AUDIT SAMPLING: A SIMULATION STUDY

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Abstract

Auditors use extensive auditing techniques to audit financial statements in an effort to accumulate evidence. However, auditor always sought a cheaper audit technique that does not compromise much on the quality of the audit. One of techniques used by auditor using cost-effective and efficient sampling plan. In practice, auditors use small sample size as minimum as 25 items. Therefore, this simulation exercise is to test whether the given sampling plan has a reasonable chance of picking up errors and estimating the degree of value error that actually exists in an accounting population.

We conclude that those firms using samples of less than 50 units for auditing accounting populations with low error rates have a low probability of picking up error. Therefore, we suggest that the minimum sample size per population should increase to at least 50 units, in order to improve their error detection process and ultimately the quality of their audit.

1.0 INTRODUCTION

In accumulating evidence auditors use extensive auditing techniques to audit financial statements. Several studies conducted in recent years on the audit techniques used by accounting firms (such as and Maysmor --Gee et. al. [1984], Higson [1987], Turley and Cooper [1990] and Mohamad-Ali [1993]), but many have question the validity of these techniques. Following this, auditors been criticized for the relevance and the quality of their audit and a vast amount of litigation brought against them for damages in the USA, further questions their credibility. The image of the auditors only straightened through improvement of the quality and credibility of the audit performed on financial statements. One way of solving this is using a cost-effective and efficient sampling techniques.

Usually there are two methods in sampling, the traditional and the statistical sampling method. Numerous articles on the sampling methods have appeared in accounting journals[1], criticizing the traditional method of audit sampling. The statistical sampling technique has received strong recognition in the literature as an effective auditing technique and increased use of the technique [Mohamad Ali (1993) and McRae (1982)] since 40 years ago. However, the validity of the conclusions drawn from studies on statistical sample size is inconclusive. McRae [1982] points out that the statistical sample sizes in the UK appear to be significantly smaller than those of audit sample sizes drawn in North America. Most firms in McRae's study stipulated a minimum sample size, usually 20 to 40 units, but there is no maximum size. Mohamad Ali's [1993] recent survey of UK firms supports McRae's findings. Most firms set a minimum sample size of 25 units and a maximum sample size of 100 units.

Due to the main constraint of confidentiality factor of accounting population, one possible solution to mitigate the confidentiality constraint is to generate values based on a simulation exercise of a real accounting population. Therefore, the main objective of this study is to find out if sampling plans using this size sample of 25 items, for example, are likely to pick up the degree and value of error that anticipated to exist in audited populations of accounting data.

2.0 RESEARCH DESIGN, THEORETICAL FRAMEWORK AND METHODOLOGY

To realize the objective of this study we used the Monte Carlo Analysis simulation technique [Hammersely and Handscomb, 1964]. A computer simulation model was build that can generate a

[1] see Gwilliam [1987] for further reading on the subject.

series of book values, audited values and error values such as might exist in an actual accounting population. The simulation involves setting up a model of a real situation and then performing experiments on the model. The main simulation program is written in BASIC and based on a stochastic or probabilistic model.

2.1 The Populations used in this Study

To generate book and audit values, three main elements in the accounting population need to be specified, namely the distributions of book values, error rates and distributions of errors.

The program is designed to simulate the population distributions found in practice by using data from empirical studies. The actual empirical data used is usually obtained from Population 4[2] of Neter and Loebbecke's [1975] study. The population consists of 4033 trade debtor accounts that are random subset of all trade debtor accounts of a large US manufacturer. Account with book balances over $25,000 are not included in the population because there were very few of these and they accounted for about 75 per cent of the total book values [Neter and Loebbecke, 1975]. Hence the auditor would probably examine each of these values individually. Table 1 contains a frequency distribution of the book values of the trade debtor accounts and also the major characteristics of these book values. We note this distribution skewed to the right.

Table 1
FREQUENCY DISTRIBUTION AND MAJOR CHARACTERISTICS OF BOOK VALUES

Class	Book Amount ($)	Number of Accounts
1	0<X<90	1,070
2	90<X<230	715
3	230<X<400	450
4	400<X<650	337
5	650<X<1,500	455
6	1,500<X<3,500	409
7	3,500<X<5,000	149
8	5,000<X<10,000	238
9	10,000<X<25,000	210
TOTAL		4,033

Source: Neter and Loebbecke, 1975, p. 26

To use this distribution of book values in the simulation model, the values divided into nine unequal class intervals. The class boundaries defined as follows: 0; 90; 230; 400; 650; 1,500; 3,500; 5,000; 10,000 and 25,000. Finally, the numbers of values in each frequency class were determined.

Errors are endemic to accounting populations. The objective of auditing is to ensure that the degree of error in accounting populations is minimized within acceptable bounds. Taylor [1974] provides a useful classification of the various types of error met in accounting populations. The error is either an error of principle or an operational error. Also errors in accounting populations can be classified as either an accidental or deliberate.

This study primarily concerned with accidental operational errors. Fraudulent errors are likely to concern the auditor in the context of his professional liability for negligence but we have ignored such errors in our simulation. Since the pattern and incidence of fraudulent error are likely to be quite different from those of accidental errors they require a separate research.

