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Applying Statistical Sampling Methods to Auditing

Glenda A. Ried

APPLYING STATISTICAL SAMPLING METHODS TO AUDITING

The author follows up her previous articles on "The Theory of Probability Sampling" by giving a comprehensive and easy to understand introduction to the practical side of statistical sampling.

Glenda A. Ried, CPA
Toledo, Ohio

Introduction

The applicability of statistical sampling in auditing has arisen because of the many technological changes in the business world. Electronic computers, linear programming, operations research are all mathematical and scientific aids. The use of automation by government and big business produces volumes of documents, paper and data which are similar or alike. Both the external and internal auditors are confronted with the problem of auditing this mass of data. Therefore, an understanding of probability sampling is of vital importance to the auditor of today.

Statistical Sampling

Statistical sampling is the scientific approach toward selecting a sample, based on the principles of random selection, equal and known probability of being chosen, bias, precision, and reliability.

Random selection (probability sampling) is a method of choosing from a large population a number of units in such a manner that each unit has a known and equal chance of being selected. The sample is selected according to the laws of chance. A simple random sample is drawn unit by unit without replacement. At any stage in the draw, this process gives an equal chance of selection to all units not previously drawn. The probability that each unit has of being selected in samples of any size can be calculated mathematically. For example, if a sample of one unit is drawn from a population of twelve, then the probability of any one being selected is one-twelfth.

Sample bias is the difference between the expected value of the estimate and the true value being estimated. Assume that a sample of two units is drawn and that the average of the two is $2,450. If the average of all samples of two units is also $2,450, then the sample is unbiased because the difference between the expected value of the sample and the true value is zero. An estimate with a small bias may be more reliable than the best unbiased estimating procedure.

Precision is a means of measuring how closely the sample results reproduce those which would be obtained by taking a sample count using the same methods of measurement. The precision of a sample estimate will increase as the size of the sample is enlarged. Therefore, any desired precision can be achieved by taking a large enough sample. This precision can be calculated mathematically when the size of the sample and the probability that its estimate will fall within a certain range of the true value are known.

Application to Auditing

Is a statistical estimate an acceptable substitute for a one-hundred per cent physical count of inventory? Statisticians have been able to show that a well-designed and administered statistical sampling plan can give better accuracy than a full count. A full count is also subject to errors, but these errors cannot be calculated in advance.

A study was undertaken under the guidance of Dr. Olin W. Blackett, professor of business statistics at the University of Michigan, for the purpose of developing information regarding the reliability of sampling plans in auditing.[1] The results of a one-hundred per cent audit were available for purposes of comparability. Six samples were selected and their results tabulated and evaluated against the results of the one-hundred per cent audit. Not all the sampling plans were scientific. The results for the statistical sampling plans, however, showed that for the protection given less audit work was required.

Four Stages of Application

The process of applying statistical sampling

GLENDA E. RIED, CPA, is Assistant Professor of Accounting at the University of Toledo, from which she received both her bachelor's and master's degrees.
She is a member of AICPA, the Ohio Society of CPAs, ASWA, and AWSCPA.
Ms. Ried is currently serving as president of the Toledo Chapter of ASWA.

to auditing may be set up in a series of four stages:[2]

(1) the design process,
(2) drawing of the random sample,
(3) the statistical evaluation, and
(4) determining the adequacy of the results.

Design Process

Design includes determination of the purpose of the audit, the evaluation of the effectiveness of internal control, an outline of the audit program, and a statement of the principles to be used in selecting the sample.

First, the auditor should have a concrete idea of the purpose of the audit. The purposes may be:[3]

(1) correctness of the dollar amounts on the financial statements,

(2) a check on the company's basic accounting policies and the effectiveness of the internal control process in administering them.

Certain problems are present in evaluating the effectiveness of internal control. Stated very briefly they can be summed up as causes of errors, area covered, interrelationship between areas, and time period covered.[4]

Emphasis must be placed upon the various causes or types of errors in the journalizing and recording of transactions. Also of importance is their frequency of occurrence. The error may be one in recording, posting, calculation, transposition, or lack of proper authorization. Where a dollar amount is concerned, it may or may not be significant. Clerical errors, such as posting to the wrong account, are usually of little more than statistical significance since they will tend to offset one another. The auditor is primarily concerned with detecting errors that would *materially* affect the financial statements. The error may be classified as to its dollar amount or in terms of whether it is material or immaterial.[5] The concept of materiality is subjective and determined by the auditor. A method of weighting the errors as to their degree of seriousness or materiality might be recommended. However, the errors must be defined and evaluated in some way to determine their importance and effect on internal control.

