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Toward Standards for Statistical Sampling

Kenneth W. Stringer

Haskins & Sells

I am always glad to have an opportunity to discuss statistical sampling, which is one of my favorite subjects. I am particularly pleased to be able to do so at the invitation of Howard Stettler because my interest in the subject was first stimulated by reading his article in *The Journal of Accountancy* in January 1954. At that point I became convinced that statistical sampling is the most rational means for determining the extent of audit tests of details of transactions and account balances. Extensive study and experience in implementation of statistical sampling in our Firm's audit practice in the intervening years has strengthened that conviction.

Although the use of statistical sampling in the profession has not progressed as rapidly as I have considered desirable, I think it is fair to say that interest in the subject is increasing currently. This observation is based on discussions with interested parties in various firms concerning the extent of their current studies and/or applications. The reasons why progress in the meantime has been more evolutionary than revolutionary are understandable, and have involved both statistical and auditing problems. The statistical problems have included the general unfamiliarity of auditors with statistical methods, and technical questions concerning the applicability of certain statistical methods to auditing situations. The auditing problems have related primarily to defining and expressing audit objectives in terms susceptible to statistical measurement, and to the difficulty of combining statistical and subjective evaluations of audit evidence in forming overall conclusions.

Because the auditing problems are equally or more difficult and also are more appropriate for my assigned topic, I will confine my discussion today to them. For this purpose I will review first the evolution of present AICPA literature concerning statistical sampling, and second the current consideration being given to the expansion of that literature.

Present Literature

The first official AICPA literature on statistical sampling was a special report of its Committee on Statistical Sampling, which was published in *The Journal of Accountancy* in February 1962. Although this report was quite general in its coverage, it was the result of extensive deliberations by the Committee and established two landmark positions. First, it stated that:

The Committee is of the opinion that the use of statistical sampling is permitted under generally accepted auditing standards.

The second position was expressed as follows:

Although statistical sampling furnishes the auditor a measure of precision and reliability, statistical techniques do not define for the auditor the values of each required to provide audit satisfaction.

Specification of the precision and reliability necessary in a given test is an auditing function and must be based upon judgment in the same way as is the decision as to audit satisfaction required when statistical sampling is not used.

The next reference to statistical sampling in AICPA literature was in Statement on Auditing Procedure No. 33, issued in December 1963, which included the following comment:

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.

The use of expressions such as "might consider using" and "statistical measurements . . . which . . . *may not* otherwise be available" (emphasis added) suggests that the Committee on Auditing Procedure was perhaps neither as enthusiastic nor as knowledgeable as the Sampling Committee. However, the foregoing excerpt did represent an advance in authoritative recognition because the Committee on Auditing Procedure is senior to the Committee on Statistical Sampling in the AICPA committee structure.

The next pronouncement was a report by the Committee on Statistical Sampling that appeared in *The Journal of Accountancy* in July 1964.

In line with the position taken in the preceding pronouncements, that report stated that the use of statistical sampling ". . . is permissive rather than mandatory under generally accepted auditing standards."

As indicated in the introduction of that report, it was 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.

The purpose as stated in this excerpt was in response to some of the principal questions that were being discussed among those interested in statistical sampling at that time. For example, there were differing views as to what auditing considerations were relevant to precision and reliability, respectively, and as to whether—and if so how—internal control should be considered.

As to the first of the questions referred to above, the Committee stated that:

Although "precision" and "reliability" are statistically inseparable,

the Committee believes that one of the ways in which these measurements can be usefully adapted to the auditor's purposes is by relating precision to materiality and reliability to the reasonableness of the basis for this opinion.

Further discussion of this concept and its relation to internal control will be presented later in this paper.

The next AICPA pronouncement involving statistical sampling was Statement on Auditing Procedure No. 36 issued in August 1966 by the Committee on Auditing Procedure. This Statement was concerned primarily with the auditing implications of the use of statistical sampling by clients in lieu of taking complete physical inventories. Pertinent excerpts from this Statement follow:

In recent years some companies have developed inventory controls or methods of determining inventories, including statistical sampling, of sufficient reliability to make an annual physical count of each item of inventory unnecessary in certain instances. The purpose of this Statement is to recognize this development. . . . If statistical sampling methods are used by the client in the taking of the physical inventory, the independent auditor must be satisfied that the sampling plan has statistical validity, that it has been properly applied, and that the resulting precision and reliability, as defined statistically, are reasonable in the circumstances.

The latest stage in evolution of the AICPA's position concerning statistical sampling did not result in the issuance of a pronouncement, but I believe it was equally significant. One of the recent projects of the Committee on Statistical Sampling was to reconsider the July 1964 report, and after extended study the Committee concluded that no revision was necessary.

Pronouncement under Consideration

One of the major projects currently on the agenda of the AICPA Committee on Auditing Procedure is a comprehensive statement concerning internal control. The present draft of the proposed statement includes a revised definition of internal accounting control and a discussion of basic concepts implicit in such definition. It also includes discussion of the review, tests, and evaluation of internal accounting control required by the second generally accepted auditing standard of field work, and of the correlation of such evaluation with the other auditing procedures as contemplated by the third standard of field work. The proposed statement was originally intended to deal also with reporting on internal control, but the Committee decided to accelerate its pronouncement on this aspect of the subject and did so by the issuance of Statement on Auditing Procedure No. 49 in November 1971.

