision level than offices of large firms.

Each respondent was requested in question 15 to choose and order the three most important criteria used in deciding what levels of confidence and precision to set. Table 9 contains the weighted results for the question from all respondents.[2] The criterion selected as being most important by all responding offices was the check of internal control which was about 1.3 times more important than audit area and more than twice as important as the preceding year's audit.

TABLE 8

A SUMMARY OF THE RESPONSES INDICATING THE MINIMUM CONFIDENCE LEVEL AND MAXIMUM PRECISION WHICH THE AUDITOR WOULD CONSIDER UNDER THE BEST CIRCUMSTANCES WHEN APPLYING STATISTICAL SAMPLING

| Minimum Confidence Level | | | | Maximum Precision | | | |
|---|---|---|---|---|---|---|---|
| Percent | Offices of Small Firms | Offices of Large Firms | Total Offices | Percent | Offices of Small Firms | Offices of Large Firms | Total Offices |
| 99 | 0.7 | 0.5 | 0.6 | ±1 | 4.3 | 1.7 | 2.4 |
| 98 | 4.3 | 2.8 | 3.3 | ±2 | 28.4 | 19.0 | 21.7 |
| 95 | 58.3 | 43.0 | 47.4 | ±3 | 19.7 | 15.9 | 16.9 |
| 90 | 33.5 | 42.2 | 39.7 | ±5 | 45.2 | 55.7 | 52.8 |
| Other | 2.9 | 11.2 | 8.9 | Other | 2.1 | 7.5 | 6.0 |
| Totals | 100.0 | 100.0 | 100.0 | Totals | 100.0 | 100.0 | 100.0 |
| Total Respondents | 137 | 346 | 483 | Total Respondents | 137 | 346 | 483 |

TABLE 9

A SUMMARY OF THE WEIGHTED IMPORTANCE (RANK) OF THE CRITERIA USED IN DECIDING WHAT LEVELS OF CONFIDENCE AND PRECISION TO SET

| Responses | Offices of Small Firms | | Offices of Large Firms | | Total Offices | |
|---|---|---|---|---|---|---|
| Internal Control Check | 473.1 | (1) | 471.6 | (1) | 472.1 | (1) |
| Audit Area | 315.9 | (2) | 367.1 | (2) | 352.5 | (2) |
| Preceding Year's Audit | 250.7 | (4) | 220.3 | (3) | 229.0 | (3) |
| Individual Experience | 286.9 | (3) | 176.0 | (5) | 107.5 | (4) |
| Firm Policy | 160.1 | (5) | 210.8 | (4) | 196.5 | (5) |
| Other | 13.0 | (6) | 53.9 | (6) | 42.2 | (6) |

Question 20 was designed to obtain the opinion of the individual respondent about setting standard levels of confidence and precision within the accounting profession. A summary of responses to the question is contained in Table 10. As indicated in the table, offices of small firms favored establishment of such guidelines for both levels of confidence and precision by approximately a three-to-one margin. More than 50 percent of the offices of large firms rejected the idea of setting standard guidelines for levels of confidence and precision. Considering responses of all offices, establishment of such guidelines was only favored approximately 51 percent of the time. Offices of small firms favored establishment of guidelines 20 percent more of the time than offices of large firms, which indicated that offices of small firms apparently felt they needed guidelines for using statistical sampling; while offices of large firms, with their more highly trained staffs, preferred to set their own.

Question 21 inquired whether a firm had policies about confidence levels and precision for applying statistical sampling on an audit. Table 11 contains a summary of responses to the question. Approximately 7 percent of the offices of small firms indicated their firm had a policy for setting levels of confidence, while about 30 percent of the offices of large firms indicated that they had such policies. About 5 percent of the respondents

TABLE 10

A SUMMARY OF RESPONDENT OPINIONS INDICATING WHETHER GUIDELINES FOR CONFIDENCE LEVELS AND PRECISION SHOULD BE ESTABLISHED BY THE ACCOUNTING PROFESSION
(Amounts Expressed as Percentages)

| Responses | Offices of Small Firms | | Offices of Large Firms | | Total Offices | |
|---|---|---|---|---|---|---|
| | Confidence Levels | Precision | Confidence Levels | Precision | Confidence Levels | Precision |
| Yes | 62.7 | 62.4 | 42.5 | 42.5 | 51.4 | 51.2 |
| No | 23.6 | 23.6 | 52.2 | 52.2 | 39.7 | 39.7 |
| No Opinion | 13.7 | 14.0 | 5.3 | 5.3 | 8.9 | 9.1 |
| Totals | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Total Respondents | 292 | 292 | 377 | 377 | 669 | 669 |

TABLE 11

A SUMMARY OF THE RESPONDENTS INDICATING WHETHER THEY HAD AN IN-HOUSE POLICY FOR SETTING CONFIDENCE LEVELS AND PRECISION
(Amounts Expressed as Percentages)

| Responses | Offices of Small Firms | | Offices of Large Firms | | Total Offices | |
|---|---|---|---|---|---|---|
| | Confidence Levels | Precision | Confidence Levels | Precision | Confidence Levels | Precision |
| Yes | 6.7 | 5.1 | 29.5 | 23.8 | 21.8 | 17.6 |
| No | 93.3 | 94.9 | 70.5 | 76.2 | 78.2 | 82.4 |
| Totals | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Total Respondents | 180 | 178 | 356 | 357 | 536 | 535 |

from offices of small firms indicated that their firm had a policy for setting precision; approximately 24 percent of the offices of large firms indicated they had such policies. Offices of large firms had set policies for confidence level and precision more than four times as often as offices of small firms.

Of the 117 respondents who indicated that their firm had a standard policy for setting levels of confidence, 73 stated what that policy was. Generally, the stated levels ranged from 90 percent to 95 percent, with a few as low as 63 percent; however, the most frequently chosen level was 95 percent. Fifty-seven of the 94 respondents who indicated that their firm had a standard policy for setting levels of precision indicated what their policy was. Most of these precision levels lay between $\pm 1$ percent and $\pm 5$ percent, with a few as high as $\pm 10$ percent; however, the most frequently chosen level was $\pm 5$ percent.

Considering all offices together, the typical respondent chose a confidence level that ranged between 90 and 95 percent and $\pm 5$ percent level of precision. The most important criterion for making the decision about setting levels of confidence and precision was a check of internal control, which was favored 1.3 times more often than audit area and twice as often as preceding year's audit. Even though most respondents did not have standard policies for levels of confidence and precision, offices of large firms

had them four times as often as offices of small firms. Although mixed opinion existed about setting profession-wide standards, the idea was rejected overall by a 10 percent margin.

## Statistical Sampling Education and Aides

Questions 7 and 8 were designed to determine the existence and confidential nature of in-house statistical sampling training courses and manuals, while questions 10 and 11 were designed to establish the accessibility to the respondents of standard programs for retrieval and analysis of audit data. Each respondent to question 7 was asked to indicate whether his office had an in-house training course or manual describing the application of statistical sampling to auditing. The results of the question are summarized in Table 12. As indicated in the table, only about 15 percent of the offices of small firms had firm training courses, while over 81 percent of the offices of large firms had such courses. An additional observation from Table 12 shows that approximately 24 percent of offices of small firms had training manuals, while over 82 percent of offices of large firms had them.

As evidenced by the high percentage of offices of large firms who had training courses and manuals, statistical sampling must have been considered important enough for them to have committed resources to educate their staff members in methods of application. Because of their

TABLE 12

A SUMMARY OF THE RESPONDENTS INDICATING WHETHER THE FIRM HAD AN IN-HOUSE TRAINING COURSE OR MANUAL DESCRIBING THE USE OF STATISTICAL SAMPLING IN AUDITING
(Amounts Expressed as Percentages)

| Responses | Offices of Small Firms | | Offices of Large Firms | | Total Offices | |
|---|---|---|---|---|---|---|
| | Training Course | Training Manual | Training Course | Training Manual | Training Course | Training Manual |
| Yes | 15.1 | 24.3 | 81.5 | 82.3 | 61.4 | 64.8 |
| No | 84.9 | 75.7 | 18.5 | 17.7 | 38.6 | 35.2 |
| Totals | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Total Respondents | 152 | 152 | 351 | 351 | 503 | 503 |

reliance on the AICPA for training manuals and the associated smaller investment, offices of small firms were more likely to have a manual than a course.

Question 8 was designed to determine the confidential nature of the firm's in-house training. Essentially, the question inquired whether the firm's training course or manual describing the use of statistical sampling in auditing could be examined under a pledge of complete security. If the courses or manuals could not be examined under security conditions, they were considered to be confidential. Of those offices which had in-house training, 96 percent of offices of small firms and 78 percent of offices of large firms indicated that theirs were confidential. The confidential nature of the training aids seemed to be directly related to the dissemination of knowledge for applying statistical sampling; the higher the confidentiality, the lower the dissemination of knowledge. Even though many offices of small firms relied upon the AICPA as their source of training, they seemed to be extremely reluctant to share their knowledge, which was pointed out by the fact that practically all indicated that their training was confidential.

Questions 10 and 11 were designed to determine whether the respondent's office had or had access to a standard selection and retrieval program or a standard statistical analysis program for selecting and analyzing

audit data. The question results are contained in Table 13. As shown in the table, approximately 26 percent of the offices of small firms had or had access to a standard selection and retrieval program, while over 93 percent of the offices of large firms had such a program. Additionally, about 29 percent of the offices of small firms had or had access to a standard computer program for analyzing retrieved audit data, while over 90 percent of the offices of large firms had such a computer program. The wide divergence of accessibility of selection and retrieval programs or analysis programs between offices of small and large firms may be explained by the fact that offices of large firms generally had larger clients with computers, more audit staff specialization, and greater resources in manpower and money to develop such programs.

Considering all offices together, about 63 percent had in-house training describing the application of statistical sampling to auditing; however, few offices of small firms had such training, while most offices of large firms did. Most respondents, especially from offices of small firms, implied that their in-house training was confidential, which seemed to be a deterrent to the dissemination of knowledge about statistical sampling. About 72 percent of all offices had access to standard computer programs for retrieving and analyzing audit data, with offices of large firms having access to such programs by a three-to-one

TABLE 13

A SUMMARY OF THE ACCESSIBILITY TO THE RESPONDENTS OF STANDARD PROGRAMS FOR RETRIEVAL AND ANALYSIS OF AUDIT DATA
(Amounts Expressed as Percentages)

| Responses | Offices of Small Firms | | Offices of Large Firms | | Total Offices | |
|---|---|---|---|---|---|---|
| | Retrieval | Analysis | Retrieval | Analysis | Retrieval | Analysis |
| Have | 5.5 | 5.5 | 60.8 | 58.9 | 44.2 | 42.9 |
| Have Access To | 20.9 | 23.6 | 32.4 | 31.4 | 29.2 | 29.2 |
| Do Not Have | 73.6 | 70.9 | 6.8 | 9.7 | 26.6 | 27.9 |
| Totals | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Total Respondents | 148 | 148 | 351 | 350 | 499 | 498 |

margin over offices of small firms.

## Application Experience

The experience which respondents had encountered when applying statistical sampling on audits during the past year was the subject of questions 13, 16, 17, and 18. Since the questions requested respondents to place in order various criteria according to frequency of use, a weighting system was used to rank the responses in order of overall importance. The weighting system corresponds to that one previously described which was used to evaluate question 5.

Each respondent to question 13 was requested to rank a series of population ranges in the order they had most frequently applied statistical sampling. Results of the question are summarized in Table 14.[3] As may be observed from the table, for all offices statistical sampling was about as likely to be applied to a population range of 501-5,000 as to a range of 5,001-50,000. Apparently most auditors felt that they must have a fairly large-size population before the use of statistical sampling was practical.

Question 16 was designed to determine the three methods of statistical sample selection most frequently used in gathering audit data for analysis. Table 15 contains summarized results of the question.[4] For offices of small firms, the most frequently employed statistical sampling selection method was simple random, which was chosen about 1.5 times more often than systematic: single start

TABLE 14

A SUMMARY OF THE WEIGHTED IMPORTANCE (RANK) OF THE POPULATION RANGES WHERE STATISTICAL SAMPLING WAS MOST OFTEN APPLIED

| Responses | Offices of Small Firms | | Offices of Large Firms | | Total Offices | |
|---|---|---|---|---|---|---|
| 501 - 5,000 | 537.4 | (1) | 507.4 | (2) | 515.9 | (1) |
| 5,001 - 50,000 | 499.9 | (2) | 512.6 | (1) | 509.0 | (2) |
| Over 50,000 | 386.9 | (3) | 421.7 | (3) | 411.8 | (3) |
| 0 - 500 | 375.6 | (4) | 358.1 | (4) | 363.1 | (4) |

TABLE 15

A SUMMARY OF THE WEIGHTED IMPORTANCE (RANK) OF THE MOST FREQUENTLY USED STATISTICAL SAMPLING SELECTION METHODS

| Responses | Offices of Small Firms | Offices of Large Firms | Total Offices |
|---|---|---|---|
| Simple Random | 541.7 (1) | 465.2 (1) | 487.0 (1) |
| Systematic: Single Start | 357.6 (2) | 353.4 (3) | 354.7 (2) |
| Stratified | 240.7 (3) | 369.2 (2) | 332.5 (3) |
| Systematic: Multiple Start | 184.7 (4) | 227.0 (4) | 214.8 (4) |
| Cluster | 155.5 (5) | 50.9 (5) | 80.8 (5) |
| Other | 19.5 (6) | 34.1 (6) | 30.0 (6) |

and more than 2.2 times as often as stratified. The method most frequently employed by offices of large firms was simple random, which was used about 1.3 times as often as stratified or systematic: single start. Offices of large firms tended to use more complex methods of statistical sampling selection than did offices of small firms, apparently because they had more highly trained audit personnel.

Question 17 requested each respondent to select and place in order the three steps for applying statistical sampling where problems were most frequently encountered. The weighted results of the question are contained in Table 16.[5] Offices of small firms indicated that defining the error to be investigated was the most frequently encountered problem about 1.2 times as often as interpreting test results and investigating errors. Offices of large firms also chose defining the error as the most frequently encountered problem, closely followed by interpreting test results and defining test objectives. Auditors were apparently having more trouble with the subjective decision aspects of sampling, and less trouble with the mechanical.