[2] Neter and Loebbecke [1975] study consists of Population 1, 2, 3 and 4. For further details please refer to the article.

Sampling is unlikely be used for detecting errors of principle. Errors of principle usually detected in the analytical review stage of an audit. The errors that simulated in this program are monetary errors i.e. errors arising when a wrong value assigned to an accounting number. Most substantive errors are monetary errors [McRae,1982].

The error rate is the proportion of errors in a population. Thus an error rate of 0.2, i.e. 20%, means that out of a total population of say 100 items, 20 items are in error. The error rate in most accounting populations is very low, a problem which every auditor face when they must sample accounting populations [Neter and Loebbecke, 1975]. A study on the pattern of accounting error [Jones, 1947], suggests those error rates below 0.3 per cent are "acceptable" and between 0.3 - 0.9 per cent is consider "fair" in clerical work. While Vance [1950] took 0.5 per cent as being acceptable and 3 per cent and above as being unacceptable error rates in a clerical work. Other studies of actual error rates discovered in clerical work were: in debtors' accounts: Johnson and Rowles [1957] found the acceptable range was between 0.54--1.03 per cent; Aly and Duboff [1971] 2 per cent; Neter and Loebbecke [1975] 5.7 per cent.

In this study we classify the error rate into three categories, 1%, 2.5% and 5% (low, moderate and high respectively) and seed these error rates into the population. To make the process simpler the error items decided in advance to be 50, 100 and 200 errors respectively (rounded to ten). This approach creates a 3 study population.

The term "tainting" used in audit sampling to describe the ratio between the value of an error and the value of the item in error. An item of $60 containing a $15 error said to be 25 per cent tainted. The probability of finding a given tainted percentage appears to be affected by the relative size of the items in error [McRae,1982].

The simulations in this study have classified the tainting percentage into three groups. Those discovered in audited items exceeding $10,000, those discovered in audited items of less than $2,000 and those discovered in audited items between $10,000 and $2,000. The tainting distributions are shown in Table 2. For example, 33% of the errors discovered with the value exceeding more than $10,000 were within the tainting of 2% to 10% of the book value. While 25% and 17% of the errors discovered with the value between $2000 to $10,000 and less than $2000 respectively, within the tainting of 2% to 10%.

Table 2

TAINTING PERCENTAGES: A CLASSIFICATION BY RELATIVE SIZE THE ITEM IN ERROR

	Audited Items		
Tainting	Exceeding $10,000	Between $2,000-$10,00	Less than $2,000
0 to 1%	35%	19.0%	3%
> 1 to 10%	33%	25.0%	17%
>10 to 20%	5%	12.0%	19%
>20 to 99%	17%	19.0%	21%
100%	10%	23.5%	37%
> 100%	0%	1.5%	3%
	100%	100.0%	100%

Source: McRae [1982]

2.2 Audit Sample Selection Procedure

Currently Monetary Unit Sampling (MUS) is the most widely used statistical method for evaluating error in audited populations. Mohamad-Ali's [1993] and McRae's [1982] surveys suggest that over 90 per cent of applications of statistical sampling that attempt to evaluate error value use some form of MUS. The version of MUS used in this study is a simplified version of the Dollar Unit Sampling (DUS) method described in Leslie, Teitlabaum and Anderson [1980].

The sampling method used in this approach is the systematic selection method. This method divides the total population of dollars into equal groups and intervals of dollars. A logical unit is then systematically selected from each interval. In our case let say BV = $600,000 and n = 88, then the sampling interval is $6,818 ($600,000 / 88). The initial step in the selection process is to pick a random number between 1 and 6,818. The auditor than selects the logical unit that contains every 6,818th dollar thereafter in the population.

2.3 Hypotheses to be tested

The computing simulation model was the method used to test the hypotheses:

H1 Probability of finding one error with sample size of 25
The hypothesis tested is that the chance of finding one error is more than 90% with the sample size of 25 for each three error rate; low (1%), moderate (2.5%), and high (5%).

H2 Probability of finding one error with sample size of 50
The hypothesis tested here is that the chance of finding one error is more than 90% with the sample size of 50 for each error rate; low (1%), moderate (2.5%), and high (5%).

H3 Probability of finding one error with sample size of 100
The hypothesis tested is that the chance of finding one error is more than 90% with the sample size of 100 for each three error rate; low (1%), moderate (2.5%), and high (5%).

3.0 RESULTS AND DISCUSSIONS

The following simulation tests with different sampling sizes used by the auditors, would tests the likelihood of picking up error with the given three error levels and three sample sizes. Table 3 and 4 summarises the major results of this simulation for each of the three sample sizes and three errors' rates used. The three error rates were: low error rate (1%), moderate error rate (2.5%), and high error rate (5%). The sample sizes were 25 items, 50 items and 100 items respectively. Tables 3 and 4 illustrates the application of simulation on audit sampling procedure to an empirical population of values seeded with erroneous items drawn from an empirical distribution of error values.