Should decisions based on the effectiveness of internal control cover each audit area separately or the process as a whole? The problem here may be one of combining the results from the various areas of the internal control process in order to measure the effectiveness of the entire process.

Effective internal control in one area may or may not influence the effectiveness of internal control in another area. The extent of any such influence must be judged by the auditor.

The auditor may use the entire period (fiscal year) or a sub-period (two selected months during the year plus the first and last month of the period) in evaluating the effectiveness of internal control. Also, the time period subsequent to the close of the year may be taken into consideration.

In preparing an outline of the audit program it might be necessary to make additions and adjustments to adapt it to statistical methods. After the audit program is determined, the auditor must devise a sampling approach based on the existing administrative procedures. He or she must make certain that the sampling plan conforms to auditing standards and that proper statistical techniques are used. The principles and steps to be followed in selecting the random sample should be in writing.

Drawing of the Random Sample

Drawing a random sample is a formal method of selecting the sample of items to be examined through the use of a table of random numbers. A basic rule is that the sample must be representative, which means the sample must be typical of the entire mass of documents (universe) from which it is drawn.

If there is any doubt as to whether the items in a universe are randomly distributed the universe, if at all possible, should be segregated into groups (strata), each of which is fairly uniform throughout. Random sampling can then be applied to the strata. An example might be the testing of the pricing of a physical inventory. The pages of inventory tabulation may be grouped by product classes with a random sample being chosen from the items within each product class. If the universe is not a random one and cannot be divided into homogeneous units, a statistician should be consulted who can apply a number of tests for randomness, and if necessary, design a special sampling plan.[6]

Before the sample can be drawn, the population must be numbered, either physically or conceptually. If documents are serially numbered, such as sales invoices, the existing numbers may be used.

Some populations are not pre-numbered. Examples of this are postings, footings, and inventory extensions. One method is to assign consecutive numbers to the items so that the principle of random selection can be applied. An illustration is the numbering of items in an inventory for checking the extensions. Numbers can be assigned to the lines on the inventory sheets. If there are twenty lines to a page, the third item on the fourteenth page would be number 283, fourteen times twenty

plus three. Random numbers may be used even though blank lines on some of the pages will leave gaps in the population.

As an alternative there is no requirement that the items in a universe be prenumbered. A number can be mentally ascribed to each item as it is counted, checking to see if it corresponds to an already selected random number.[7] The procedure is as follows: Random numbers are copied from a table of random numbers. When the necessary number is reached, they are listed in ascending order. The auditor then counts through the items, numbering them consecutively in the order in which they appear. Whenever the number attached to the item corresponds to a number which appears in the list of random numbers, that item is removed for examination. This process is continued until all items are selected. Groupings may be used in this procedure.

A third possibility for the items in an unnumbered population is the use of systematic sampling.[8] Every fifth, tenth, or twentieth item may be selected. A random number table should be used to select the first item in the sample. The constant interval is used to select the succeeding items. This alternative is useful when the actual number of items in the universe is not known, yet a specified proportion of the population is desired in the sample.

The method of sample selection chosen in any specific instance will depend upon the administrative simplicity of drawing a sample using the available alternatives, the efficiency of the various sampling methods, and upon the judgment of the person drawing the sample.

Sample Size

The adequacy of the internal control system must be reviewed and evaluated in determining the size of the sample. Generally speaking, if the system of internal control is operating effectively and exceptions or errors are few, then the acceptability of that system can be established by means of a relatively small sample. If the opposite is true, then a larger sample must be drawn to give the auditor a sound basis on which to establish the extent of error.

The errors may range from the insignificant to those requiring refusal of an over-all opinion. Minor and major errors might be classified by dollar amounts. Minor errors might exist in substantial numbers without requiring rejection of the population. A similar number of serious errors would probably mean rejection. The disadvantage of the above principle is that many minor errors may be of major importance and have a direct effect on the accounting statements.

How does one define how big is "big" or what constitutes a serious error? Three possible criteria are:[9]

(1) An error that would seriously affect the statements,

(2) An error that, if found, would be adjusted by the auditor, and

(3) An error that would be ignored if it occurred in one percent or less of the transactions, but would require a detailed examination if it occurred in three per cent or more of the transactions.

The specific effects of poor internal control on the financial statements are not known with certainty; it is simply believed that poor control tends to produce poor statements.

What per cent of errors in a population can be tolerated is a debatable issue among accountants. Auditors cannot agree as to whether specific standards (an acceptable quality level) should be established for uniform use or whether the standards to be applied in each instance should be left to the discretion of the individual auditor.