Each respondent to question 18 was asked to select and rank in order the five audit areas where statistical sampling had been most frequently applied. Table 17 contains a summary of the five audit areas.[6] Statistical sampling was applied by offices of small firms for receivable

TABLE 16

A SUMMARY OF THE WEIGHTED IMPORTANCE (RANK) OF THE STATISTICAL SAMPLING STEPS WHERE PROBLEMS HAD BEEN ENCOUNTERED

| Responses | Offices of Small Firms | | Offices of Large Firms | | Total Offices | |
|---|---|---|---|---|---|---|
| Defining Error | 344.5 | (1) | 393.0 | (1) | 379.2 | (1) |
| Interpreting Test Results | 288.3 | (2) | 366.2 | (2) | 344.1 | (2) |
| Defining Test Objectives | 227.7 | (4) | 309.4 | (3) | 286.2 | (3) |
| Investigating Errors | 275.9 | (3) | 186.8 | (4) | 212.2 | (4) |
| Selecting Sample | 181.0 | (5) | 102.5 | (5) | 124.7 | (5) |
| Defining Universe | 85.4 | (7) | 72.7 | (6) | 76.3 | (6) |
| Examining Sample Units | 92.7 | (6) | 54.2 | (7) | 65.1 | (7) |
| Other | 4.3 | (8) | 14.7 | (8) | 11.8 | (8) |

TABLE 17

A SUMMARY OF THE WEIGHTED IMPORTANCE (RANK) OF THE AUDIT AREAS WHERE STATISTICAL SAMPLING HAD BEEN APPLIED

| Responses | Offices of Small Firms | | Offices of Large Firms | | Total Offices | |
|---|---|---|---|---|---|---|
| Receivable Confirmations | 455.0 | (1) | 416.1 | (1) | 427.1 | (1) |
| Purchase or Voucher Test | 328.9 | (3) | 400.0 | (2) | 379.9 | (2) |
| Inventory | 366.1 | (2) | 341.0 | (3) | 348.1 | (3) |
| Sales | 256.1 | (4) | 232.4 | (5) | 241.7 | (4) |
| Payroll | 143.7 | (7) | 233.9 | (4) | 208.1 | (5) |
| Expenses | 209.6 | (5) | 186.0 | (6) | 192.8 | (6) |
| Cash | 168.3 | (6) | 121.1 | (7) | 134.4 | (7) |
| Other | 63.1 | (8) | 69.2 | (8) | 67.4 | (8) |

confirmation 1.2 times more often than for inventory, 1.4 times more often than for purchase or voucher test, and 1.8 times more often than for sales. For offices of large firms, statistical sampling was applied for receivable confirmation and purchase or voucher test 1.2 times more often than for inventory and 1.8 times more often than for payroll. Apparently statistical sampling was applied primarily to those audit areas concerned with the Statement of Financial Position where voluminous data existed.

Considering all offices together, the population range where statistical sampling was most likely to be used ranged from 501-50,000. Audit evidence was gathered by the use of simple random sampling about 1.4 times as often as systematic: single start and stratified. Application problems were about as likely to be encountered in defining the error as interpreting the test results, followed by defining test objectives. Audit areas where statistical sampling was most likely to be applied were receivable confirmation, purchase or voucher test, and inventory determination. The audit area of application results differed slightly from those obtained by Ross, Hoyt, and Shaw in their study; in which the audit areas were receivable confirmation followed by inventory determination and purchase or voucher test.[7] The differences may be due to the limited geographic nature of their study.

## Level of Application

Questions 3 and 9 were designed to estimate the actual level of statistical sampling's use in auditing, while questions 1, 6, and 19 were designed to measure the attitudes of the respondents surrounding the use of statistical sampling. Question 3 requested each respondent to estimate on what percentage of the previous year's audits some statistical sampling was used. Determination of the percentage of offices that used or did not use statistical sampling as well as the level of use for all responding offices was possible since the question included a response for zero use. A summary of the results for the level of use is contained in Table 18.

As derived from the information contained in Table 18, between 61.1 and 71.7 percent of the offices of small firms used statistical sampling at some time during the previous year.[8] However, statistical sampling was only used on 17.7 percent of all audits conducted by them during the previous year. The percentage of the offices of large firms which used statistical sampling during the previous year ranged between 91.9 and 95.3 percent, with statistical sampling being used on 43.7 percent of the audits conducted by them during the year. Excluding offices which did not apply any statistical sampling during the previous year, some statistical sampling was used on 26.8 percent of all audits conducted by offices of small firms

TABLE 18

A SUMMARY OF THE PERCENTAGE OF AUDITS ON WHICH STATISTICAL SAMPLING HAD BEEN USED
(Amounts Expressed as Percentages)

| Level of Use | Offices of Small Firms | | Offices of Large Firms | | Total Offices | |
|---|---|---|---|---|---|---|
| | Percentage | Cumulative | Percentage | Cumulative | Percentage | Cumulative |
| 0 | 33.5 | 33.5 | 6.3 | 6.3 | 18.2 | 18.2 |
| 1 - 10 | 33.5 | 67.0 | 20.9 | 27.2 | 26.3 | 44.5 |
| 11 - 20 | 8.9 | 75.9 | 9.2 | 38.4 | 9.1 | 53.6 |
| 21 - 30 | 6.1 | 82.0 | 11.4 | 47.8 | 9.1 | 62.7 |
| 31 - 40 | 2.0 | 84.0 | 4.2 | 52.0 | 3.2 | 65.9 |
| 41 - 50 | 1.3 | 85.3 | 3.7 | 55.7 | 2.6 | 68.5 |
| 51 - 60 | 2.0 | 87.3 | 6.3 | 62.0 | 4.4 | 72.9 |
| 61 - 70 | 2.0 | 89.3 | 7.4 | 69.4 | 5.7 | 78.6 |
| 71 - 80 | 2.7 | 92.0 | 6.1 | 75.5 | 4.6 | 83.2 |
| 81 - 90 | 2.6 | 94.6 | 10.0 | 85.5 | 6.5 | 89.7 |
| 91 - 100 | 5.4 | 100.0 | 14.5 | 100.0 | 10.3 | 100.0 |
| Totals | 100.0 | | 100.0 | | 100.0 | |
| Means | 17.7 | | 43.7 | | 32.4 | |
| Total Respondents | 292 | | 377 | | 669 | |

and on 46.7 percent of all audits conducted by offices of large firms.

Sixty-seven percent of offices of small firms used statistical sampling on 0 to 10 percent of their audits, while 73 percent of offices of large firms used statistical sampling on 10 to 100 percent of their audits. Offices of small firms were five times as likely not to use statistical sampling as offices of large firms. Although the likelihood was that offices of large firms used statistical sampling 1.4 times more often than offices of small firms, the actual level of use on audits was 2.5 times higher. Not only were offices of large firms more likely to use statistical sampling, the level of use on audits was likely to be much higher than in offices of small firms.

In question 9 each respondent was asked to estimate the percentage of time during the previous year that statistical sampling was used for estimating attributes (occurrence rates) and estimating variables (values). The sum of the percentage of time spent estimating attributes plus the sum of the percentage of time spent estimating variables should equal approximately 100 percent. Offices of small firms used statistical sampling to estimate attributes 79.2 percent of the time and to estimate variables 19.4 percent of the time; while for offices of large firms statistical sampling was used to estimate attributes 76.5 percent of the time and to estimate variables 22.9 percent of the time.[9]

Overwhelmingly statistical sampling was used to estimate attributes by a margin of four-to-one over variables.

Question 1 was designed to determine whether respondents considered statistical sampling a valid audit tool or technique. Table 19 contains a summary of responses to the question. As may be observed from the table, 89 percent of offices of small firms and 99 percent of offices of large firms considered statistical sampling a valid audit tool. Offices of small firms expressed no opinion nine times more often than offices of large firms, perhaps reflecting a lower level of knowledge on their part.

Question 6 asked each respondent to select in order the three most important reasons on which an increased use of statistical sampling should be based. The weighting system used to analyze question 5 was used here to determine the overall importance of each reason. Table 20 summarizes question responses.[10] For both offices of small and large firms, increased validity of audit evidence was the reason chosen for increasing the use of statistical sampling on audits 1.2 times more often than decreased audit time and 1.5 times more often than decreased audit fee. The ranking of decreased audit fee seemed to be in line with its extremely low rank on question 5, which dealt with the criteria used in deciding to use statistical sampling.

TABLE 19

A SUMMARY OF THE RESPONSES CONCERNING WHETHER STATISTICAL SAMPLING WAS CONSIDERED A VALID AUDIT TOOL OR TECHNIQUE
(Amounts Expressed as Percentages)

| Responses | Offices of Small Firms | Offices of Large Firms | Total Offices |
|---|---|---|---|
| Yes | 89.0 | 98.6 | 94.4 |
| No | 1.3 | 0.2 | 0.7 |
| No Opinion | 9.5 | 1.0 | 4.7 |
| Totals | 100.0 | 100.0 | 100.0 |
| Total Respondents | 292 | 377 | 669 |

TABLE 20

A SUMMARY OF THE WEIGHTED IMPORTANCE (RANK) OF THE CRITERIA AN INCREASED USE OF STATISTICAL SAMPLING HAD BEEN BASED

| Responses | Offices of Small Firms | | Offices of Large Firms | | Total Offices | |
|---|---|---|---|---|---|---|
| Increased Validity of Audit Evidence | 571.1 | (1) | 572.2 | (1) | 572.0 | (1) |
| Decreased Audit Time | 496.0 | (2) | 484.0 | (2) | 487.5 | (2) |
| Decreased Audit Fee | 395.2 | (3) | 385.9 | (3) | 388.6 | (3) |
| Other | 37.5 | (4) | 57.6 | (4) | 51.7 | (4) |

Question 19 was designed to determine respondent opinion concerning the level of use of statistical sampling in the auditing profession. A summary of the responses is located in Table 21. As indicated in the table, only 78.4 percent of offices of small firms favored increasing the use of statistical sampling in auditing, while 92.8 percent of offices of large firms favored such an increase. The major divergence in responses to the question was that offices of small firms felt that the level of use of statistical sampling should remain the same three times as often as offices of large firms. The divergence apparently reflected a lack of confidence and ability to apply statistical sampling by offices of small firms.

Considering all offices together, between 78.9 and 84.5 percent used statistical sampling at some time during the previous year, with statistical sampling being used on 32.4 percent of all audits conducted by them. Excluding offices which did not apply any statistical sampling during the previous year, the percentage of audits on which statistical sampling was used increased to 39.7 percent. Overwhelmingly the use of statistical sampling was employed to estimate attributes by a margin of about four-to-one over variables. Ninety-four percent of the respondents considered statistical sampling a valid audit tool, with less than one percent not considering statistical sampling a valid audit tool. Respondents favored an increased use of statistical

TABLE 21

A SUMMARY OF OPINIONS CONCERNING THE LEVEL OF THE USE OF STATISTICAL SAMPLING IN THE AUDITING PROFESSION
(Amounts Expressed as Percentages)

| Responses | Offices of Small Firms | Offices of Large Firms | Total Offices |
|---|---|---|---|
| Increased | 78.4 | 92.8 | 86.5 |
| Remain the Same | 17.1 | 6.3 | 11.0 |
| Decreased | 2.0 | 0.8 | 1.3 |
| No Opinion | 2.4 | 0.0 | 1.0 |
| Totals | 100.0 | 100.0 | 100.0 |
| Total Respondents | 292 | 377 | 669 |

sampling based upon increased validity of audit evidence 1.2 times more often than decreased audit time and 1.5 times more often than decreased audit fee.

Ross, Hoyt, and Shaw concluded that the use of statistical sampling was not widespread; however, this study found that the use of statistical sampling was widespread among firms, but the level of use by those firms was relatively low. Both studies concluded that statistical sampling was considered a valid audit tool. Ross, Hoyt, and Shaw also concluded that the use of statistical sampling would increase, while this study concluded that the use of statistical sampling should be increased.[11]

## Additional Comments

Question 23 invited each respondent to make additional comments if he wished about statistical sampling as used in auditing today or as it should be used in the future. Only 72, or 10.7 percent of the total 669 respondents, chose to make additional comments. Of the 292 offices of small firms which responded, 36, or 12.3 percent, made additional comments; while 36, or 9.5 percent of the total 377 offices of large firms, did likewise.

Some of the more important comments frequently made by respondents from offices of small firms included:

1. Reasons given for not using statistical sampling on audits were the small size of their firm, the small size of clients, the small number of audits done, and the training inadequacy of the firm's staff members.

2. Many firms used statistical sampling only for sample selection, since they felt that the increased validity from statistical inference was not worth the additional effort.

3. Others felt that the increased validity from the use of statistical sampling was helpful in avoiding or limiting legal liability from possible lawsuits.

4. Although many respondents indicated that they relied upon the AICPA for training materials and standard operational guidelines, they felt that the availability of simplified materials and guidelines for applying statistical sampling to auditing was lacking.

Some of the more important comments frequently made by respondents from offices of large firms included:

1. The use of statistical sampling in auditing provides greater confidence in the audit because the use decreases the possibility of introducing the personal bias of the auditor and enables him to do a more effective job. However, the problem of objectively incorporating statistical conclusions into the auditor's opinion still exists.

2. The level of the auditor's statistical expertise should be increased in order to use statistical sampling more effectively. Suggestions to accomplish an increased use included improving training materials, refining and simplifying statistical sampling methods, and adopting guidelines for the application of statistical sampling on audits.

3. A fear exists among some auditors that their lack of statistical expertise might lead to possible liability when challenged by expert statisticians in court. In order to prevent the occurrence of the problem, some suggested the adoption of standard guidelines by all members of the accounting and legal professions.

4. Since statistical sampling is not a substitute for judgment but only an additional tool for making the final judgment and the formulation of conclusions, some accountants insisted that the Bayesian approach was the most logical method to use.

5. Many firms used statistical sampling only for sample selection, since they felt that the increased validity from statistical inference was not worth the additional effort.

6. Several firms indicated that they were appalled at the lack of the use of scientific sampling by certain other firms to gather and evaluate evidence in order to formulate and state an opinion.

7. Some firms would like to see statistical sampling used to obtain an objective measure of internal control which could be used to determine the extent of further statistical audit tests.

## Summary

Single frequency analysis was used to analyze primary data obtained from the questionnaire. The analysis discussion was based on major subject areas of the questionnaire. A brief recapitulation from the viewpoint of the typical respondent was included at the end of the discussion for each subject area.

The initial decision to use statistical sampling on an audit was made by the senior twice as often as by the manager and four times more often than by the partner-in-charge of auditing. The final approval to use statistical sampling was made by the partner-in-charge of auditing 2.5 times more often than the manager. Offices of small firms tended to make the initial and final decisions to use statistical sampling at higher levels of authority than did offices of large firms. By slightly less than a two-to-one margin over all others, the primary criteria in the decision process were population size and audit evidence validity, followed distantly by client size and audit area. Overwhelmingly, the minimum population size most frequently chosen by a three-to-one margin for which the respondent

would consider using statistical sampling on an audit under the best circumstances was the range of 501-5,000.

The statistical accuracy most likely to be chosen was a confidence level of 90 to 95 percent and a precision of ±5 percent. A check of internal control was chosen as the most important criterion for setting statistical accuracy 1.4 times more often than audit area and twice as often as the preceding year's audit. Only about 18 percent of the respondents had standard, in-house policies for setting the statistical accuracy; offices of large firms had policies four times as often as offices of small firms. Even though offices of small firms favored the establishment of profession-wide guidelines for statistical accuracy by a three-to-one margin, the idea was rejected overall by a ten percent margin.

