

# Statistical Auditing

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# Statistical Auditing

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# Foreword

This book is for auditors who want to use statistical sampling. Even a scanning of it should convince many auditors that statistical sampling is as specialized an audit tool as the computer and also that it holds nearly as much promise for enhancing audit practice. Both statistical sampling and the computer require improved audit planning and a more thorough understanding of the objectives of audit tests. However, until now, there has not been an understandable and comprehensive explanation of statistical sampling in auditing comparable to material available on the computer.

The book covers the array of statistical techniques available to the auditor thoroughly, yet understandably, and explains what they are, the assumptions on which they are based, and in what circumstances they should be used. Some statistical techniques—such as dollar unit sampling, discovery sampling, or difference estimation—have been touted as ideally suited to the needs of auditors. This book makes clear that no sampling plan is superior in every situation. More important, it explains the considerations that should determine the auditor's choice of a particular sampling plan.

The book provides practical ideas on incorporating statistical sampling into audit practice. Advice is given on establishing firm-wide policies, conducting training programs, and documenting and reviewing statistical applications. Often, valid application of statistical sampling in auditing requires specialized knowledge that exceeds the practical knowledge and skills of a staff auditor; this book will increase recognition of that. However, it will also provide the basis for a CPA firm to develop and implement the specialization required for efficient and effective use of statistical sampling in its practice.

Manual application of statistical sampling is often expensive, tedious, and time-consuming—disadvantages that usually offset the expected advantages of statistical sampling. This book not only recognizes the importance of the computer to effective and efficient application of statistical sampling, but supplies useful computer programs as well.

Finally, although some progress has been made in relating statistical tests to audit judgments, this book is more comprehensive in this area. Statistical tests often provide only part of the audit evidence for a particular account or class of transactions and never provide more than a portion of the evidence supporting an opinion on financial statements. This book offers many suggestions for integrating statistical tests with other audit tests and relating statistical judgments to other audit judgments.

Auditors have long needed a practical and knowledgeable explanation of statistical applications in auditing. Most discussions about statistics in auditing are either simplified introductions without enough detail to permit direct application or esoteric

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dissertations filled with statistical jargon and complex formulas. This book is neither simplistic nor esoteric; it provides a systematic approach to audit planning that includes statistics as an important tool.

Douglas R. Carmichael

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# Preface

The purpose of this book is to help the auditor use statistical sampling in audit practice. Statistical techniques currently being used in practice are discussed together with some suggestions concerning how and when each may be implemented. The major topic addressed is the integration of statistical sampling into the auditing process.

Although a brief review is provided, the reader is expected to be familiar with the basic concepts of statistical sampling. The exposition is directed to auditors who already know something about commonly used statistical techniques and want to incorporate them into an audit practice.

The necessary background in statistical concepts may have been acquired in a variety of ways: the programmed instruction series published by the AICPA, college coursework, or programs available through organizations such as the Institute of Internal Auditors, the state societies of CPAs, or one of the CPA firms. However, those persons whose backgrounds consist of self-instruction would benefit from discussion with others who have had some experience in using statistical techniques in auditing.

The first chapter discusses the audit process from the point of view of the auditor who wishes to limit audit risk and, thus, demonstrates the *role* of statistical sampling. Chapters 2 through 6 summarize the basic statistical concepts and techniques that are currently used in statistical auditing. Chapter 7 suggests procedures that might be used in integrating these techniques into the auditing process in order to limit the risk caused by observing only a sample. Chapter 8 illustrates those procedures by means of an extended case study, and chapter 9 describes the set of computer programs that assist the auditor in planning, selecting, and evaluating statistical samples. Finally, the problems of training and implementation are discussed in chapter 10.

Preparation of this book began after publication of the six-volume series, *An Auditor's Approach to Statistical Sampling*. The first five volumes of that series are programmed texts treating the basic statistical techniques; volume 6 is a field manual that illustrates, by means of case studies, tables, and time sharing computer programs, how these techniques can be applied. While these books serve the useful purpose of introducing basic statistical concepts, it was felt that something more would be needed if a practice unit were to decide that statistical sampling should be used in audit engagements.