Statistical Evaluation

Statistical evaluation means a mathematical analysis of the sample results with objective estimates of the expected precision and reliability. The auditor can expect to be within, for example, plus or minus two per cent of the true population. It is also possible to predict that the auditor may be right only ninety-five per cent of the time or, expressed in another way, nineteen times out of twenty.

Tolerance limits should be set according to considerations of risk and materiality. For example, it might be that for an error of $8,000 there is about a ten percent risk of accepting the particular group of accounts as correct. The auditor must decide, as a matter of judgment, whether this is a reasonable risk to take. And, is it consistent with accepted accounting standards? Tolerances can be set by statistical methods to assure that the risks taken in sampling do not exceed those judged to be acceptable. If the original level of tolerances is judged to be too strict, they should not be abandoned merely to lighten the work load.

Adequacy of the Results

The appraisal of the sample results is made by the auditor and is not, in any way, connected with mathematics. One evaluation is on the preciseness of the sample estimate. Does its preciseness meet the standards of the auditing profession? If, for a particular audit problem, the auditor feels the estimate is not precise enough, he or she can compute how much larger the sample should be to

give a satisfactory estimate. Or, if the estimate was more precise than necessary, the auditor can compute how much the sample size could be reduced. This information might be desired if the sampling procedure were to be repeated.

Detection of fraud is not a primary objective of sampling. Samples adequate to support opinions regarding the financial statements will not necessarily detect any fraudulent items or transactions. Here, statistical theory backs the auditor.

However, in auditing the auditor will not derive a conclusion solely from the sample. The interrelation of auditing procedures must be taken into account.[10] Either one step or several steps may contribute to a conclusion or conclusions. For example, in establishing the market value of an inventory, the auditor might examine trade journals listing market quotations, obtain quotations from suppliers, and investigate the prices of similar items purchased just before and after the date of the financial statements. The market values also contribute to the reasonableness of the cost figure of the inventory. Any substantial differences should be explainable by differences in time of acquisition or by the influence of the trade practice.

Another example can show how audit steps must be taken before expressing an opinion. The sampling of a physical inventory at any date other than the end of the fiscal year will not, by itself, lead to a valid conclusion about the year-end inventories. Other audit steps must be taken, such as reviews of gross profit percentages, examination of entries, and so on.

However, in many instances statistics will lend objectivity to findings made by other means during the course of an audit. Statistics, other audit steps, and judgment play an important and integrated part before the auditor expresses an opinion on the financial statements.

Advantages of Statistical Methods in Auditing

The advantages of using statistical methods in auditing are:

(1) Sampling risks are calculable, and the auditor, after specifying the tolerance of the sampling risks, can determine the necessary sample size.

(2) The auditor is forced to objectively define the standards of "accounting quality."

(3) Based on specified risks and a stated accounting quality, the sample results can be objectively interpreted.

(4) The auditor has better control over the sampling risks.

(5) Advance planning will save time in the field work.

(6) Relationship with the client should be improved because statistical methods give the auditor a defensible position in justifying the number of items to be tested and the amount of work to be done.

(7) Samples may be smaller and each item in the sample more exhaustively examined in comparison with larger samples where the items may be processed in a more routine manner.

(8) The auditor has better administrative control over the sampling and testing procedures, especially for the audit of a decentralized, widely spread organization. The method for selecting the sample can be planned in advance and revealed to operating personnel only when the sample is to be drawn. The advance planning could include a description of the universe, the size of the sample, the selection method used, the starting point in a table of random numbers, and so forth.

(9) Subsequent review or follow-up can be handled with more flexibility. Someone else on the audit staff could evaluate the concept and carrying out of the sampling plan.

(10) Statistical methods can be adopted without an increase in cost. Very frequently they result in a saving of time, effort, and money.

Once again, statistical methods are tools to be applied in conjunction with numerous decisions based on the professional judgment of the auditor.

NOTES

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3. John Neter, "Problems in Experimenting with the Application of Statistical Techniques in Auditing," *The Accounting Review,* (October, 1954), p. 594.
4. *Ibid.,* p. 597.
5. James G. Carter, "A Suggested Supplement to Audit Test Programs," *The Accounting Review,* (XXVII, 1952), p. 91.
6. Robert W. Johnson, "The Use and Significance of Random Samples in Audit Tests," *The Journal of Accountancy,* (December, 1957), p. 47.
7. *Ibid.,* p. 44.
8. Lawrence Lee Vance and John Neter, *Statistical Sampling for Auditors and Accountants* (New York: John Wiley and Sons, Inc., 1956), p. 237.
9. *Ibid.,* p. 127.
10. Henry P. Hill, "An Accountant Looks at Statistics," *The Journal of Accountancy,* (April, 1958), p. 62.