About 63 percent of all offices had in-house training covering the application of statistical sampling to auditing; however, few offices of small firms had such training, while most offices of large firms did. Most respondents, especially from offices of small firms, implied that their in-house training was confidential, which seemed to be a deterrent to the dissemination of knowledge about statistical sampling. About 72 percent of all offices had access to standard computer programs for retrieving and analyzing audit data, with offices of large firms having access to such programs three times more

often than offices of small firms.

The population size where statistical sampling was most likely to be used lay between 501 and 50,000. Audit evidence was gathered by the use of simple random sampling about 1.4 times as often as systematic: single start and stratified, with offices of small firms favoring simple random sampling. Application problems were about as likely to be encountered in defining the error as in interpreting test results. The audit areas where statistical sampling was most likely to be applied were receivable confirmation, followed by purchase or voucher test and inventory determination.

Between 78.9 and 84.5 percent of all firms used statistical sampling at some time during the previous year, with statistical sampling being used on 32.4 percent of all audits conducted by them. Not only were offices of large firms more likely to use statistical sampling, but the level of use of statistical sampling on all of their audits was twice as high as for offices of small firms. Overwhelmingly the use of statistical sampling was employed to estimate attributes by a margin of about four-to-one over variables. Ninety-four percent of the respondents considered statistical sampling a valid audit tool, with less than one percent not considering statistical sampling a valid audit tool. Respondents favored an increased use of statistical sampling based upon increased validity of

audit evidence 1.2 times more often than decreased audit time and 1.5 times more often than decreased audit fee.

Offices of small firms were as likely as offices of large firms to make additional comments on the questionnaire. Many offices of small firms indicated that they did not use statistical sampling because of the small size of the CPA firm, small size of audits, small number of audits done, and the training inadequacy of the firm's staff members. Some offices of large firms mentioned that statistical sampling provided greater reliability of audit evidence upon which they based their opinion. Offices of small firms were likely to use statistical sampling for sample selection, while offices of large firms generally used statistical sampling for sample selection and for statistical inference. Many offices of small and large firms depended on the AICPA for training materials, while offices of large firms were much more likely to have their own materials in addition.

According to their comments, some offices of small firms apparently looked upon the use of statistical sampling as a panacea for avoiding or limiting legal liability from possible lawsuits. Offices of large firms expressed their apprehension about accepting the use of statistical sampling, because of the disadvantages when placed in the hands of inadequately trained personnel. They pointed to the fact that lack of statistical expertise might increase or lead

to possible liability when challenged by expert statisticians in court.

## FOOTNOTES

[1]For details see Tables 23, 24, and 25 located in Appendix C.

[2]For details see Table 26 located in Appendix C.

[3]For details see Tables 27, 28, and 29 located in Appendix C.

[4]For details see Table 30 located in Appendix C.

[5]For details see Table 31 located in Appendix C.

[6]For details see Tables 32, 33, and 34 located in Appendix C.

[7]Timothy Ross, Hugh Hoyt, and Herb Shaw, "The Use of Statistical Sampling in Auditing--An Empirical Study," The Ohio CPA, Winter, 1971, pp. 5-13.

[8]The ranges were calculated by determining the confidence intervals at the 95 percent level of confidence. For example, the mean for all offices who used statistical sampling at some time during the year was 66.4 percent, with a standard deviation of 2.7 percent. The confidence interval of 61.1 to 71.7 percent was found from 66.4 - (2.7 x 1.96) mean 66.4 + (2.7 x 1.96).

[9]For details see Table 35 located in Appendix C.

[10]For details see Table 36 located in Appendix C.

[11]Ross, Hoyt, and Shaw, op. cit.

# CHAPTER VI

## FINDINGS OF EMPIRICAL RESEARCH: CORRELATION ANALYSIS

Correlation analysis was used to measure the degree of dependence, association, relationship, or interrelationship between the different pairs of variables derived from the questionnaire. Since the primary data were either qualitative or contained wide ranges which were essentially qualitative, the contingency coefficient was used to measure the strength of any existing relationship.[1] The purpose of the chapter was to cover the correlation method used here and to present the results of the data analysis along with the related implications.

The first step in the correlation analysis was to use chi-square tests at the .05 level of significance to detect significant relationships between pairs of variables. If the calculated amounts for chi-square were large enough to reject the null hypothesis of no relationship, a significant relationship was presumed to exist between the various pairs of variables.

If the chi-square test at the .05 level indicated a significant relationship between the variable pairs, a

contingency coefficient was calculated to measure the strength of the relationship. Since the contingency coefficient as frequently calculated has the undesirable property of a varying maximal value, two corrections are necessary to produce correlation measures which have comparable properties to the ordinary correlation coefficient.[2] The contingency coefficients calculated and referred to in this section will actually be the adjusted contingency coefficients.

For interpretation purposes, contingency coefficients are close to zero when the correlation is weak and close to one when the correlation is strong. The most common form of the contingency coefficient (C) used in measuring the strength of the relationship between two variables is the square of the contingency coefficient ($C^2$). For example, if C equals .5, then approximately .25 of the variation of one variable may be accounted for and perhaps caused by changes in the other variable. Hereafter the squared contingency coefficient will be referred to as a correlation measure.

The relative strength of the correlation measures for different pairs of variables may be found by obtaining the ratio of the two correlations: $C^2_{ij}/C^2_{kl}$. For example, a correlation measure of .60 is twice as strong as a correlation measure of .30: (.60/.30) = 2.

Since the correlation measure as calculated always

resulted in a positive figure, the direction of the relationship wasn't provided. Determination of the sign of the correlation measure was only possible when responses to both variables were ordered. The sign of the correlation measure was determined from the dual frequency tables. A negative sign was assigned to correlation measures whose distributions had a negative slope and a positive sign was assigned to those correlation measures whose distributions had a positive slope.

Since the correlation measure calculation required the pairing of variables, each response on the questionnaire was assigned a separate variable number. Table 22 contains a summary of the variables and their corresponding questionnaire references. As indicated in the table, the responses to question 1 of the questionnaire were assigned the variable number two. For multiple-response questions, each response was assigned a separate variable number.

Based upon opinions formed while coding questionnaire data for analysis and objectives of the study as discussed in Chapter 1, five variables were considered important enough to determine and analyze their relationship with all other variables. The five variables selected for complete correlation analysis were:

(1) whether an office used statistical sampling on audits (variable 5),

(2) percentage level of use of statistical sampling on audits (variable 4),

TABLE 22

A SUMMARY OF THE VARIABLES AND THEIR CORRESPONDING QUESTIONNAIRE REFERENCES USED IN THE CORRELATION ANALYSIS

| Variable Number | Questionnaire Reference (Question Number) | Variable Number | Questionnaire Reference (Question Number) | Variable Number | Questionnaire Reference (Question Number) |
|---|---|---|---|---|---|
| 2 | 1 | 21 | 9.1 | 39 | 17.1 |
| 3 | 2 | 22 | 9.2 | 40 | 17.2 |
| 4 | 3.1 | 23 | 10 | 41 | 17.3 |
| 5 | 3.2 | 24 | 11 | 42 | 18.1 |
| 6 | 4.1 | 25 | 12.1 | 43 | 18.2 |
| 8 | 4.2 | 26 | 12.2 | 44 | 18.3 |
| 9 | 5.1 | 27 | 13.1 | 45 | 18.4 |
| 10 | 5.2 | 28 | 13.2 | 46 | 18.5 |
| 11 | 5.3 | 29 | 13.3 | 47 | 19 |
| 12 | 5.4 | 30 | 13.4 | 48 | 20.1 |
| 13 | 5.5 | 31 | 14.1 | 49 | 20.2 |
| 14 | 5.6 | 32 | 14.2 | 50 | 21.1 |
| 15 | 6.1 | 33 | 15.1 | 51 | 21.2 |
| 16 | 6.2 | 34 | 15.2 | 52 | 21.3 |
| 17 | 6.3 | 35 | 15.3 | 53 | 21.4 |
| 18 | 7.1 | 36 | 16.1 | 54 | 22 |
| 19 | 7.2 | 37 | 16.2 | 55 | 23 |
| 20 | 8 | 38 | 16.3 | 56 | * |

*Fifty-six is an artificial variable created to distinguish between responses from offices of small firms and offices of large firms.

(3) whether a response came from the office of a small or large firm (variable 56),

(4) audit staff size of each office (variable 3), and

(5) the respondent's position within his firm (variable 54).

Other variables considered to be of lesser importance were correlated on a more limited basis.

Whether an Office Used Statistical Sampling on Audits

To detect the existence of any interrelationships between whether a firm had applied statistical sampling on any audit during the previous year (variable 5) and all other variables, chi-square was used as previously discussed. Only when a significant relationship existed was a correlation measure calculated to determine the strength of that relationship. A summary of the results from the analysis is contained in Table 38, located in Appendix D.

Only four correlation measures worthy of mention resulted. The interrelationship from correlating whether a firm had used statistical sampling on any audit during the previous year was:

(a) positive and weak for the total audit staff size of firm (variable 3);

(b) moderate for whether statistical sampling was considered to be a valid audit tool (variable 2);

(c) positive and moderate for whether a response came from the office of a small or large firm (variable 56); and

(d) positive and very strong for the percentage level of use of statistical sampling on audits (variable 4).

As expected, perfect correlation was achieved between a firm using statistical sampling and the level of statistical sampling's use, since the use of statistical sampling requires that it be used at some level. Excluding the perfect correlation identity, the most important factor in determining whether an office used statistical sampling was whether a response came from the office of a small or large firm, which was 1.7 times as important as whether the respondent considered statistical sampling a valid audit tool and 2.3 times as important as audit staff size.[4]

## Percentage Level of Use of Statistical Sampling on Audits

The level of use of statistical sampling (variable 4) was paired with all other variables to detect and measure the strength of any existing interrelationships. The resulting correlation measures are summarized in Table 39, located in Appendix D.

Six correlation measures worthy of mention resulted. The interrelationship from correlating the percentage level of use of statistical sampling on audits was moderate:

(a) and positive for the firm's total audit staff size (variable 3);

(b) and negative for the level of authority of the initial decision to use statistical sampling (variable 6);

(c) for whether the firm had a training course describing the use of statistical sampling (variable 18);

(d) for whether the firm had a policy about levels of confidence (variable 50);

(e) and positive for whether a response came from the office of a small or large firm (variable 56).

As discussed in the previous section, perfect correlation was achieved between the level of statistical sampling's use and whether a firm used statistical sampling.

Excluding the perfect correlation identity, the most important factor in determining the level of use of statistical sampling was whether the firm had a training course, which was 1.3 times as important as the level of authority for the initial decision and whether a response came from the office of a small or a large firm. Additionally, whether the firm had a training course was 1.6 times more important than whether the firm had a policy for levels of confidence and audit staff size. The negative, moderate relationship achieved between the level of use and the level of authority of the initial decision implied that the lower the level of the initial decision, the higher the level of use.

## Whether a Response Came from the Office of a Small or Large Firm

Whether a response came from the office of a small firm or the office of a large firm (variable 56) was paired with all other variables to detect and measure any existing interrelationships. Table 40, located in Appendix D, contains the resulting correlation measures. Thirteen correlation measures worthy of mention resulted. A positive, moderate-to-strong interrelationship for the firm's total

audit staff size (variable 3), indicated that the population was highly stratified according to staff size between offices of small and large firms.

Positive, moderate correlation measures existed between whether a response came from the office of a small or large firm variable and the variables for percentage level of use of statistical sampling on audits (variable 4) and whether an office had used statistical sampling on audits (variable 5). The moderate interrelationships indicated that not only were offices of large firms more likely to use statistical sampling, but the level of use on their audits was much higher.

Negative, moderate correlation measures existed between whether a response came from the office of a small or large firm variable and the variables for level of authority of the initial decision (variable 6) and final approval (variable 8) to use statistical sampling on an audit. The negative correlation measures indicated that the initial decision and final approval were likely to be made at lower levels of authority for offices of large firms. The initial decision was 2.3 times more likely to be made at a lower level of authority for offices of large firms than was the decision of final approval.

Moderate correlation measures existed between whether a response came from the office of a small or large firm variable and the variables for whether a firm had a

training course (variable 18) or a training manual (variable 19) and the confidential nature of the training materials (variable 20). The moderate interrelationships indicated that offices of large firms were more likely to have training courses and materials, which were less likely to be confidential.

Moderate correlation measures existed between whether a response came from the office of a small or large firm and the variables for the accessibility to the firm of a standard selection and retrieval program for use on clients who had computers (variable 23) and of a standard statistical sampling program for analyzing retrieved data (variable 24). The moderate interrelationships indicated that offices of large firms were more likely to have both standard selection and retrieval programs and a standard statistical analysis program.

Moderate correlation measures existed between whether a response came from the office of a small or large firm variable and the variables for whether a respondent favored profession-wide guidelines for setting confidence levels (variable 48) and for setting precision (variable 49) and whether the firm had in-house policies for setting confidence levels and precision (variable 50). The interrelationships indicated that offices of large firms were more likely to have in-house policies for setting confidence levels and precision and to disapprove of

profession-wide guidelines for setting them.

The large number of important correlation measures worthy of mention indicated that whether a response came from the office of a small or large firm was the most important factor affecting responses to the questionnaire. Excluding the correlation measure associated with audit staff size, the two most important factors affected by whether the response came from the office of a small or large firm were the level of authority of the initial decision to use statistical sampling and whether the firm had a training course.

## Audit Staff Size of Each Office

The total audit staff size of each office (variable 3) was paired with all other variables to detect and measure the strength of any existing interrelationships. A summary of the analysis is contained in Table 41, located in Appendix D. Eight correlation measures worthy of mention resulted. The moderate-to-strong interrelationship obtained here between audit staff size and whether a response came from the office of a small or large firm was discussed in the previous section.

A positive, moderate interrelationship existed between the variable for audit staff size and the level of use of statistical sampling on audits (variable 4); indicating that the larger the staff size, the higher the level of use. A negative, moderate interrelationship existed for

the level of the initial decision to use statistical sampling (variable 6), which indicated that as the audit staff size increased, the initial decision was made at a lower level of authority.

Moderate correlation measures existed between the audit staff size variable and the variables for whether a firm had a training course (variable 18) or a training manual (variable 19) and the confidential nature of the training materials (variable 20). The moderate interrelationships indicated that the larger the audit staff size, the more likely were offices to have training courses and manuals, which were less likely to be confidential.

Moderate correlation measures existed between the audit staff size variable and the variables for the accessibility to the firm of a standard selection and retrieval program for use on clients who had computers (variable 23) and of a standard statistical sampling program for analyzing retrieved data (variable 24). The moderate interrelationships indicated that offices of large firms were more likely to have both retrieval and analysis programs.

## Respondent's Position within His Firm

To determine what effect a respondent's position within the firm had upon his answers to the questionnaire, the respondent's position variable was paired with all other variables to detect and measure any existing interrelationships.

The correlation measures are summarized in Table 42, located in Appendix D. The correlation measures between the respondent's position within the firm and all other variables produced only one interrelationship worthy of note, indicating that the respondent's position within the firm had no apparent effect on his responses to the questionnaire. A positive, moderate interrelationship was observed between the respondent's position within the firm and the level of authority of the final approval for the decision to use statistical sampling. The correlation measure may be explained by the fact that the respondents generally held a position at a higher level of authority within the firm and that the final approval of the decision to use statistical sampling was usually made at a higher level. Essentially, this was a spurious correlation measure, and indicated the lack of any cause-effect interrelationship.