I began work on this book in June 1974 at the AICPA in New York where I spent a delightful year as a research associate on the staff of the auditing standards division. I received much help and encouragement from my colleagues, especially Douglas R. Carmichael. Throughout the writing process, members of the Statistical Sampling Subcommittee have been active collaborators. Their suggestions and criticisms have helped to improve the book, and I wish to express my deep gratitude for their efforts.

Nevertheless, I accept the responsibility for the final product. Many subcommittee members have strongly suggested that the present level of exposition is not suitable for the majority of practitioners. I acknowledge that charge and offer in defense the plea that the subject matter is complex and attempts to make it appear simple would be dangerous. The danger is that simple solutions to complex problems are often inappropriate.

It is hoped that the reader will find some suggestions that can be put into immediate practice and others that will require thought and considerable modification before they can be implemented. The issues discussed are important for the practitioner who wants to improve usage of statistical techniques.

A special note of thanks is due to the members of the subcommittee—past and present—who gave so much of their time and effort to this project. I want to acknowledge especially the efforts of Robert B. Ilderton, who wrote all the time sharing computer programs in chapter 9; Carmen Spinelli, who is responsible for both the CPA-1 and CPA-2 programs; COMSHARE, INC., which donated computer time during the development of the program; James Kusko, who read all the early drafts and made many valuable suggestions; James K. Loebbecke, who was chairman of the subcommittee during most of the process and who personally contributed much to the book; and Robert K. Elliott, the present chairman, who thoroughly reviewed a final draft and offered many excellent suggestions.

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D.R.

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# 1

## Statistical Sampling in the Audit Process

Statistics has been defined as “a body of methods for making wise decisions in the face of uncertainty.”<sup>1</sup> Similarly, statistical auditing could be defined as a body of methods for making wise auditing decisions in the face of uncertainty. At first glance such a definition appears pretentious: After all, auditors have made wise decisions for years without the aid of statistical sampling. What, then, does statistics offer the auditor?

Roughly speaking, statistical sampling helps answer one of the auditor’s three key questions concerning the nature, extent, and timing of his audit procedures. The auditor can determine the *extent* of testing more objectively when using statistical sampling in tests of details rather than judgmental samples. That is not to say that statistical sampling replaces the auditor’s judgment. Rather, statistical sampling allows the auditor to exercise judgment relative to the amount of sampling risk that can be borne and to express that sampling risk quantitatively.

The problem of controlling the sampling risk that an incorrect conclusion will be reached because only a sample has been examined has been extensively studied only when a single audit procedure is considered. However, some technical statistical problems remain unresolved. These pertain to which statistical techniques may be validly used in a particular set of circumstances. Both theoretical and empirical research studies have contributed to improving the statistical techniques the auditor may use.

Auditing is a very complex process in which the auditor uses many sources of evidence—some statistical and some nonstatistical. There are strong interrelationships among the many audit procedures requiring the auditor who wishes to use them to integrate statistical tests into the general audit process.

While controlling the sampling risk for a single audit test is important, it is an even greater challenge to control the sampling risk for audit tests considered as a whole. Doing this requires careful planning of the audit program, including nonstatistical

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1. See Wallis and Roberts [22], page 3.

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as well as statistical procedures. It requires the auditor to think statistically—not to be a statistician, but to understand thoroughly the concepts of sampling risk and be able to apply them creatively.

The goal of this book is to help the auditor achieve that understanding. To do this the auditor needs to grapple with some difficult problems, among the most difficult of which are those that require quantification of some aspects of professional judgment. For example, what is the quantifiable likelihood that a particular set of accounting controls would prevent or detect a particular type of error?

Many auditors feel uncomfortable with the prospect of attaching numbers to these kinds of judgments; assigning a number may create a false sense of exactness.

Such an attitude is understandable. However, quantification merely makes explicit that which has always been implicit. With or without statistical sampling, the auditor has determined the extent of his tests of details, the timing of the auditing procedures, and the nature of those procedures. Consequently, an expression of some judgments on a numerical scale does not entail procedures different from those normally required—only that judgments be rendered explicitly.