Because of the obvious applicability of statistical sampling to tests of compliance with internal control under the second standard and to the sufficiency of evidential matter under the third standard, the earlier drafts of the proposed statement included some discussion of these matters. However, in deference to the view of some committee members that any extended discussion of statistical sampling in the text of the proposed statement would give it a degree of prominence incompatible with its permissive status, such discussion has been relegated

to appendices in the more recent drafts. Because of the subject matter involved the AICPA Committee on Statistical Sampling has assisted by reviewing and commenting on the drafts of the appendices.

In order to comply fully with our professional standards of reporting, I want to express an unequivocal "disclaimer of opinion" as to the extent, if any, to which the presently proposed appendices on statistical sampling will be included in any statement issued by the Committee on Auditing Procedure. However, since the word "toward" in my assigned topic implies movement in the direction of standards and not necessarily their attainment, I believe it is appropriate to discuss the purpose and nature of the proposed appendices. The present draft of the proposed Statement on Auditing Procedure includes an Appendix A and an Appendix B.

Appendix A is the July 1964 report of the Committee on Statistical Sampling, which was referred to earlier. This report would be included because of its general conceptual relevance, and to provide background for Appendix B.

The purpose of Appendix B would be to amplify certain of the concepts in Appendix A and to provide quantitative criteria or guidelines for their application in practice. Such criteria were not considered timely when the 1964 report was issued, but they have been included in the draft of Appendix B on the premise that the intervening years of education, experience, and changing audit environment have made their inclusion appropriate at this time. In making this statement, I should confess my personal bias and reiterate my earlier disclaimer as to the eventual decision of the Committee.

The proposed Appendix B discusses criteria for reliability and precision for tests of compliance with internal control, and also for substantive tests as to the validity and the propriety of the accounting treatment of transactions and balances. Although compliance tests and substantive tests are discussed separately in the proposed Appendix because of the separate considerations relevant to each, the draft recognizes that a single sample can be designed to serve both of these purposes simultaneously.

Compliance Tests. The objective of compliance tests is to obtain evidence of compliance with, or conversely, of deviations from procedures the auditor considers critical for purposes of his evaluation of a particular aspect of internal control being tested. Samples designed for this purpose should be evaluated in terms of deviations from such procedures, either as to the number of such deviations or the monetary amount of the transactions on which the deviations occurred.

For compliance tests, the present drafts suggest a reliability level of 95% with reference to the upper precision limit related to the estimated internal control deviations. The draft also suggests that an upper precision limit of 5% with respect to internal control deviations would provide satisfactory evidence of compliance to justify maximum reliance on internal control in performing substantive tests, as discussed later. If the upper precision limit exceeds 5%, the draft suggests that reliance should be reduced accordingly. In developing this position, the draft points out that although internal control deviations increase the risk of errors in the accounting records, such errors do not necessarily follow from the deviations. Deviations from internal control procedures would result in errors at the same occurrence rate in the accounting records to be audited only if such deviations and the actual errors occurred on the same transactions. Conse-

quently, internal control deviations of as much as 5% of the number or amount of transactions rarely would be expected to result in errors of that magnitude in the accounting records being audited.

Substantive Tests. In the proposed Appendix, all auditing procedures other than compliance tests are referred to as substantive tests, and the feature of audit interest in performing such tests is considered to be the monetary amount of any errors that would affect the financial statements being audited. It should be noted that this definition of substantive tests includes both tests of details, which are susceptible to the use of statistical sampling, and other types of auditing procedures, which are not.

As indicated above, the proposed Appendix suggests a single reliability level for compliance tests. This was considered appropriate for such tests because the evidence obtained from them is the primary source of the auditor's reliance with respect to compliance with internal control procedures. This is not the case, however, in considering the reliability level for substantive tests, because the reliance on the latter is to be combined with the reliance on internal control in forming the auditor's final opinion on the financial statements. This concept was expressed in the July 1964 report as follows:

These standards [the second and third standards of field work] taken together imply that the combination of the auditor's reliance on internal control and on his auditing procedures should provide a reasonable basis for his opinion in all cases, although the portion of reliance derived from the respective sources may properly vary between cases. For statistical samples designed to test the validity or bona fides of accounting data and to be evaluated in monetary terms, the committee believes the foregoing concept should be applied 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.

The foregoing reference to "subjective reliance assigned to internal control" introduces an important element on which judgment is required. The proposed appendix would express the Committee's judgment in this respect by establishing a range of reliability levels to be used where statistical sampling is utilized in conjunction with the auditor's principal substantive tests.

The upper limit for this range would apply where the auditor's evaluation indicates that little if any reliance should be assigned to internal control, and the present draft suggests that a 95% reliability level is reasonable in such circumstances.