## Additional Correlation Measures

Additional correlation analysis was conducted on the basis of the broad subject areas used for the single frequency analysis to determine whether answers to the questionnaire within the areas were interrelated. Responses to questions 1, 6, and 19, dealing with respondent opinion about the level of application of statistical sampling, were paired for analysis. The results from pairing the variables representing these questions are presented in

Table 43, located in Appendix D. Only one correlation measure worthy of mention was observed. A moderate interreiationship was detected as a result of pairing whether statistical sampling was considered to be a valid audit tool variable with the respondent opinion concerning the level of use of statistical sampling in auditing variable (variable pair 2, 47). The variable pair represented the pair of questions included on the questionnaire to test the internal integrity of the responses. As indicated by the observed correlation measure, the responses were fairly consistent.

Variables representing responses to questions 7, 8, 10, and 11, which dealt with educational aids and electronic tools for applying statistical sampling to auditing, were paired to determine their interrelationships. The moderate-to-strong correlation measure that existed between whether a firm had a training manual or a training course describing the use of statistical sampling in auditing (variable pair 18, 19) indicated that if the firm had a training course, they were also likely to have a training manual. The interrelationship of the variable pair with the confidential nature of the course or manual (variable 20) also produced a moderate-to-strong correlation measures indicated that if a firm had a training course or manual, it was likely to consider them confidential. Additionally, a strong interrelationship existed between

the firm's access to a standard selection and retrieval program for use on clients who had computers and their access to a standard statistical sampling program for analyzing the retrieved data (variable pair 23, 24). The correlation measures indicated that if the firm had a retrieval program, they were also likely to have an analysis program.

In order to determine the interrelationships between the minimum size population a respondent would consider using statistical sampling on an audit and his application experience, paired responses to questions 12 and 13 were analyzed. Correlation measures from the analysis of the paired variables are contained in Table 44, located in Appendix D. Moderate correlation measures existed between all the pairs of variables, indicating that the minimum size population range that an individual would consider when estimating attributes or variables was also likely to be the same as the range where the respondent most frequently applied statistical sampling.

Responses to questions 14 and 15, dealing with setting levels of confidence and precision, were compared to determine their interrelationships. The results from pairing and analyzing the variables representing these two questions are presented in Table 45, located in Appendix D. A moderate, negative correlation measure was observed between the minimum level of confidence and the maximum

level of precision (variable pair 31, 32), which indicated that the lower the minimum confidence level, the higher the maximum precision.

Responses to questions 13, 16, 17, and 18, dealing with application experience as to population size, methods of sample selection employed, problem areas encountered, and areas of use, were all compared to determine their interrelationships. Table 46, located in Appendix D, contains the results from pairing and analyzing the variables representing the responses to these questions. Two groups of weak-to-moderate interrelationships were observed as a result of pairing and analyzing variables associated with the questions. The first group resulted from pairing the variables for method of statistical sample selection with the variables for the type of problems encountered, indicating that the method of sample selection used apparently determined to some degree the problems encountered. The second group resulted from pairing the variables for the method of statistical sample selection with the variables for the audit area, indicating that apparently the audit area under investigation explained to some degree the method of sample selection chosen.

Variables for questions 19 and 20, concerning respondent opinion about the level of use of statistical sampling in auditing and about setting standard guidelines for confidence and precision, were paired and analyzed.

The weak-to-very weak correlation measures observed indicated that favoring an increased use of statistical sampling probably was not based upon setting of profession-wide guidelines for levels of confidence and precision. The correlation measure obtained from analyzing the two variables for question 20 indicated that the respondents consistently favored or opposed setting standard guidelines.

To determine the interrelationships between respondent opinion about the establishment of standard guidelines for setting confidence levels and precision and whether the firm had policies for setting confidence levels and precision, variables for questions 20 and 21 were paired and analyzed. Results from the analysis are presented in Table 47, located in Appendix D. The absence of any meaningful correlation measures indicated that the position taken on setting standard guidelines was not apparently affected by whether the firm had such in-house policies.

Question 4, concerning the level of authority at which the initial and final decisions were made to use statistical sampling, was compared with question 5 concerning the criteria considered when making the decision to use statistical sampling. The correlation measures that resulted from pairing and analyzing the variables are contained in Table 48, located in Appendix D. No correlation measures worthy of note resulted, indicating that generally the decision levels did not affect the selection of the

decision criteria. When the variables for the level of authority for the initial and final decisions (variable pair 6, 8) were paired and analyzed, a strong, negative correlation measure was observed, which indicated that the initial decision was likely to be made at lower levels within the firm, while the final decision was likely to be made at higher levels.

## Summary

Correlation analysis was used to detect and measure interrelationships of variable pairs derived from primary data on the questionnaire. Since the primary data were essentially qualitative, a corrected contingency coefficient was used to obtain correlation measures for variable pairs where the relationship proved to be significant. The selection of variable pairs for analysis was based upon objectives of the study and opinions formed while coding questionnaire data. Five variables were considered important enough to determine and analyze their relationship with all others. Other variables were correlated on a more limited basis.

To detect and measure the strength of significant interrelationships, the variable for whether a firm had applied statistical sampling on any audit during the previous year was paired and analyzed with all others. As a result of the analysis the most important factor in determining whether an office used statistical sampling was

whether a response came from the office of a small or large firm, which was 1.7 times as important as whether the respondent considered statistical sampling a valid audit tool and 2.3 times as important as audit staff size.

The level of use of statistical sampling variable was paired with all other variables for correlation analysis. The most important factor in determining the level of use of statistical sampling was whether the firm had a statistical sampling training course, which was 1.3 times as important as the level of authority for the initial decision to use statistical sampling and whether a response came from the office of a small or a large firm. Additionally, whether the firm had a training course was 1.6 times more important than whether the firm had a policy for levels of confidence and audit staff size. The negative, moderate relationship achieved between the level of use and the level of authority of the initial decision implied that the lower the level of the initial decision, the higher the level of use.

The results of correlating the variable for whether the response came from the office of a small firm or the office of a large firm with all others were:

(1) The population was highly stratified according to audit staff size between offices of small firms and offices of large firms.

(2) Not only were offices of large firms more likely to use statistical sampling, but the level of use on all their audits was much higher.

(3) The initial and final decisions to use statistical sampling, especially the initial decision, were likely to be made at lower levels of authority in offices of large firms.

(4) Offices of large firms were more likely to have statistical sampling training courses and manuals and were less likely to consider them confidential.

(5) Standard selection and retrieval programs, and standard statistical analysis programs were more accessible to offices of large firms.

(6) Offices of large firms were more likely to have in-house policies for setting confidence levels and precision and to disapprove of profession-wide guidelines for setting them.

The results of correlating the variable for total audit staff size of each office with all other variables were:

(1) As the audit staff size increased, the initial decision to use statistical sampling was made at a lower level of authority.

(2) As the audit staff size increased, the office was more likely to have training courses and manuals, which were less likely to be confidential.

(3) The larger the staff size, the more likely the office was to have both selection and retrieval programs, and statistical analysis programs.

(4) Audit staff size was not as important for determining the level of use as was whether a response came from the office of a small or large firm.

To determine whether a respondent's position within the firm had any effect upon his answers to the questionnaire, the respondent's position variable was paired with all other variables for correlation. The results of the correlation analysis were that no important interrelationships existed, indicating that the respondent's position within

the firm had no material effect on his responses to the questionnaire.

Additional correlation analysis was conducted on the basis of the broad subject areas used for the single frequency analysis to determine whether answers to the questionnaire within the areas were interrelated. The results of the additional correlation analysis were:

(1) The observed correlation measures obtained from pairing variables for questions 1 and 19 indicated that the responses were fairly consistent, establishing the internal integrity of the questionnaire responses.

(2) Firms with training courses were also likely to have training manuals, and both were likely to be confidential.

(3) Firms which had retrieval programs were also likely to have analysis programs.

(4) The minimum size population range that an individual would consider when estimating attributes or variables was also likely to be the same as the range where the respondent most frequently applied statistical sampling.

(5) In setting levels of confidence and precision, firms using lower levels of confidence were likely to use higher levels of precision.

(6) The method of statistical sample selection to some extent dictated the type of problems encountered when applying statistical sampling; and the audit area to which statistical sampling was being applied to some extent dictated the method of statistical sample selection.

(7) Little relationship existed between favoring an increased use of statistical sampling and profession-wide guidelines for setting levels of confidence and precision. Additionally, the respondent's opinion concerning profession-wide guidelines for setting levels of confidence and precision was apparently not influenced by the firm having such in-house policies of their own.

(8) The selection of the decision criteria for using statistical sampling had no apparent effect upon the levels of authority at which the decision to use statistical sampling was made. The initial decision was likely to be made at lower levels within the firm, and the final decision was likely to be made at higher levels.

Whether a response came from the office of a small or large firm apparently was the most important variable affecting responses to the questionnaire. The next most important variable was audit staff size, followed by the level of use of statistical sampling.

## FOOTNOTES

[1]John E. Freund and J. Frank Williams, Modern Business Statistics (Revised edition; Englewood Cliffs, New Jersey: Prentice Hall, Inc., 1969), pp. 334-336. Freund and Williams point out that if one or both of the variables being analyzed are qualitative, the ordinary coefficient of correlation cannot be relied upon to measure the relationship between the variables. Instead, they indicate that the strength of the linear relationship between pairs of variables may be determined by using the contingency coefficient.

[2]For an in-depth discussion of the concepts surrounding the contingency coefficient and related corrections, refer to: E. S. Pearson, Karl Pearson's Early Statistical Papers (Cambridge, England: Cambridge University Press, 1948), pp. 443-475; Truman L. Kelley, Statistical Method (New York: The Macmillan Company, 1924), pp. 265-271; and Quinn McNemar, Psychological Statistics (Fourth edition; New York: John Wiley and Sons, Inc., 1969), pp. 227-231.

[3]Variable 5 was generated from responses to Question 3 and indicated whether a particular firm had applied statistical sampling on any audit during the previous year.

[4]As previously discussed, the relative strength of correlation measures for different pairs of variables may be found by obtaining the ratio of the two: $C^2_{ij}/C^2_{kl}$.

# CHAPTER VII

## SUMMARY AND RECOMMENDATIONS

Very little empirical data or information was available about the extent to which independent auditors used statistical sampling to gather and analyze audit evidence, and that which was available was very superficial. If objective decisions were going to be made about the use of statistical sampling methods as employed by independent auditors, a verified benchmark was necessary. The problem was that no verified benchmark existed. More specifically, there was no information available about the process surrounding the decision to use statistical sampling; attitudes and experience toward setting levels of confidence and precision; how extensive was the use of statistical sampling training and aids; experience surrounding the use of statistical sampling; and how extensive was the use of statistical sampling.

The purpose of the study was to empirically determine the status of statistical sampling's use to quantify and incorporate the risks that an auditor accepted in forming his opinion. For the study, the population sampled was defined as all offices of certified public accounting firms

in the United States with two or more certified members. The scope of the study was limited to those facts obtained from reviewing available literature; by interviewing audit staff members of various CPA firms located in Norman and Oklahoma City, Oklahoma; and from mailing a questionnaire to offices of CPA firms throughout the United States.

The questionnaire was developed and mailed to a stratified sample of 883 offices of CPA firms throughout the United States. The exclusion of the individual practitioner seemed reasonable since his influence on auditing procedures and techniques was considered to be minimal. The 669 good responses to the questionnaire exceeded the 618 previously calculated as necessary to allow conclusions to be drawn about the level of use of statistical sampling at a preset level of statistical accuracy. Additionally, the response rate was high and in line with similar studies of CPA firms.

The assumption made about the competency, ability, integrity, and willingness of the respondent from the CPA firm to provide data appeared acceptable. The response validity test suggested that the questionnaire responses could be accepted as reasonably valid.

Single frequency and correlation analysis of the two questions dealing with the characteristics of the respondents indicated that the division of the population produced highly homogeneous subpopulations. Since the

partner-in-charge of auditing, generally the most knowledgeable individual about the overall office audit policies and procedures, was also the most frequent respondent, the questionnaire responses were considered highly factual and very reliable. Apparently no material bias resulted from the assumption that the respondent's views represented the view of the entire office, since the most frequent respondent was the partner-in-charge of auditing.

To compensate for the omission of relevant questions on the questionnaire, the final question of the questionnaire invited each respondent to make any additional comments which he wished. A summary of the more important comments is located in Chapter V. Single frequency and correlation analysis were used to analyze the primary data obtained from the questionnaire. The limitations of data analysis were not considered to be important. The methodology used in obtaining and analyzing empirical data was considered adequate to achieve the stated objectives of the study.

The findings of the study indicated that the initial decision to use statistical sampling on the audit was made at the senior level of authority at least twice as often as any other; and the final decision of approval was made at the partner-in-charge of auditing level 2.5 times more often than any other. Offices of large firms tended to make the initial and final decisions to use

statistical sampling at lower levels of authority. Correlation analysis indicated that as the audit staff size increased, both the initial and final decisions to use statistical sampling were made at a lower level of authority. Additionally, the initial decision was likely to be made at lower levels, while the final decision was likely to be made at higher levels.

By about a two-to-one margin, both population size and audit evidence validity were favored over all other criteria as the most important in the decision process. As indicated by correlation analysis, there was no apparent cause-effect relationship between the selection of decision criteria and the levels of authority at which the decision to use statistical sampling was made.

Overwhelmingly, the minimum population range for which the respondent would most frequently consider using statistical sampling on an audit under the best circumstances was between 501 and 5,000. The experience of the respondents indicated that they were most likely to use statistical sampling when the population size lay between 501 and 50,000. Correlation analysis indicated that the minimum size population range that an individual would consider when estimating attributes or variables was likely to be the same as the range where the respondent most frequently applied statistical sampling.

The statistical accuracy most likely to be chosen

was a confidence level between 90 and 95 percent and a precision of ±5 percent. As indicated by correlation analysis, firms using lower levels of confidence were likely to use higher levels of precision.

A check of internal control was chosen as the most important criterion for setting statistical accuracy at least 1.4 times more often than any other. Even though only 18 percent of the respondents had standard in-house policies for setting statistical accuracy, offices of large firms had such policies four times more often than offices of small firms. Establishment of profession-wide guidelines for statistical accuracy was rejected by a ten percent margin, even though offices of small firms favored them by three-to-one. Correlation analysis indicated that little relationship existed between having in-house policies about statistical accuracy and favoring the establishment of such profession-wide guidelines.

About 63 percent of all offices had in-house training covering the application of statistical sampling to auditing; however, few offices of small firms had such training, while most offices of large firms did. Most respondents, especially from offices of small firms, implied that their in-house training was confidential, which seemed to be a deterrent to the dissemination of knowledge about statistical sampling. As indicated by correlation analysis, firms with training courses were also likely to

have training manuals, and both were likely to be confidential. Additionally, as the audit staff size increased, the office was more likely to have training courses and manuals, which were less likely to be confidential.