Using numbers to reflect professional judgment improves an auditor's ability to communicate examination results to others. The auditor called upon to defend procedures can demonstrate their rationality and consistency. The numbers are the result of a reasoned process—the auditor's examination and evaluation. For example, while different auditors examining the same evidence may use different numerical assignments, their results would ordinarily exhibit strong similarities. Thus, if both use a numerical scale to express the maximum possible reliance, both would probably assign a low number to a weak system of internal control and a high number to a strong system.

The attitude expressed in this book is that attempting to quantify certain judgments is worthwhile as long as the inexactness of the resulting numbers is recognized. To place the role of sampling risk into perspective, the following discussion focuses on the basic audit process and the problems of developing an audit strategy. The purposes of this discussion are to demonstrate the role that sampling plays in the auditor's audit program and to highlight the relative contribution of sampling risk to overall risk.

### The Basic Audit Process

The auditor uses many techniques in addition to statistical sampling to gather the evidential matter on which to base a professional opinion. The portions of the audit process that are relevant to that decision to use statistical sampling are the following:

1. System review and preliminary evaluation of internal accounting control.
2. Audit program design.
3. Application of the audit procedures, evaluation of the evidential matter, and refinement of the audit program as required.

#### System Review

Statistical sampling is not used to review the system of internal accounting control. However, the results of the system review and preliminary evaluation directly affect the auditor's decision to use statistical sampling in his tests of details. From

the system review, the auditor obtains detailed information concerning the procedures and methods prescribed to achieve internal accounting control. The preliminary evaluation of the system of internal accounting control is made on the basis of this review and consequently is a conditional evaluation that assumes satisfactory compliance.

Section 320 of Statement on Auditing Standards (SAS) no. 1 describes the auditor's study and evaluation of internal control, and SAS no. 3 considers how electronic data processing affects it. To obtain maximum benefits from this book, the reader should be familiar with those professional pronouncements. Unless otherwise indicated, section numbers cited throughout the book refer to SAS no. 1.

### Audit Program Design

The next phase of the basic audit process is to design a tentative audit program. The tentative audit program specifies, in detail, the set of audit procedures to be used to satisfy the third standard of field work concerning the sufficiency and competence of evidential matter. As section 320.70 states,

The evidential matter required by the third standard is obtained through two general classes of auditing procedures: (a) tests of details of transactions and balances and (b) analytical review of significant ratios and trends and resulting investigation of unusual fluctuations and questionable items. These procedures are referred to . . . as "substantive tests."

In addition to specifying the substantive audit procedures, the auditor specifies the compliance tests to be conducted. As section 320.55 indicates, compliance tests are necessary when the prescribed internal control procedures are to be relied upon in determining the nature, timing, or extent of substantive tests, but are unnecessary otherwise.

*Audit Risk.* Uncertainty is inherent in auditing. Indeed, the general purpose of auditing procedures is to reduce the auditor's uncertainty to a tolerable level.<sup>2</sup> The risk the auditor faces is that material errors or irregularities, if they exist, will not be detected. The auditor is responsible for controlling this risk and exercises control by determining the nature, extent, and timing of his substantive procedures.

A major portion of the auditor's tentative decisions concerning the nature, extent, and timing of his substantive procedures depend upon his preliminary evaluation of the system of internal control. During the review of the system, the auditor considers the type of errors and irregularities that could occur and the accounting control procedures that should prevent or detect such errors and irregularities.<sup>3</sup> The preliminary evaluation reflects his assessment of the likelihood that each type of error or irregularity could occur in a material amount.<sup>4</sup> As a working hypothesis, his assessment assumes satisfactory compliance with the prescribed internal control procedures that he considers pertinent. Pertinent procedures are defined in section 320B.15 as

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2. Section 330.10 states: "In the great majority of cases, the auditor finds it necessary to rely on evidence that is persuasive rather than convincing. Both the individual assertions in financial statements and the overall proposition that the financial statements as a whole present fairly, in conformity with generally accepted accounting principles, the financial position, results of operations, and changes in financial position are of such a nature that even an experienced auditor is seldom convinced beyond all doubt with respect to all aspects of the statements being examined."

3. Section 320.65.

4. Throughout this book the term *likelihood* is used to designate a probability that is subjectively determined.

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“those which, if not purported to be in use, would have affected adversely the auditor’s preliminary evaluation of the system prior to his tests of compliance.”