Table 3 shows that at one per cent error rate there is a 55% chance that no errors found in a sample of 25 items. When the sample size rises to 50 random units the chance of missing all the errors is still as high as 36%. When the sample size increased to 100 random units the chance of not picking up a single error is reduced to 9%. In other words at a sample size of 25 and 50 the chance of finding one error is less than 90 per cent.

Table 3
ERRONEOUS ITEM PICKED FOR AUDIT- At 1%, 2.5% and 5% Error Rate

No. of Error Found	1% Sample size			2.5% Sample size			5% Sample size		
	25	50	100	25	50	100	25	50	100
0	55	36	9	19	6	5	18	9	6
1	35	32	22	27	10	2	28	7	2
2	7	21	32	26	26	2	26	28	2
3	7	11	20	15	27	10	15	26	10
4	2		8	10	13	13	10	12	12
5	1		7	3	8	20	3	7	19
6			1		9	7		10	7
7					1	9			9
8						10			11
9						9			9
10						2			2
11						9			9
12						1			1
13						1			1
	100	100	100	10 0	100	100	100	100	100

Table 4
SUMMARY OF ERRONEOUS ITEM PICKED OUT FOR AUDIT

n=sample size	Error rates		
	At 1%	At 2.5%	At 5%
25	45%	81%	82%
50	64%	94%	91%
100	91%	95%	94%

On the other hand, when the error rate increased to 2.5 per cent the chances of not finding one error when using a random sample size of 25, 50 and 100 are 19%, 6% and 5% respectively. These findings imply that if the error rate is 1% and a 90% level of confidence required, a sample of 100 units is needed to have a reasonable probability of picking up one error unit. If the error rate increases to 2.5% a sample of 50 is adequate. Even when the error rate rises to 5%, a high rate in accounting work, a sample size of 25 is still inadequate to achieve a confidence level of 90%.

The purpose of this simulation exercise is to point out that a sample size of 25 is not reliable for audit work. A sample of the order of 50 is needed to achieve a confidence of around 90% assuming low levels of error.

The findings suggest that, given the joint empirical distributions, the chance of picking up an erroneous unit is highly sensitive to the sample size used. The error rate in the population being audited also has an important effect on the probability of picking out an error, however, with a 5 % error rate an increase in sample size does not significantly increase the probability of picking out an error with more than 100 per cent tainting (see Table 5).

Table 5
TAINTING PER CENT OF ERROR GREATER THAN 100 % PICKED OUT FOR AUDIT

Sample Size	Error Rate		
	1 %	2.5 %	5 %
25	18	48	48
50	29	75	66
100	59	87	86

We conclude that those firms using samples of less than 50 units for auditing accounting populations with low error rates have a low probability of picking up error and so should increase their minimum sample size per population to at least 50 units, to improve their error detection process and ultimately the quality of their audit.

4.0 IMPLICATION FOR THE AUDITOR

Since only one accounting population was studied in this study and a comparatively low number of simulation runs (100) were conducted, the conclusions drawn are largely tentative. Nevertheless the results suggest that an auditor using statistical sampling should be concerned when using sample sizes below 50 units per population sampled.

The result of this simulation, based on empirical distributions drawn from actual accounting data, suggests that samples below 50 are not large enough to provide a successful sampling plan unless the error value is very low, say, less than 1% of the population.

To prove the implication of the findings of this study, at present simulation study is being carried out by using a larger number of runs (500 runs) and with different distributions of book and error values. Tests of other estimators as suggested by McCray [1980], such as the so-called (MEST) bounds are also being considered. The findings of this on-going research will be the subject matter for future publications.

5.0 SUMMARY AND CONCLUSIONS

The main objective of this study was to test whether the sample sizes drawn by medium sized audit firms can provide adequate reliance to the auditor that the value of error in the population is below an acceptable minimum.

The study based on an accounting distribution taken from Neter and Loebbecke [1975] Population 4. The Neter and Loebbecke populations are well known in the audit sampling literature and have been widely used by other researchers for comparing the performance of alternative sampling techniques (for example, see Frost and Tamura [1982]). Population 4 was selected because this population contains only one-sided errors. Population 4 consists of the 4033 debtors accounts of a large manufacturer. The sample sizes used in this simulation study were 25, 50 and 100 units with confidence levels set at 90 %.

The principal criteria for judging the quality of the audit procedure is to assume that the procedure gives an acceptable answer if the likelihood of picking up, at least, one erroneous item is 90% or above. Table 6 summarises the results of Hypothesis 1 to 3. The results show that within the range of sample sizes normally used by auditors in practice, namely 25 to 100 units per population audited the procedures only work consistently if the sample size is around 100 units. With samples of 50 units the results are variable. With samples of 25 units the results are consistently negative. Since many of the auditors questioned in our survey use, on average, less than 50 sampling units per population audited this results should be of concern to these auditors.

TABLE 6
SUMMARY OF RESULTS OF SIMULATION ANALYSIS

Hypothesis	Accept/Reject
Hypothesis 1	*Rejected*
Hypothesis 2	*Accepted in part* *
Hypothesis 3	*Accepted* +

* at error rate of 1 %, the hypothesis is rejected
+ at error rate of 2.5 %, it is significantly above 95 %

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