About 72 percent of all offices had access to standard computer programs for retrieving and analyzing audit data, with offices of large firms having access to such programs three times more often than offices of small firms. Correlation analysis indicated that offices which had retrieval programs were also likely to have analysis programs.

Audit evidence was gathered by the use of simple random sampling about 1.4 times more often than any other. Application problems were about as likely to be encountered in defining the error as in interpreting test results. The audit areas where statistical sampling was most likely to be applied were receivable confirmation, followed by purchase or voucher test and inventory determination. As indicated by correlation analysis, the method of statistical sample selection to some extent dictated the type of problems encountered when applying statistical sampling; and the audit area to which statistical sampling was being applied to some extent dictated the method of statistical sample selection.

Approximately 81.7 percent of all firms used statistical sampling at some time during the previous year,

with statistical sampling being used on 32.4 percent of all audits conducted. As a result of correlation analysis, the most important factor in determining whether an office used statistical sampling was whether a response came from the office of a small or large firm, which was 1.7 times as important as whether the respondent considered statistical sampling a valid audit tool and 2.3 times as important as audit staff size. The most important factor in determining the level of use of statistical sampling was whether the firm had a statistical sampling training course, which was 1.3 times as important as the level of authority for the initial decision to use statistical sampling and whether a response came from the office of a small or large firm. The negative, moderate relationship achieved between the level of use and the level of authority of the initial decision implied that the lower the level of the initial decision, the higher the level of use. Not only were offices of large firms more likely to use statistical sampling, but the level of use of statistical sampling on all of their audits was twice as high as for offices of small firms. Correlation analysis indicated that audit staff size was not as important for determining the level of use as was whether a response came from the office of a small or large firm.

The use of statistical sampling was employed to estimate attributes by a margin of about four-to-one

over estimating variables. Ninety-four percent of the respondents considered statistical sampling a valid audit tool, while less than one percent did not. Respondents favored an increased use of statistical sampling based upon increased validity of audit evidence 1.2 times more often than for other criteria.

Whether a response came from the office of a small or large firm was found to be the most important variable affecting responses to the questionnaire. The next most important variable was audit staff size, followed by the level of use of statistical sampling.

Offices of small firms were as likely as offices of large firms to make additional comments on the questionnaire. Many offices of small firms indicated that they did not use statistical sampling because of the small size of their firm, small size of audits, small number of audits done, and the training inadequacy of the firm's staff members. Some offices of large firms mentioned that statistical sampling provided greater reliability of audit evidence upon which they based their opinion. Offices of small firms were likely to use statistical sampling for sample selection, while offices of large firms generally used statistical sampling for sample selection and for statistical inference. Many offices of small and large firms depended on the AICPA for training materials, while offices of large firms were much more likely to have their

own materials in addition.

According to their comments, some offices of small firms apparently looked upon the use of statistical sampling as a panacea for avoiding or limiting legal liability from possible lawsuits. Offices of large firms expressed their apprehension about accepting the use of statistical sampling, because of the disadvantages when placed in the hands of inadequately trained personnel. They pointed to the fact that lack of statistical expertise might increase or even lead to possible liability when challenged by expert statisticians in court.

## General Conclusions

Most respondents, especially those from offices of small firms, implied that their in-house statistical sampling training and aids were confidential, apparently for competitive reasons. Since public accounting firms generally have been forbidden from competing with other firms on the basis of fees, apparently they have attempted to compete by increasing the quality of the services provided.

Establishment of profession-wide guidelines for statistical accuracy was rejected by a ten percent margin, even though offices of small firms favored them by three-to-one. Offices of small firms applying statistical sampling apparently felt they would be more comfortable with such guidelines. Due to their limited resources to

acquire expertise, they seemed willing to pay the price of additional outside control resulting from the establishment of profession-wide guidelines. On the other hand, because offices of large firms had resources to acquire the expertise necessary to set their own statistical accuracy, these offices were apparently more inclined to favor retaining their autonomy.

Since inventory observation and receivable confirmation have been required auditing procedures for many years, many firms appeared anxious to be as confident of these audit areas as possible. Apparently firms felt that the use of statistical sampling helped provide the desired assurance in these audit areas. Thus receivable confirmation and inventory determination were among the top three audit areas where statistical sampling was most often applied.

Even though 93.6 percent of the offices of large firms used statistical sampling at some time during the previous year, the level of application on all of their audits was only 43.7 percent. For offices of small firms the percentages were much lower: the proportion of those who used statistical sampling was 66.4 percent and the level of application was only 17.7 percent. Both the number of firms which use statistical sampling and especially the level of use on audits they conduct should be increased. This would raise the level of validity of audit evidence,

which would perhaps reduce the liability of potential lawsuits.

With the exceptions noted below, CPA firms are apparently adequately applying statistical sampling. One exception is that many firms simply used statistical sampling for sample selection rather than for selection and analysis. Additionally, statistical sampling was used almost exclusively for estimating attributes rather than variables. This seems unreasonable since auditors are just as concerned with balances as internal control. Finally, many respondents did not consider using statistical sampling on population ranges of less than 500; yet, statistical sampling can often be efficiently applied to these small populations.

## Recommendations

As a result of the study, the following recommendations are made:

(1) To minimize the confusion caused by varying nomenclatures for the same statistical concept, uniform statistical sampling terminology as employed in auditing should be agreed upon and used by auditors.

(2) Since statistical sampling provides an objective evaluation of audit test results which are defensible, CPA firms which conduct audits should have in-house policies requiring either the use of statistical sampling on all audits or justification for failure to use it.

## Implications for Further Research

Almost all research poses problems which require further research. Implications for further research as a result of the study are:

(1) A followup study similar to this one should be made at some time in the future for trend analysis.

(2) To evaluate the effectiveness of statistical sampling training provided by CPA firms, colleges, and universities, an empirical study should be made to establish what is being done in these settings.

(3) The Committee on Auditing Procedure of the AICPA should investigate the feasibility of developing a quantitative method for determining levels of confidence and precision which would provide auditors with defensible guidelines in the one area of statistical sampling that now requires the auditor's subjective judgment.

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# APPENDIX A

## GLOSSARY OF STATISTICAL TERMS

The glossary was designed to assist readers who are unfamiliar with definitions of statistical terms. No technical sophistication which would satisfy professional statisticians is intended. Many of the terms defined here were obtained from Lawrence L. Vance's Glossary of Statistical Terms for Accountants which he developed in 1958 for the Committee on Statistical Sampling of the AICPA.[1]

Arithmetic mean. A measure of central tendency for some frequency distribution. The formula for the mean ($\bar{x}$) is:

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

where $x_i$ are the individual observations of the frequency distribution; $\sum_{i=1}^{n} x_i$ is the sum of the individual observations; and n is the number of observed $x_i$'s.

Association. The tendency for two or more sets of characteristics or classifications to display interrelationships, relationships, or dependence.

Attribute. A quality or group of qualities reduced to quantitative form by a coding or classification scheme for purposes of accounting, mathematical, or statistical analysis.

Average. See arithmetic mean.

Chi-square test. A statistical test to detect the existence of any association between various attributes or variables.

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[1]Lawrence L. Vance, Glossary of Statistical Terms for Accountants, Report to Committee on Statistical Sampling, American Institute of Certified Public Accountants, New York, September 8, 1958 (New York: American Institute of Certified Public Accountants, 1958).

Coefficient of correlation. A measure of the relationship between two series of numbers designed so that +1 = perfect correspondence, -1 = perfect inverse correspondence and 0 = no correspondence.

Confidence interval. See precision.

Contingency coefficient. A type of correlation measure. See correlation measure.

Correlation analysis. A quantitative method for discovering and analyzing associations between various attributes or variables.

Correlation measure. Any measure designed to show the degree of association between two sets of variables or attributes.

Dependence. See association.

Descriptive statistics. The part of statistics devoted to various measures or summaries of data.

Distribution. A classification of data into specified groups; also, a mathematical formula or function describing (often approximately) the distribution of certain data or classes of data.

Dual frequency table. A table constructed for the purpose of analyzing or discovering associations between pairs of attributes or variables.

Finite population correction factor. The formula used to correct the standard deviation of a sample mean when a finite population is involved, since the standard deviation is calculated by a formula that assumes an infinite population. The correction factor is

$\sqrt{\frac{N - n}{N - 1}}$ where N is the number of units in the population and n is the number in the sample.

Frame. See population.

Frequency. Number of items in a given class.

Frequency chart. Chart showing frequency of items in various classes, for example, persons with incomes of different amounts.

Frequency distribution. A list of frequencies of items in specified classes.

Hypothesis. An assumption about the population which allows a decision to accept as a true statement about the population or to reject as untrue depending upon the results seen in a sample to be made.

Hypothesis testing. Determining whether or not an assumption about a population shall be allowed to stand as a conclusion about that population by sampling the population and determining whether or not the result suggests disbelief in the hypothesis. The probability of getting the particular sample from a population of the quality assumed is the essential basis for accepting or rejecting the hypothesis.

Interrelationship. See association.

Level of confidence. The probability that the true value being estimated will be contained within the precision interval. For example, the probability that a true value might lie within the precision interval from 45 to 55 about a sample estimate of 50 might be 95%.

Likelihood. A figure, computed as a probability is computed, but used in circumstances in which a "probability" is not technically the result. For example, we can compute the probability of drawing a hand of 13 spades in a bridge game, because we know--or can compute--all the possibilities. But if we draw a sample from a population whose characteristics we do not know, we may set up a hypothesis--an assumption--about the population, then calculate the probability of getting such a sample as we have from the assumed population and consider the likelihood that our population actually was of the character assumed judging by the probability obtained from the assumed population.

Linear relationship. Having mathematical properties of a straight line or plane surface.

Mean. See arithmetic mean.

Mode. The value of those items occurring most frequently in a population. When the population is represented by a frequency distribution, the model value appears as the highest point on the curve.

Multi-variet analysis. Consists of analyzing relationships that involve more than one independent variable or attribute, such as multiple linear regression or factor analysis.

Non-response. Failure to obtain the information desired from items selected for a sample. Familiar to accountants in confirming accounts. May introduce significant bias.

Normal distribution. A distribution described by a normal curve.

Null hypothesis. See hypothesis testing.

Occurrence rate. See attribute.

Parameter. A characteristic of the population, such as arithmetic mean or standard deviation.

Population. All the individual units under examination; for example, all the U.S. federal income tax returns for 1956.

Precision. May be expressed as absolute precision, relative precision, or as a confidence interval. Absolute precision is the precision interval expressed as a plus or minus distance about the sample estimate, e.g., the precision interval from 45 to 55 for the sample estimate of 50 would be expressed as an absolute precision of plus and minus 5. Relative precision is absolute precision divided by the sample estimate and expressed as a percent, e.g., for the above example, the relative precision is plus and minus 10%.

Probability. The ratio of certain events to all possible events in a series or set; expressed as a percentage, a decimal, or natural fraction, or as so many chances out of so many. For example: the probability that a two will turn up on the throw of a single die is 1/6. However, statisticians debate the definition of probability to the point where some of them conclude that it is indefinable.

Qualitative. Relating to quality: distinguished from quantitative.

Random. An order or selection governed by chance.

Random numbers. Tables of numbers running in no regular order by means of which random samples may be drawn.

Random sample. A sample the content of which is determined by chance; a sample drawn so that every other combination of the same number of items in the population had an equal chance to the drawn.

Random variation. The variation of sample results from a population characteristic due to the chance selection of the items in the sample.

Relationship. See association.

Reliability. See level of confidence.

Risk. See sampling risk.

Sample. That portion of a population chosen to represent the whole.

Sample design. Used variously to designate one or more parts or the whole scheme of a sampling procedure; sometimes refers specifically to the rules for drawing a sample from a given frame.

Sample statistic. A figure calculated from a sample.

Sampling distribution. The distribution of population characteristics estimated by repeatedly sampling from a single population. A distribution exists because the variability in samples produces a series of estimates of a population characteristic. Often expressed for particular sample statistics in formulae covering all the possibilities which permit mathematical treatment.

Sampling error. The difference between the figure obtained from a sampling procedure and the figure that would have been obtained by examining every item in the population. Statistical sampling permits an evaluation of these errors by the laws of probability.

Sampling inspection. A process of inspection or examination using statistical sampling methods.

Sampling precision. See precision.

Sampling risk. The chance that a sample drawn and interpreted by statistical principles will lead to the wrong conclusion or to a wrong estimate. Expressed as a percentage, fraction, or as "chances."

Single frequency analysis. A method by which the measure of central tendency (mean) and the variability (standard deviation) are determined for various attributes or variables.

Single sampling. A sampling plan in which a single sample of a predetermined number of items is drawn.

Skewness. Ordinarily used in describing curves representing frequency distributions that differ from a normal distribution.

Standard deviation. A measure of the variability of the frequency distribution. Mathematically, the square root of the average square of the deviations from the mean. Often denoted by the lower case Greek letter sigma. The formula is:

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n}}$$

where $x_i$ are the individual observations, $\bar{x}$ is their mean, and n is the number of observed $x_i$'s.

Standard error. Estimate of the population standard deviation obtained from the sampling distribution.

Statistic. A value calculated from a sample as contrasted with a similar value calculated from the population.

Statistical accuracy. Includes the two statistical concepts of precision and level of confidence. Precision and level of confidence are interdependent, and if one is arbitrarily set, the other is determined by characteristics of the population being sampled and the sampling plan used. The usage of statistical accuracy is not uniform and the term is occasionally used as a synonym for precision.

Statistical distribution. Distribution showing the frequency of different values a particular statistic can take. Used in calculating probabilities, confidence limits, and precision of a sample.

Statistical estimation. Process of making estimates from samples by formal statistical methods.

Statistical inference. The process of reaching conclusions about populations from samples, and based upon probability calculations.

Statistics. The science that uses probability calculations in making estimates and drawing conclusions about populations; in a broader sense, the science or art of presenting and analyzing numerical data effectively and properly; the plural of statistic; in accounting, figures not derived directly from the books of account.

Stratify. To divide a population into relatively homogeneous subgroups or stratas.

Survey sampling. Sampling designed to provide information about some population which might otherwise be examined in its entirety; usually used in reference to studies of economic or other social phenomena.

Unit of sampling. A unit of the population under examination drawn for a sample. The unit may be a primary unit from which further sample units are to be drawn, or an individual item drawn directly from the population for the final sample.

Universe. See population.

Value. See variable.

Variable. A quantity that varies; mathematically, a quantity that can take any one of a set of values.

Variance. Square of the standard deviation defined as:

$$\sigma^2 = \frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n}$$

the average square of the deviations of the variation from the mean of the population.

# APPENDIX B

The University of Oklahoma
Department of Accounting
307 West Brooks, AH 200
Norman, Oklahoma 73069

To the Partner-in-Charge:

At the present time I am engaged in gathering information for my doctoral dissertation. The purpose of my study is to determine the current status of statistical sampling methods used by certified public accounting firms of the United States in performing their independent audit functions. The only way to determine this status is to survey public accounting firms.