The auditor’s effort to reduce the risk of not detecting a material amount of error depends on an assessment of the likelihood that material errors could occur in the accounting process. The risk levels of the planned substantive tests are based on this assessment. When the auditor decides not to rely on the system, he determines the nature, extent, and timing of the substantive tests so that they alone achieve a tolerably low risk of failing to detect a material error. As reliance on the system increases, the tolerable risk that the substantive tests would fail to detect a material error is allowed to increase. This increased risk is justified whenever the planned reliance is appropriate. When the auditor relies on the system to a greater extent than he would if he knew the true effectiveness of the pertinent procedures, the risk of missing a material error is higher than is appropriate. The risk that the auditor relies on the system to a greater extent than he would if he had complete knowledge is called here the *risk of unwarranted reliance*.

Unwarranted reliance may occur when the auditor overrates the strength of the system of internal accounting control. This may happen when preliminary assessment of the likelihood that material errors could occur is too low or when tests of compliance with pertinent procedures incorrectly indicate that compliance is satisfactory. Although unwarranted reliance is not explicitly mentioned in section 320, it is implicitly recognized there. For instance, the risk that the preliminary assessment of the likelihood of material error is too low depends on both the auditor’s judgment and the actual risk that material errors will occur in the accounting process.

Viewed in this way, the auditor’s risk of not detecting a material error can be controlled only if he controls both the risk that substantive tests fail to detect a material amount of error and the risk of unwarranted reliance on the system of internal accounting controls.

Statistical sampling pertains only to one aspect of the total audit risk. This is the possibility that audit procedures—both compliance and substantive—restricted to a sample of details of transactions or balances might produce results that are different from those produced when the procedures are applied in the same way to all the details. This aspect, known as *sampling risk*, can be objectively measured and controlled when statistical sampling is used to determine the extent of the application of audit procedures. Thus, sampling risk is a function of how much evidential matter the auditor obtains during the audit.

The other aspect of risk is a function of the competence of evidential matter. It involves the possibility that applying the procedures to all details of the transactions or balances might fail to detect a material error that occurs or fail to reveal compliance deviations that would influence the auditor’s evaluation of the system of internal control. This aspect is known as the *nonsampling risk*, and it is attributable to the nature of the audit procedures, the timing of the procedures, the system being examined, and the skill and care of the auditor. Controlling this nonsampling risk is very important and should be carefully considered by the auditor in determining the nature and timing of the auditing procedures.

The distinction between the two aspects of risk is recognized in section 320A.17, which states:

The competence of evidential matter as 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. In a strict sense, the statistical evaluation relates only to the probability that items having certain characteristics in terms of monetary amounts,

quantities, errors, or other features of interest will be included in the sample—not the auditor’s treatment of such items. Consequently, the use of statistical sampling does not directly affect the auditor’s decisions as to the auditing procedures to be performed, the acceptability of the evidential matter obtained with respect to individual items in the sample, or the action which might be taken in the light of the nature and cause of particular errors.

Design of the audit program entails considering control over each aspect of audit risk—both sampling risk and nonsampling risk—in both the substantive tests as well as any compliance tests. For each type of test, the risk attributable to sampling may be considered as an additional risk over and above the nonsampling risk. As an approximation, the auditor may regard his total risk as being the *sum* of the two risks.

For example, an auditor may examine a sample of sales orders to determine whether credit sales are being approved as required. When the only evidence that an order was properly approved is the presence of an authorized signature, there is some risk that the sale was not, in fact, approved for credit even though a signature exists. The auditor’s risk of incorrectly deciding that sales have been properly approved for credit is approximately the sum of the risk that credit was not approved even though a signature exists (nonsampling risk) plus the risk that the sample incorrectly indicates the appropriate signatures are present on the sales orders not included in the sample (sampling risk).

A result of both sampling and nonsampling aspects of audit risk is that the auditor can never reduce audit risk to a lower level than the nonsampling risk. Consequently, unless the audit procedures have a nonsampling risk well below a tolerable level of audit risk, neither statistical nor nonstatistical sampling will be particularly helpful.