Establishing the lower limit for the range of reliability factors for substantive tests is more difficult. If the auditor's evaluation of internal control indicates that both the prescribed procedures and the degree of compliance with them are satisfactory, the extreme position would be to assign all of the desired reliance to internal control and require none from other auditing procedures. This would be tantamount to setting the lower limit for reliability levels for substantive tests at zero. The draft rejects this extreme, however, on the grounds that generally accepted auditing standards contemplate that substantive tests will be restricted, but not eliminated, through reliance on internal control. This position recognizes that the maximum potential effectiveness of internal control is

something less than complete because of the inherent limitations in any such system.

These limitations arise from such causes as misunderstandings, carelessness, distraction, fatigue, mistakes of judgment, dishonesty, or collusion, all of which relate primarily to the potential behavioral characteristics of individuals. The auditor ordinarily has little if any basis for making a realistic judgment as to the likelihood that such behavior will occur in individual situations. Accordingly, the draft suggests that a limit as to the maximum reliance to be assigned to internal control based on the collective judgment of the Committee would be useful for guidance to auditors in practice.

The risks to be considered for this purpose were described in the July 1964 report as follows:

The ultimate risk against which the auditor and those who rely on his opinion require reasonable protection is a combination of two separate risks. The first of these is that material errors will occur in the accounting process by which the financial statements are developed. The second is that any material errors that occur will not be detected in the auditor's examination.

The auditor relies on internal control to reduce the first risk and on his tests of details and his other auditing procedures to reduce the second.

In mathematical terms the excerpt quoted above describes a conditional probability, because the second of the adverse events referred to cannot occur unless the first has occurred also. Therefore, the combined risk of both of the related events occurring jointly is the product of the respective risks of their occurring individually. This concept is illustrated numerically in a tabulation that follows after brief comments concerning the nature of the respective risks.

The magnitude of the inherent risk of occurrence of material errors in the absence of satisfactory internal control is unknown, but experience indicates that this risk is moderate. Although this risk is an unknown quantity, it may be dealt with as such in the illustration that follows by simply designating it as "X."

The reliance that should be assigned to satisfactory internal control is the portion of the risk of occurrence that may reasonably be expected to be eliminated by such control, while the residual risk of occurrence is the portion reasonably attributable to the inherent limitations on internal control.

The risk arising from sampling and other auditing procedures (and the complementary reliability) is that which is required to establish the combined audit risk at a specified level. (These risks exclude the risk of any non-sampling errors and any similar errors relating to other auditing procedures.) Since the risk from sampling and other auditing procedures may include both of these elements, the concept being discussed here is broad enough to comprehend quantification of the latter also. I believe there is a reasonable basis for such quantification in many cases, but this is beyond the scope of the proposed Appendix B and of this paper. In both, the discussion of sampling reliability levels applies only to cases in which a sample is the principal element in the auditor's substantive tests of a particular aspect of the transactions or balances comprising the population.

Subject to the preceding comments concerning respective risks the following

tabulation shows for several assumed levels of reliance on internal control, the resulting risk and reliability that will provide an assumed uniform combined risk:

Inherent Risk of Occurrence Of Errors	Reliance Assigned to Internal Control	Residual Risk of Occurrence Of Errors	Risk from Sampling and Other Procedures	Combined Audit Risk	Reliability from Sampling and Other Procedures
X	.00X	1.00X	.05	.05X	.95
X	.50X	.50X	.10	.05X	.90
X	.75X	.25X	.20	.05X	.80
X	.80X	.20X	.25	.05X	.75
X	.85X	.15X	.33	.05X	.67
X	.90X	.10X	.50	.05X	.50

Any presentation of a mathematical model in which subjective judgments and objective measurements are combined invites the somewhat annoying, but nevertheless completely accurate, criticism that the former cannot be quantified precisely. This criticism, however, does not impugn the usefulness of a model in focusing attention on the separate elements of a complex problem, and in showing the relationship between those elements. Furthermore, this criticism invites the rebuttal that it is more rational to quantify some of the separate elements of a problem, subjectively if necessary, than to deal subjectively with the entire set of elements where some can be measured objectively.

If this analytic approach is accepted, the following two observations about the tabulation presented may be helpful in considering it. First, auditors' experience and understanding of the potential and the limitations of internal control makes it more realistic for them to exercise professional judgment in deciding in the framework of that model what reliance should reasonably be assigned to internal control, than in deciding in the abstract what sampling reliability level should be used. Second, although the inherent risk "X" is unknown, experience shows clearly that it is substantially less than 100% and consequently the combined risk ".05X" is substantially less than 5% of all audit populations sampled.

The present draft of Appendix B provides for but has not yet proposed the reliability level to be used for substantive tests where internal control is considered satisfactory.

As to precision limits for substantive tests, the present draft of the proposed Appendix B accepts the concept that these should be based on the auditor's judgment concerning materiality in relation to the financial statements and it does not propose any further guidelines in this respect.

The determination of reliability levels and precision limits is the vital interface between the subjectivity of auditing judgment and the objectivity of statistical sampling. I believe the concepts discussed in this paper are sound in theory and workable in practice. I hope they will become steps—in the words of my assigned topic—"toward standards for statistical sampling."