You will note that the questionnaire has been designed so that you may quickly and easily respond. Since I am desirous of obtaining the most complete picture possible of the current statistical sampling methods used, please feel free to make any additional comments or remarks.

No firm will be identified in the results of the study appearing in the published report and all information furnished by you will be treated as strictly confidential. No signature is necessary.

In order for me to complete all requirements for graduation by August, 1972, I must begin my statistical analysis of the data by early February. Won't you please take a few minutes now to complete the questionnaire and return it in the enclosed, addressed, stamped envelope. I thank you in advance for your time and effort.

Sincerely,

Joseph J. Joseph, Jr., C.P.A.
Special Instructor in Accounting

JJJ/pas

Enclosure

C O N F I D E N T I A L

INSTRUCTIONS: For those questions which do not include specific instructions, please check the appropriate box (☒). Additionally, for those questions in which no time period is specified, please reply on the basis of your experience during the past year.

1. Do you consider statistical sampling a valid audit tool or technique?
   ☐ yes ☐ no ☐ no opinion

2. What is the total number of auditing staff members, including partners, employed by your office.
   ☐ 1-5 ☐ 6-10 ☐ 11-20 ☐ 21-30 ☐ 31-40 ☐ 41-50 ☐ 51-100 ☐ 101-200 ☐ over 200

3. Please estimate on what percentage of the audits your office conducted during the past year that some statistical sampling was used.
   ☐ 0 ☐ 1-10 ☐ 11-20 ☐ 21-30 ☐ 31-40 ☐ 41-50 ☐ 51-60 ☐ 61-70 ☐ 71-80 ☐ 81-90 ☐ 91-100

4. Considering the following persons, place an (X) in the box beside that person who most often initially decides whether or not to use statistical sampling on an audit and an (V) in the box beside that person who most often finally approves or disapproves the use of statistical sampling on an audit.
   ☐ ☐ junior ☐ ☐ principal ☐ ☐ other (specify)_____
   ☐ ☐ senior ☐ ☐ partner-in-charge of audit _____
   ☐ ☐ manager ☐ ☐ partner-in-charge of office

5. Select and place in order from the following criteria the six you consider most important when deciding whether or not to use statistical sampling on an audit--most important first, etc.
   a. audit time e. client's business type i. auditor's statistical expertise
   b. audit fee f. population size j. computerization of client's records
   c. audit area g. numbered accounts
   d. client's size h. audit evidence validity k. other (specify)_____
   1___ 2___ 3___ 4___ 5___ 6___ _____

6. If you feel statistical sampling should be used more in auditing, select and place in order from the following reasons the three most important ones that you think the increased use should be based upon--most important first, etc.
   a. decreased audit fee c. increased validity of audit evidence
   b. decreased audit time d. other (specify)_____
   1___ 2___ 3___

7. Does your firm have an in-house training course or manual describing the use of statistical sampling in auditing?
   firm training course: ☐ yes ☐ no
   firm training manual: ☐ yes ☐ no

8. Under a pledge of complete security, may I examine your in-house training courses or manuals describing the use of statistical sampling in auditing? ☐ Yes ☐ No

9. During the past year what percentage of the times you used statistical sampling were you:
   estimating attributes (occurrence rates): ☐ 0-20 ☐ 21-40 ☐ 41-60 ☐ 61-80 ☐ 81-100
   estimating variables (values): ☐ 0-20 ☐ 21-40 ☐ 41-60 ☐ 61-80 ☐ 81-100

10. Does your office have or have access to a standard selection and retrieval program for use on clients who have computers? ☐ have ☐ have access to ☐ no

11. Does your office have or have access to a standard statistical sampling program for analyzing retrieved data from the client's computer? ☐ have ☐ have access to ☐ no

12. Under the best circumstances, indicate the minimum size population on which you would consider using statistical sampling on an audit when
    estimating attributes: ☐ 0-500 ☐ 501-5,000 ☐ 5,001-50,000 ☐ over 50,000
    estimating variables: ☐ 0-500 ☐ 501-5,000 ☐ 5,001-50,000 ☐ over 50,000

13. Considering the audits on which you have used statistical sampling during the past year, place in order the following population ranges by letting that range where statistical sampling was most often applied be first, etc.
a. 0-500 b. 501-5,000 c. 5,001-50,000 d. over 50,000
1___ 2___ 3___ 4___

14. Under the best circumstances, indicate the minimum confidence level and maximum precision you would consider when applying statistical sampling on an audit:
min. confidence level: ☐ 99% ☐ 98% ☐ 95% ☐ 90% ☐ other (specify)_____
max. precision: ☐ ±1% ☐ ±2% ☐ ±3% ☐ ±5% ☐ other (specify)_____

15. Select and place in order from the following criteria the three most important ones used in deciding what level of confidence and precision to set--most important first, etc.
a. firm policy c. individual experience e. preceding year's audit
b. audit area d. internal control check f. other (specify)_____
1___ 2___ 3___ _____

16. Select and place in order from the following methods of statistical sampling selection the three most frequently used methods--most frequently used first, etc.
a. simple random d. systematic: single start
b. stratified e. systematic: multiple start
c. cluster f. other (specify)_____
1___ 2___ 3___

17. From the following statistical sampling steps, select and place in order the three steps where problems are encountered most frequently--let that step where problems are encountered most frequently be first, etc.
a. defining error d. investigating errors g. interpreting test results
b. selecting sample e. examining sample units h. other (specify)_____
c. defining universe f. defining test objectives _____
1___ 2___ 3___

18. According to your experience during the past year, select and place in order from the following audit areas the five areas where statistical sampling was most frequently applied--most frequently applied to area first, etc.
a. cash d. expenses g. purchases or vouchers tests
b. sales e. inventory h. other (specify)_____
c. payroll f. receivable confirmation i. other (specify)_____
1___ 2___ 3___ 4___ 5___

19. Do you feel that statistical sampling in the auditing profession should be
☐ increased ☐ remain the same ☐ decreased?

20. Do you feel that the accounting profession (perhaps through the Committee on Auditing Procedure of the AICPA) should establish standard guidelines for:
confidence levels: ☐ yes ☐ no ☐ no opinion
precision: ☐ yes ☐ no ☐ no opinion

21. Does your firm have a policy about confidence level and precision to be used when applying statistical sampling on an audit?
confidence level: ☐ yes ☐ no If yes, please indicate what it is._____
_____
precision: ☐ yes ☐ no If yes, please indicate what it is._____
_____

22. What is your title or position within the firm?_____

23. Please make any additional comments on the back, that you wish to, about statistical sampling as used today in auditing or as it should be used in the future.

307 West Brooks, AH 200
Norman, Oklahoma 73069
February 5, 1972

Partner-in-Charge:

Recently I mailed you a questionnaire designed to obtain information for my doctoral dissertation. Since the original questionnaire may have not been received or have been misplaced, an additional copy is enclosed for your convenience.

To obtain a representative sample of the population, your particular office was singled out from all accounting firms to participate in this study. Your individual response is vital to get good and accurate results on which to determine the current status of statistical sampling's use in auditing.

Would you please take a few moments now to complete the questionnaire or pass it along to that person most qualified to complete it so that the questionnaire may be returned to me at the earliest. Your promptness and attention to this matter are of utmost importance to me.

Sincerely yours

Joseph J. Joseph Jr. CPA

P. S. If you have already reponded, please disregard this request.

Note: If your office doesn't use statistical sampling, please respond only to questions 1, 2, 3, 19, 20, 22 and 23.

# APPENDIX C

TABLE 23

A SUMMARY OF CRITERIA USED BY OFFICES OF SMALL FIRMS IN DECIDING TO USE STATISTICAL SAMPLING
(Amounts Expressed as Percentages)

| Response | First | Second | Third | Fourth | Fifth | Sixth | Weighted Importance | (Rank) |
|---|---|---|---|---|---|---|---|---|
| Population Size | 28.2 | 20.8 | 9.0 | 9.9 | 2.8 | 1.4 | 347.1 | ( 1) |
| Client's Size | 17.9 | 18.0 | 17.4 | 14.8 | 10.0 | 10.7 | 343.4 | ( 2) |
| Audit Evidence Validity | 13.7 | 17.3 | 10.4 | 9.2 | 13.6 | 8.6 | 275.1 | ( 3) |
| Client's Business Type | 9.6 | 12.5 | 6.9 | 15.6 | 7.9 | 8.6 | 219.6 | ( 4) |
| Audit Time | 4.8 | 9.0 | 13.2 | 14.8 | 15.1 | 12.9 | 215.1 | ( 5) |
| Auditor's Statistical Expertise | 5.5 | 6.2 | 7.6 | 9.9 | 11.5 | 13.6 | 161.6 | ( 6) |
| Audit Area | 11.0 | 5.5 | 8.3 | 0.7 | 9.3 | 4.3 | 152.6 | ( 7) |
| Numbered Accounts | 3.4 | 0.6 | 17.4 | 9.9 | 10.0 | 7.1 | 151.1 | ( 8) |
| Computerization of Client's Records | 4.1 | 9.7 | 2.8 | 6.3 | 5.7 | 20.1 | 135.4 | ( 9) |
| Audit Fee | 0.0 | 0.0 | 5.5 | 7.8 | 12.9 | 10.0 | 81.7 | (10) |
| Other | 1.3 | 0.0 | 0.7 | 0.7 | 0.7 | 2.1 | 16.8 | (11) |
| Totals | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | | |
| Total Respondents | 145 | 144 | 143 | 141 | 139 | 139 | | |

TABLE 24

A SUMMARY OF CRITERIA USED BY OFFICES OF LARGE FIRMS IN DECIDING TO USE STATISTICAL SAMPLING
(Amounts Expressed as Percentages)

| Response | First | Second | Third | Fourth | Fifth | Sixth | Weighted Importance | (Rank) |
|---|---|---|---|---|---|---|---|---|
| Population Size | 27.2 | 29.1 | 17.0 | 13.3 | 4.1 | 2.6 | 427.8 | ( 1) |
| Audit Evidence Validity | 35.8 | 16.1 | 8.9 | 11.9 | 7.0 | 2.0 | 383.2 | ( 2) |
| Audit Area | 10.8 | 10.9 | 12.1 | 14.5 | 6.1 | 7.6 | 232.1 | ( 3) |
| Client's Size | 6.8 | 12.3 | 11.8 | 7.8 | 9.1 | 9.4 | 201.7 | ( 4) |
| Audit Time | 2.8 | 6.6 | 13.2 | 15.1 | 17.3 | 16.2 | 199.7 | ( 5) |
| Computerization of Client's Records | 3.4 | 6.0 | 9.2 | 12.7 | 17.9 | 12.4 | 174.4 | ( 6) |
| Auditor's Statistical Expertise | 4.3 | 9.8 | 8.9 | 7.8 | 7.9 | 19.5 | 169.4 | ( 7) |
| Numbered Accounts | 0.5 | 3.4 | 6.0 | 6.9 | 17.6 | 12.1 | 113.2 | ( 8) |
| Client's Business Type | 1.1 | 4.0 | 10.0 | 3.7 | 7.9 | 7.6 | 102.3 | ( 9) |
| Other | 6.8 | 0.8 | 0.2 | 1.7 | 0.0 | 0.3 | 52.2 | (10) |
| Audit Fee | 0.0 | 0.5 | 2.3 | 4.0 | 4.7 | 9.7 | 43.5 | (11) |
| Totals | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | | |
| Total Respondents | 349 | 347 | 347 | 344 | 340 | 338 | | |

TABLE 25

A SUMMARY OF CRITERIA USED BY ALL OFFICES IN DECIDING TO USE STATISTICAL SAMPLING
(Amounts Expressed as Percentages)

| Response | First | Second | Third | Fourth | Fifth | Sixth | Weighted Importance | (Rank) |
|---|---|---|---|---|---|---|---|---|
| Population Size | 27.5 | 26.6 | 14.6 | 12.3 | 3.7 | 2.3 | 404.2 | ( 1) |
| Audit Evidence Validity | 29.3 | 16.5 | 9.3 | 11.1 | 8.9 | 3.9 | 351.4 | ( 2) |
| Client's Size | 10.1 | 14.0 | 13.4 | 9.9 | 9.3 | 9.8 | 243.1 | ( 3) |
| Audit Area | 10.9 | 9.3 | 11.0 | 10.5 | 7.1 | 6.7 | 208.9 | ( 4) |
| Audit Time | 3.4 | 7.3 | 13.2 | 15.0 | 16.7 | 15.3 | 204.2 | ( 5) |
| Auditor's Statistical Expertise | 4.6 | 8.7 | 8.5 | 8.4 | 8.9 | 17.8 | 167.1 | ( 6) |
| Computerization of Client's Records | 3.6 | 7.1 | 7.3 | 10.9 | 14.4 | 14.6 | 163.1 | ( 7) |
| Client's Business Type | 3.6 | 6.5 | 9.1 | 7.2 | 7.9 | 7.9 | 136.6 | ( 8) |
| Numbered Accounts | 1.4 | 2.6 | 9.3 | 7.8 | 15.4 | 10.6 | 124.4 | ( 9) |
| Audit Fee | 0.0 | 0.4 | 3.2 | 5.1 | 7.1 | 9.8 | 54.6 | (10) |
| Other | 5.2 | 0.6 | 0.4 | 1.4 | 0.2 | 0.8 | 41.8 | (11) |
| Totals | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | | |
| Total Respondents | 494 | 491 | 490 | 485 | 479 | 477 | | |

TABLE 26

A SUMMARY OF CRITERIA USED IN SETTING
LEVELS OF CONFIDENCE AND PRECISION
(Amounts Expressed as Percentages)

| ...nses | Offices of Small Firms | | | | | Offices of Large Firms | | | | | Total Offices | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | First | Second | Third | Weighted Importance | (Rank) | First | Second | Third | Weighted Importance | (Rank) | First | Second | Third | Weighted Importance | (Rank) |
| ...nal Control Check | 44.9 | 23.9 | 21.0 | 473.1 | (1) | 41.0 | 35.2 | 12.2 | 471.6 | (1) | 42.1 | 32.0 | 14.7 | 472.1 | (1) |
| ...t Area | 17.3 | 23.1 | 23.9 | 315.9 | (2) | 33.2 | 26.8 | 23.2 | 367.1 | (2) | 21.6 | 25.8 | 23.4 | 352.5 | (2) |
| ...ding Year's Audit | 8.7 | 27.5 | 15.2 | 250.7 | (4) | 7.1 | 20.8 | 18.3 | 220.3 | (3) | 7.6 | 22.7 | 17.4 | 229.0 | (3) |
| ...vidual Experience | 18.1 | 15.9 | 24.6 | 286.9 | (3) | 2.0 | 8.3 | 30.5 | 176.0 | (5) | 6.5 | 10.5 | 28.8 | 207.5 | (4) |
| ... Policy | 8.7 | 9.4 | 15.2 | 160.1 | (5) | 21.2 | 6.6 | 12.5 | 210.8 | (4) | 17.7 | 7.4 | 13.2 | 196.5 | (5) |
| ...r | 3.1 | 0.0 | 0.0 | 13.0 | (6) | 5.1 | 2.0 | 3.2 | 53.9 | (6) | 4.3 | 1.4 | 2.2 | 42.2 | (6) |
| Totals | 100.0 | 100.0 | 100.0 | | | 100.0 | 100.0 | 100.0 | | | 100.0 | 100.0 | 100.0 | | |
| ...l Respondents | 138 | 138 | 138 | | | 348 | 346 | 344 | | | 486 | 484 | 482 | | |