*Compliance Tests.* Section 320.55 says, “The purpose of tests of compliance is to provide reasonable assurance that the accounting control procedures are being applied as described.” Accounting control procedures may be divided into two categories—those that leave an audit trail of documentary evidence and those that leave no trail. Controls in the first category can be tested by using statistical sampling, while those in the second, of necessity, are tested by nonstatistical means—inquiry and observation.

Controls from either category are grouped according to the type of error or irregularity each is designed to prevent or detect. As section 320B.20 says:

In some situations, the primary control against a particular type of error or irregularity may be provided by a single procedure or a set of related procedures; in others, auxiliary control that is overlapping or to some degree duplicative may be provided by another procedure or set of related procedures. In either situation, a set of two or more procedures necessary for a single purpose should be regarded as a single procedure. . . .

The auditor’s compliance tests of the pertinent procedures are designed to ascertain whether the preliminary evaluation is warranted. For those pertinent control procedures or sets of control procedures that leave no audit trail of evidence, the auditor’s professional judgment is the basic determinant of the amount and kind of evidence required to provide the “reasonable assurance.” Some risk that compliance is not as good as it appears always exists, and if the potential for management override is significant, this risk may be large. The possibility that compliance is less than the auditor tentatively expects directly contributes to the risk of unwarranted reliance. Consequently, the auditor needs to be cautious in evaluating the likelihood of the



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occurrence of a material error or irregularity because noncompliance with those pertinent controls may leave no audit trail of evidence.

Those pertinent accounting controls or sets of controls that leave an audit trail can be tested using a statistical sample. As previously stated, using a sample to test compliance introduces an additional source of risk. For a compliance test, this is the sampling risk that by restricting the procedures to a sample of the transactions, the auditor may decide compliance is satisfactory when, in fact, were every transaction to be examined, it would be discovered that compliance is not satisfactory. The risk of unwarranted reliance is approximately equal to the sampling risk of incorrectly deciding that compliance is satisfactory plus the nonsampling risk that the procedures used by the auditor might fail to detect noncompliance. This relationship between sampling and nonsampling risks is true whether the sampling process is statistical or judgmental. Statistical procedures allow the auditor to measure and hence control the sampling risk.

While there is a need to control the sampling risk of statistical compliance tests, it should be done in the broader context of controlling all aspects of the risk of unwarranted reliance. In determining whether the auditor's reliance is warranted, the audit procedures employed may be far more important than the sample size. The relative importance of the procedures is recognized in section 320B.16, which states:

In addition to the statistical evaluation of the quantitative significance of deviations from pertinent procedures, consideration should be given to the qualitative aspects of the deviations. These include (a) the nature and cause of errors, such as whether they are errors in principle or in application, are deliberate or unintentional, are due to misunderstanding of instructions or to careless compliance, and the like and (b) the possible relationship of errors to other phases of the audit.

Performing a thorough error analysis on each observed compliance deviation may be far more informative to the auditor than any quantitative projections that may be obtained from a sample.

The objective of a statistical compliance test is to determine the reasonableness of the auditor's assumption of satisfactory compliance that derived from preliminary evaluation of the system of internal accounting control. His assessment of the likelihood that material amounts of errors or irregularities could occur and remain undetected assumed that compliance was satisfactory. When statistical sampling is used to test compliance, the range or rates of compliance deviation that constitute "satisfactory compliance" needs to be made explicit. How does the auditor do this? There is no completely satisfactory answer, but the following remarks may be helpful.

*Compliance Deviation.* Following the conceptual approach described in section 320.65, the auditor identifies the set of prevention and detection controls that have been designed to prevent or detect and correct each major type of error or irregularity. Assuming that no compliance deviations occurred, the auditor might first consider the likelihood that a material amount of error *could* occur and remain undetected within the particular account balance or set of transactions. Unless this likelihood is judged to be small, the auditor would not contemplate relying on the particular controls, and no further tests for compliance would be required.

Having established the likelihood assuming no compliance deviations as a benchmark, the auditor might then assess the effect of increasing the rate of non-compliance for those controls that leave an audit trail of evidence. This step is, of course, very difficult because it involves relating compliance deviation rates to monetary error rates. How to accomplish this is a large, unresolved problem, and the suggestions made here are offered only as tentative first steps.