TABLE 27

A SUMMARY OF THE POPULATION RANGES WHERE STATISTICAL SAMPLING WAS APPLIED BY OFFICES OF SMALL FIRMS
(Amounts Expressed as Percentages)

| Responses | First | Second | Third | Fourth | Weighted Importance | (Rank) |
|---|---|---|---|---|---|---|
| 501 - 5,000 | 59.4 | 21.7 | 17.5 | 0.7 | 537.4 | (1) |
| 5,001 - 50,000 | 28.2 | 47.1 | 22.6 | 1.4 | 499.9 | (2) |
| Over 50,000 | 5.8 | 11.5 | 42.3 | 41.6 | 386.9 | (3) |
| 0 - 500 | 6.5 | 19.5 | 17.5 | 56.2 | 375.6 | (4) |
| Totals | 100.0 | 100.0 | 100.0 | 100.0 | | |
| Total Respondents | 138 | 138 | 137 | 137 | | |

TABLE 28

A SUMMARY OF THE POPULATION RANGES WHERE STATISTICAL SAMPLING WAS APPLIED BY OFFICES OF LARGE FIRMS
(Amounts Expressed as Percentages)

| Responses | First | Second | Third | Fourth | Weighted Importance | (Rank) |
|---|---|---|---|---|---|---|
| 5,001 - 50,000 | 31.1 | 51.1 | 17.1 | 0.5 | 512.6 | (1) |
| 501 - 5,000 | 41.8 | 25.2 | 32.4 | 0.0 | 507.4 | (2) |
| Over 50,000 | 18.0 | 15.4 | 36.2 | 30.4 | 421.7 | (3) |
| 0 - 500 | 9.0 | 8.1 | 14.1 | 68.9 | 358.1 | (4) |
| Totals | 100.0 | 100.0 | 100.0 | 100.0 | | |
| Total Respondents | 344 | 344 | 339 | 338 | | |

TABLE 29

A SUMMARY OF THE POPULATION RANGES WHERE STATISTICAL SAMPLING WAS APPLIED BY ALL OFFICES
(Amounts Expressed as Percentages)

| Responses | First | Second | Third | Fourth | Weighted Importance | (Rank) |
|---|---|---|---|---|---|---|
| 501 - 5,000 | 46.8 | 24.2 | 28.1 | 0.2 | 515.9 | (1) |
| 5,001 - 50,000 | 30.2 | 50.0 | 18.7 | 0.8 | 509.0 | (2) |
| Over 50,000 | 14.5 | 14.3 | 38.0 | 33.6 | 411.8 | (3) |
| 0 - 500 | 8.3 | 11.4 | 15.1 | 65.2 | 363.1 | (4) |
| Totals | 100.0 | 100.0 | 100.0 | 100.0 | | |
| Total Respondents | 482 | 482 | 476 | 475 | | |

TABLE 30

A SUMMARY OF THE STATISTICAL SAMPLING
SELECTION METHODS EMPLOYED
(Amounts Expressed as Percentages)

| ponses | Offices of Small Firms | | | | | Offices of Large Firms | | | | | Total Offices | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | First | Second | Third | Weighted Importance | (Rank) | First | Second | Third | Weighted Importance | (Rank) | First | Second | Third | Weighted Importance | (Rank) |
| ple Random | 74.6 | 15.2 | 4.4 | 541.7 | (1) | 47.1 | 22.1 | 17.9 | 465.2 | (1) | 54.9 | 20.1 | 14.1 | 487.0 | (1) |
| tematic: Single Start | 10.8 | 41.3 | 21.4 | 357.6 | (2) | 20.2 | 22.1 | 30.2 | 353.4 | (3) | 17.5 | 27.6 | 27.7 | 354.7 | (2) |
| atified | 11.5 | 25.3 | 11.1 | 240.7 | (3) | 20.8 | 34.9 | 17.3 | 369.2 | (2) | 18.1 | 32.2 | 15.5 | 332.5 | (3) |
| tematic: Multiple Start | 0.0 | 4.3 | 40.7 | 184.7 | (4) | 6.3 | 17.7 | 25.0 | 227.0 | (4) | 4.5 | 13.9 | 29.4 | 214.8 | (4) |
| ster | 1.4 | 11.5 | 22.2 | 155.5 | (5) | 0.8 | 2.3 | 8.5 | 50.9 | (5) | 1.0 | 4.9 | 12.4 | 80.8 | (5) |
| er | 1.4 | 2.1 | 0.0 | 19.5 | (6) | 4.6 | 0.5 | 0.8 | 34.1 | (6) | 3.7 | 1.0 | 0.6 | 30.0 | (6) |
| Totals | 100.0 | 100.0 | 100.0 | | | 100.0 | 100.0 | 100.0 | | | 100.0 | 100.0 | 100.0 | | |
| al Respondents | 138 | 138 | 135 | | | 346 | 343 | 340 | | | 484 | 481 | 475 | | |

TABLE 31

A SUMMARY OF THE STATISTICAL SAMPLING STEPS WHERE PROBLEMS ARE ENCOUNTERED
(Amounts Expressed as Percentages)

| onses | Offices of Small Firms | | | | | Offices of Large Firms | | | | | Total Offices | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | First | Second | Third | Weighted Importance | (Rank) | First | Second | Third | Weighted Importance | (Rank) | First | Second | Third | Weighted Importance | (Rank) |
| ning Error | 27.0 | 21.9 | 18.2 | 344.5 | (1) | 34.1 | 22.2 | 19.3 | 393.0 | (1) | 32.0 | 22.1 | 19.0 | 379.2 | (1) |
| rpreting Test Results | 21.9 | 13.8 | 21.9 | 288.3 | (2) | 19.9 | 28.0 | 26.6 | 366.2 | (2) | 20.5 | 24.0 | 25.2 | 344.1 | (2) |
| ining Test Objectives | 16.0 | 17.5 | 10.9 | 227.7 | (4) | 23.1 | 19.6 | 18.1 | 309.4 | (3) | 21.1 | 19.0 | 16.0 | 286.2 | (3) |
| stigating Errors | 16.0 | 13.1 | 28.4 | 275.9 | (3) | 8.6 | 13.8 | 16.3 | 186.8 | (4) | 10.7 | 13.6 | 19.8 | 212.2 | (4) |
| cting Sample | 14.6 | 11.6 | 8.7 | 181.0 | (5) | 9.5 | 5.7 | 4.0 | 102.5 | (5) | 10.9 | 7.4 | 5.4 | 124.7 | (5) |
| ining Universe | 1.4 | 9.4 | 7.3 | 85.4 | (7) | 3.4 | 6.6 | 4.6 | 72.7 | (6) | 2.9 | 7.4 | 5.4 | 76.3 | (6) |
| mining Sample Units | 2.1 | 12.4 | 4.3 | 92.7 | (6) | 0.2 | 2.3 | 10.2 | 54.2 | (7) | 0.8 | 5.1 | 8.5 | 65.1 | (7) |
| er | 0.7 | 0.0 | 0.0 | 4.3 | (8) | 0.8 | 1.4 | 0.5 | 14.7 | (8) | 0.8 | 1.0 | 0.4 | 11.8 | (8) |
| Totals | 100.0 | 100.0 | 100.0 | | | 100.0 | 100.0 | 100.0 | | | 100.0 | 100.0 | 100.0 | | |
| al Respondents | 137 | 137 | 137 | | | 346 | 346 | 342 | | | 483 | 483 | 479 | | |

TABLE 32

A SUMMARY OF THE AUDIT AREAS WHERE STATISTICAL SAMPLING WAS APPLIED BY OFFICES OF SMALL FIRMS
(Amounts Expressed as Percentages)

| Responses | First | Second | Third | Fourth | Fifth | Weighted Importance | (Rank) |
|---|---|---|---|---|---|---|---|
| Receivable Confirmations | 40.1 | 18.9 | 17.0 | 10.5 | 9.7 | 455.0 | (1) |
| Inventory | 13.8 | 30.6 | 20.0 | 7.5 | 13.5 | 366.1 | (2) |
| Purchase or Vouchers Test | 13.1 | 20.4 | 16.3 | 12.0 | 23.3 | 328.9 | (3) |
| Sales | 8.7 | 11.6 | 11.8 | 22.5 | 19.5 | 256.1 | (4) |
| Expenses | 3.6 | 4.3 | 17.7 | 24.0 | 11.2 | 209.6 | (5) |
| Cash | 16.0 | 4.3 | 5.1 | 5.2 | 6.7 | 168.3 | (6) |
| Payroll | 1.4 | 2.9 | 11.8 | 14.2 | 15.0 | 143.7 | (7) |
| Other | 2.9 | 6.5 | 0.0 | 3.7 | 0.7 | 63.1 | (8) |
| Totals | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | | |
| Total Respondents | 137 | 137 | 135 | 133 | 133 | | |

TABLE 33

A SUMMARY OF THE AUDIT AREAS WHERE STATISTICAL SAMPLING WAS APPLIED BY OFFICES OF LARGE FIRMS
(Amounts Expressed as Percentages)

| Responses | First | Second | Third | Fourth | Fifth | Weighted Importance | (Rank) |
|---|---|---|---|---|---|---|---|
| Receivable Confirmation | 36.8 | 19.7 | 8.0 | 13.2 | 12.1 | 416.1 | (1) |
| Purchases or Vouchers Test | 27.6 | 21.7 | 15.4 | 12.6 | 12.7 | 400.0 | (2) |
| Inventory | 12.9 | 24.6 | 16.6 | 16.0 | 12.7 | 341.0 | (3) |
| Payroll | 2.8 | 6.3 | 18.6 | 20.2 | 24.6 | 233.9 | (4) |
| Sales | 3.1 | 14.4 | 16.9 | 13.2 | 16.7 | 232.4 | (5) |
| Expenses | 5.7 | 4.0 | 14.2 | 16.6 | 12.1 | 186.0 | (6) |
| Cash | 5.7 | 5.8 | 6.2 | 6.6 | 6.3 | 121.1 | (7) |
| Other | 4.9 | 3.1 | 3.8 | 1.2 | 2.4 | 69.2 | (8) |
| Totals | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | | |
| Total Respondents | 347 | 345 | 337 | 331 | 329 | | |

TABLE 34

A SUMMARY OF THE AUDIT AREAS WHERE STATISTICAL SAMPLING WAS APPLIED BY ALL OFFICES
(Amounts Expressed as Percentages)

| Responses | First | Second | Third | Fourth | Fifth | Weighted Importance | (Rank) |
|---|---|---|---|---|---|---|---|
| Receivables Confirmation | 37.8 | 19.5 | 10.5 | 12.5 | 11.4 | 427.1 | (1) |
| Purchases or Vouchers Test | 23.5 | 21.3 | 15.6 | 12.5 | 15.8 | 379.9 | (2) |
| Inventory | 13.2 | 26.3 | 17.5 | 13.5 | 12.9 | 348.1 | (3) |
| Sales | 4.7 | 13.6 | 15.4 | 15.9 | 17.5 | 241.7 | (4) |
| Payroll | 2.4 | 5.3 | 16.7 | 18.5 | 21.8 | 208.1 | (5) |
| Expenses | 5.1 | 4.1 | 15.2 | 18.7 | 11.9 | 192.8 | (6) |
| Cash | 8.6 | 5.3 | 5.9 | 6.2 | 6.4 | 134.4 | (7) |
| Other | 4.3 | 4.1 | 2.7 | 1.9 | 1.9 | 67.4 | (8) |
| Totals | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | | |
| Total Respondents | 484 | 482 | 472 | 464 | 462 | | |

TABLE 35

A SUMMARY OF THE DISTRIBUTION BETWEEN ESTIMATING ATTRIBUTES AND ESTIMATING VARIABLES WHEN STATISTICAL SAMPLING WAS USED
(Amounts Expressed as Percentages)

| Level of Use | Offices of Small Firms | | Offices of Large Firms | | Total Offices | |
|---|---|---|---|---|---|---|
| | Attributes | Variables | Attributes | Variables | Attributes | Variables |
| 0 - 20 | 4.3 | 72.6 | 5.4 | 66.2 | 5.1 | 68.1 |
| 21 - 40 | 1.4 | 14.3 | 3.7 | 16.1 | 3.0 | 15.6 |
| 41 - 60 | 8.6 | 8.6 | 8.6 | 8.6 | 8.6 | 8.6 |
| 61 - 80 | 14.3 | 1.4 | 16.1 | 3.7 | 15.6 | 3.0 |
| 81 - 100 | 71.2 | 2.8 | 65.9 | 5.1 | 67.4 | 4.5 |
| Totals | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Means | 79.2 | 19.4 | 76.5 | 22.9 | 77.4 | 22.1 |
| Total Respondents | 139 | 139 | 347 | 347 | 486 | 486 |

TABLE 36

A SUMMARY OF THE MOST IMPORTANT CRITERIA THAT AN INCREASED USE OF STATISTICAL SAMPLING SHOULD BE BASED UPON
(Amounts Expressed as Percentages)

| ponses | Offices of Small Firms | | | | | Offices of Large Firms | | | | | Total Offices | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | First | Second | Third | Weighted Importance | (Rank) | First | Second | Third | Weighted Importance | (Rank) | First | Second | Third | Weighted Importance | (Rank) |
| reased Validity of udit Evidence | 80.4 | 12.0 | 7.0 | 571.1 | (1) | 90.5 | 3.2 | 3.2 | 572.2 | (1) | 87.5 | 5.8 | 4.3 | 572.0 | (1) |
| reased Audit Time | 12.5 | 77.3 | 8.5 | 496.0 | (2) | 5.1 | 80.9 | 12.0 | 484.0 | (2) | 7.3 | 79.8 | 11.0 | 487.5 | (2) |
| reased Audit Fee | 5.5 | 7.0 | 81.5 | 395.2 | (3) | 0.8 | 9.3 | 83.4 | 385.9 | (3) | 2.2 | 8.7 | 82.9 | 388.6 | (3) |
| er | 1.4 | 3.5 | 2.8 | 37.5 | (4) | 3.4 | 6.4 | 1.1 | 57.6 | (4) | 2.8 | 5.6 | 1.6 | 51.7 | (4) |
| Totals | 100.0 | 100.0 | 100.0 | | | 100.0 | 100.0 | 100.0 | | | 100.0 | 100.0 | 100.0 | | |
| al Respondents | 143 | 141 | 141 | | | 348 | 341 | 339 | | | 491 | 482 | 480 | | |

# APPENDIX D

TABLE 37

A SUMMARY OF THE VARIABLES AND THEIR CORRESPONDING QUESTIONNAIRE REFERENCES USED IN THE CORRELATION ANALYSIS

| Variable Number | Questionnaire Reference (Question Number) | Variable Number | Questionnaire Reference (Question Number) | Variable Number | Questionnaire Reference (Question Number) |
|---|---|---|---|---|---|
| 2 | 1 | 21 | 9.1 | 39 | 17.1 |
| 3 | 2 | 22 | 9.2 | 40 | 17.2 |
| 4 | 3.1 | 23 | 10 | 41 | 17.3 |
| 5 | 3.2 | 24 | 11 | 42 | 18.1 |
| 6 | 4.1 | 25 | 12.1 | 43 | 18.2 |
| 8 | 4.2 | 26 | 12.2 | 44 | 18.3 |
| 9 | 5.1 | 27 | 13.1 | 45 | 18.4 |
| 10 | 5.2 | 28 | 13.2 | 46 | 18.5 |
| 11 | 5.3 | 29 | 13.3 | 47 | 19 |
| 12 | 5.4 | 30 | 13.4 | 48 | 20.1 |
| 13 | 5.5 | 31 | 14.1 | 49 | 20.2 |
| 14 | 5.6 | 32 | 14.2 | 50 | 21.1 |
| 15 | 6.1 | 33 | 15.1 | 51 | 21.2 |
| 16 | 6.2 | 34 | 15.2 | 52 | 21.3 |
| 17 | 6.3 | 35 | 15.3 | 53 | 21.4 |
| 18 | 7.1 | 36 | 16.1 | 54 | 22 |
| 19 | 7.2 | 37 | 16.2 | 55 | 23 |
| 20 | 8 | 38 | 16.3 | 56 | * |

*Fifty-six is an artificial variable created to distinguish between responses from offices of small firms and offices of large firms.

TABLE 38

A SUMMARY OF THE CORRELATION MEASURES OBTAINED BY RELATING WHETHER AN OFFICE USED STATISTICAL SAMPLING ON AUDITS (VARIABLE 5) WITH ALL OTHER VARIABLES

| Variable Number | Correlation Measure | Variable Number | Correlation Measure | Variable Number | Correlation Measure |
|---|---|---|---|---|---|
| 2 | .255 | 22 | * | 40 | * |
| 3 | +.198 | 23 | .036 | 41 | * |
| 4 | +1.000 | 24 | .040 | 42 | * |
| 6 | -.033 | 25 | -.072 | 43 | * |
| 8 | * | 26 | -.094 | 44 | * |
| 9 | .092 | 27 | * | 45 | * |
| 10 | * | 28 | * | 46 | * |
| 11 | * | 29 | * | 47 | .040 |
| 12 | * | 30 | * | 48 | .035 |
| 13 | * | 31 | * | 49 | .025 |
| 14 | * | 32 | * | 50 | .066 |
| 15 | * | 33 | * | 51 | .028 |
| 16 | * | 34 | * | 52 | .042 |
| 17 | * | 35 | * | 53 | * |
| 18 | .080 | 36 | * | 54 | -.040 |
| 19 | .102 | 37 | * | 55 | * |
| 20 | .091 | 38 | * | 56 | +.430 |
| 21 | -.098 | 39 | * | | |

*When a chi-square test at the .05 level of significance established no relationship between the variable pairs, no correlation measure was calculated. Hereafter, an asterisk (*) appearing in correlation measure tables will indicate no interrelationship between paired variables.

TABLE 39

A SUMMARY OF THE CORRELATION MEASURES OBTAINED BY RELATING THE PERCENTAGE LEVEL OF USE OF STATISTICAL SAMPLING ON AUDITS DURING THE PREVIOUS YEAR (VARIABLE 4) WITH ALL OTHER VARIABLES

| Variable Number | Correlation Measure | Variable Number | Correlation Measure | Variable Number | Correlation Measure |
|---|---|---|---|---|---|
| 2 | .111 | 22 | +.133 | 40 | .163 |
| 3 | +.265 | 23 | .150 | 41 | * |
| 5 | +1.000 | 24 | .189 | 42 | .223 |
| 6 | -.327 | 25 | -.194 | 43 | .184 |
| 8 | -.108 | 26 | -.199 | 44 | .088 |
| 9 | .243 | 27 | -.104 | 45 | .180 |
| 10 | .145 | 28 | -.054 | 46 | .206 |
| 11 | .229 | 29 | -.105 | 47 | .063 |
| 12 | .211 | 30 | * | 48 | .042 |
| 13 | .137 | 31 | -.085 | 49 | .035 |
| 14 | .098 | 32 | +.139 | 50 | .265 |
| 15 | .065 | 33 | .145 | 51 | .196 |
| 16 | .093 | 34 | * | 52 | .203 |
| 17 | * | 35 | .160 | 53 | .161 |
| 18 | .421 | 36 | .097 | 54 | -.164 |
| 19 | .199 | 37 | .174 | 55 | * |
| 20 | .220 | 38 | .127 | 56 | +.347 |
| 21 | -.179 | 39 | .102 | | |

*For explanation see Table 38.

TABLE 40

A SUMMARY OF THE CORRELATION MEASURES OBTAINED BY RELATING WHETHER THE RESPONSE CAME FROM THE OFFICE OF A SMALL FIRM OR THE OFFICE OF A LARGE FIRM (VARIABLE 56) WITH ALL OTHER VARIABLES

| Variable Number | Correlation Measure | Variable Number | Correlation Measure | Variable Number | Correlation Measure |
|---|---|---|---|---|---|
| 2 | .117 | 21 | * | 39 | .046 |
| 3 | +.717 | 22 | * | 40 | .127 |
| 4 | +.347 | 23 | .499 | 41 | .065 |
| 5 | +.430 | 24 | .443 | 42 | .128 |
| 6 | -.588 | 25 | * | 43 | * |
| 8 | -.247 | 26 | * | 44 | .049 |
| 9 | .208 | 27 | -.078 | 45 | .056 |
| 10 | .080 | 28 | -.054 | 46 | * |
| 11 | .102 | 29 | -.044 | 47 | .111 |
| 12 | .183 | 30 | -.035 | 48 | .239 |
| 13 | .101 | 31 | -.056 | 49 | .240 |
| 14 | .060 | 32 | +.052 | 50 | .248 |
| 15 | .091 | 33 | .211 | 51 | .100 |
| 16 | .068 | 34 | .051 | 52 | .197 |
| 17 | * | 35 | * | 53 | .085 |
| 18 | .561 | 36 | .139 | 54 | -.175 |
| 19 | .472 | 37 | .200 | 55 | * |
| 20 | .461 | 38 | .171 | | |

*For explanation see Table 38.

TABLE 41

A SUMMARY OF THE CORRELATION MEASURES OBTAINED BY RELATING THE AUDIT STAFF SIZE OF EACH OFFICE (VARIABLE 3) WITH ALL OTHER VARIABLES

| Variable Number | Correlation Measure | Variable Number | Correlation Measure | Variable Number | Correlation Measure |
|---|---|---|---|---|---|
| 2 | .048 | 22 | +.054 | 40 | .104 |
| 4 | +.265 | 23 | .552 | 41 | .169 |
| 5 | +.198 | 24 | .469 | 42 | .184 |
| 6 | -.369 | 25 | * | 43 | .162 |
| 8 | -.151 | 26 | -.091 | 44 | .093 |
| 9 | .218 | 27 | -.217 | 45 | .150 |
| 10 | .178 | 28 | -.099 | 46 | .066 |
| 11 | .128 | 29 | -.135 | 47 | * |
| 12 | .247 | 30 | * | 48 | .128 |
| 13 | .134 | 31 | -.108 | 49 | .129 |
| 14 | .114 | 32 | +.113 | 50 | .138 |
| 15 | .042 | 33 | .186 | 51 | .097 |
| 16 | .049 | 34 | .121 | 52 | .090 |
| 17 | .100 | 35 | .106 | 53 | .080 |
| 18 | .457 | 36 | .172 | 54 | -.106 |
| 19 | .485 | 37 | .107 | 55 | .052 |
| 20 | .478 | 38 | .097 | 56 | +.717 |
| 21 | -.057 | 39 | .109 | | |

*For explanation see Table 38.

TABLE 42

A SUMMARY OF THE CORRELATION MEASURES OBTAINED BY RELATING EACH RESPONDENT'S POSITION WITHIN HIS FIRM (VARIABLE 54) WITH ALL OTHER VARIABLES

| Variable Number | Correlation Measure | Variable Number | Correlation Measure | Variable Number | Correlation Measure |
|---|---|---|---|---|---|
| 2 | .040 | 21 | +.074 | 39 | * |
| 3 | -.106 | 22 | -.074 | 40 | .142 |
| 4 | -.164 | 23 | .086 | 41 | .055 |
| 5 | -.040 | 24 | .055 | 42 | .148 |
| 6 | +.195 | 25 | +.039 | 43 | .081 |
| 8 | +.354 | 26 | +.046 | 44 | .053 |
| 9 | .128 | 27 | +.070 | 45 | .107 |
| 10 | .066 | 28 | * | 46 | .098 |
| 11 | .114 | 29 | +.069 | 47 | .031 |
| 12 | .090 | 30 | * | 48 | .076 |
| 13 | .065 | 31 | +.103 | 49 | .083 |
| 14 | .041 | 32 | -.092 | 50 | .121 |
| 15 | .058 | 33 | .079 | 51 | * |
| 16 | .035 | 34 | * | 52 | .107 |
| 17 | .065 | 35 | * | 53 | * |
| 18 | .114 | 36 | .042 | 55 | * |
| 19 | .126 | 37 | .042 | 56 | -.175 |
| 20 | .109 | 38 | .082 | | |

*For explanation see Table 38.

TABLE 43

A SUMMARY OF THE CORRELATION MEASURES OBTAINED BY PAIRING THE VARIABLES FOR QUESTIONS 1, 16, AND 19

| Variable Pairs | Correlation Measure | Variable Pairs | Correlation Measure |
|---|---|---|---|
| 2, 15 | .162 | 15, 47 | .123 |
| 2, 16 | .121 | 16, 47 | .159 |
| 2, 17 | .033 | 17, 47 | * |
| 2, 47 | .563 | | |

*For explanation see Table 38.

TABLE 44

A SUMMARY OF THE CORRELATION MEASURES OBTAINED BY PAIRING THE VARIABLES FOR QUESTIONS 12 AND 13

| Variable Pairs | Correlation Measure | Variable Pairs | Correlation Measure |
|---|---|---|---|
| 25, 27 | .584 | 26, 27 | .539 |
| 25, 28 | .309 | 26, 28 | .297 |
| 25, 29 | .498 | 26, 29 | .374 |
| 25, 30 | .288 | 26, 30 | .395 |

TABLE 45

A SUMMARY OF THE CORRELATION MEASURES OBTAINED BY PAIRING THE VARIABLES FOR QUESTIONS 14 and 15

| Variable Pairs | Correlation Measure | Variable Pairs | Correlation Measure |
|---|---|---|---|
| 31, 32 | -.594 | 32, 33 | .214 |
| 31, 33 | .170 | 32, 34 | .108 |
| 31, 34 | .083 | 32, 35 | .242 |
| 31, 35 | .111 | | |

TABLE 46

A SUMMARY OF THE CORRELATION MEASURES OBTAINED BY PAIRING THE VARIABLES FOR QUESTIONS 13, 16, 17, AND 18

| Variable Pairs | Correlation Measure | Variable Pairs | Correlation Measure | Variable Pairs | Correlation Measure | Variable Pairs | Correlation Measure |
|---|---|---|---|---|---|---|---|
| 27, 36 | .100 | 30, 39 | * | 30, 45 | * | 38, 42 | .068 |
| 27, 37 | .066 | 30, 40 | * | 30, 46 | * | 38, 43 | .227 |
| 27, 38 | .121 | 30, 41 | * | 36, 39 | .262 | 38, 44 | .059 |
| 28, 36 | * | 27, 42 | .128 | 36, 40 | * | 38, 45 | .055 |
| 28, 37 | .077 | 27, 43 | .092 | 36, 41 | .155 | 38, 46 | .216 |
| 28, 38 | * | 27, 44 | .118 | 37, 39 | .098 | 39, 42 | * |
| 29, 36 | .105 | 27, 45 | .071 | 37, 40 | .248 | 39, 43 | .112 |
| 29, 37 | .059 | 27, 46 | .082 | 37, 41 | .094 | 39, 44 | .111 |
| 29, 38 | .145 | 28, 42 | * | 38, 39 | .185 | 39, 45 | .133 |
| 30, 36 | * | 28, 43 | * | 38, 40 | .045 | 39, 46 | .149 |
| 30, 37 | * | 28, 44 | .049 | 38, 41 | .056 | 40, 42 | .114 |
| 30, 38 | * | 28, 45 | .059 | 36, 42 | .111 | 40, 43 | .104 |
| 27, 39 | .053 | 28, 46 | .075 | 36, 43 | .090 | 40, 44 | .088 |
| 27, 40 | .051 | 29, 42 | .100 | 36, 44 | .096 | 40, 45 | .051 |
| 27, 41 | .101 | 29, 43 | .136 | 36, 45 | .112 | 40, 46 | * |
| 28, 39 | .050 | 29, 44 | .041 | 36, 46 | .071 | 41, 42 | .044 |
| 28, 40 | .052 | 29, 45 | .089 | 37, 42 | .082 | 41, 43 | .093 |
| 28, 41 | .049 | 28, 46 | * | 37, 43 | .109 | 41, 44 | .076 |
| 29, 39 | * | 30, 42 | * | 37, 44 | .165 | 41, 45 | .072 |
| 29, 40 | * | 30, 43 | .069 | 37, 45 | .098 | 41, 46 | * |
| 29, 41 | * | 30, 44 | * | 37, 46 | * | | |

*For explanation see Table 38.

TABLE 47

A SUMMARY OF THE CORRELATION MEASURES OBTAINED BY PAIRING THE VARIABLES FOR QUESTIONS 20 AND 21

| Variable Pairs | Correlation Measure | Variable Pairs | Correlation Measure |
|---|---|---|---|
| 48, 50 | * | 49, 50 | * |
| 48, 51 | * | 49, 51 | * |
| 48, 52 | * | 49, 52 | * |
| 48, 53 | .024 | 49, 53 | .023 |

*For explanation see Table 38.

TABLE 48

A SUMMARY OF THE CORRELATION MEASURES OBTAINED BY PAIRING THE VARIABLES FOR QUESTIONS 4 AND 5

| Variable Pairs | Correlation Measure | Variable Pairs | Correlation Measure |
|---|---|---|---|
| 6, 8 | -.772 | 8, 9 | .164 |
| 6, 9 | .233 | 8, 10 | .119 |
| 6, 10 | .139 | 8, 11 | .174 |
| 6, 11 | .158 | 8, 12 | .087 |
| 6, 12 | .117 | 8, 13 | .065 |
| 6, 13 | .142 | 8, 14 | .061 |
| 6, 14 | .146 | | |