CHAPTER 17

AUDIT SAMPLING FOR TESTS OF DETAILS OF BALANCES

LEARNING OBJECTIVES

After studying this chapter, you should be able to

- **17-1** Differentiate audit sampling for tests of details of balances and for tests of controls and substantive tests of transactions.
- **17-2** Apply nonstatistical sampling to tests of details of balances.
- **17-3** Apply monetary unit sampling.
- **17-4** Describe variables sampling.
- **17-5** Use difference estimation in tests of details of balances.

Both Statistical And Nonstatistical Sampling Are Acceptable Under Auditing Standards, But Whichever Is Used, It Must Be Done Right

Bob Lake was the manager on the audit of Images, Inc., a specialty retailer that had shops throughout the Midwest. Images appealed to upscale working women and offered its own credit card. Images' accounting was done centrally. Transactions were captured online and sales and accounts receivable files were maintained on a database.

Bob Lake's firm encouraged the use of statistical sampling in its practice and provided a training program for the development of a statistical coordinator for each office. The coordinator in Bob's office was Barbara Ennis. Bob believed that sales transactions and accounts receivable confirmation tests should be done using statistical sampling and asked Barbara to help design and oversee the statistical aspects of this testing.

Barbara developed a program for the design of confirmation audit procedures as part of doing tests of details of balances for accounts receivable. Her work included determining sample sizes. She left the program with Bob to carry out and said that she would be available to help evaluate the results after the tests were performed.

When all the confirmation replies were received or alternative procedures were completed several weeks later, Bob called Barbara to do the statistical evaluation. Much to his dismay, he found out that Barbara had left the firm, and worse, there was no statistically trained person to take her place. Bob was under a lot of pressure to get the job completed and decided to make the statistical calculations himself. Based on his calculations, he concluded that the potential misstatement was large, but not material, so Bob concluded the objectives of the confirmation tests had been met.

The next year Images, Inc.'s earnings declined sharply, partially because of large write-offs of accounts receivable. The stock price dropped sharply and a class action suit was filed naming Bob's firm among the defendants. An outside expert was brought in to review the audit documentation. The expert redid all of Bob's work and found errors in the statistical calculations. The expert calculated that the misstatement in accounts receivable, based on the auditor's sample, was significantly more than a material amount. Bob's firm settled the suit for $3.5 million.

In Chapter 16, we moved into phase III of the audit process by examining analytical procedures and tests of details of balances for accounts receivable. We will now continue with phase III by determining sample size and items to select from the population for the audit of accounts receivable. Although the concepts in this chapter deal with accounts receivable, they apply to the audit of many other account balances.

As the story about the audit of Images, Inc., demonstrates, auditors must correctly use sampling to avoid making incorrect conclusions about a population. While both statistical and nonstatistical audit sampling methods are used extensively for tests of details of balances, auditors must decide which method to use, depending on their preference, experience, and knowledge about statistical sampling. This chapter should help you make correct inferences about populations using either statistical or nonstatistical methods.

Before starting the study of this chapter, we suggest you refer to Figure 13-9 on page 443 to be sure you understand where we are in the audit process. At this stage, all items in phases I and II will have been completed before auditors determine sample size and items to select from the population. Also, the auditor will have completed substantive analytical procedures and designed audit procedures for tests of details of balances, as covered in Chapter 16 (part of phase III). The auditor cannot perform the audit procedures for tests of details of balances until first deciding sample size and items to select from the population.

COMPARISONS OF AUDIT SAMPLING FOR TESTS OF DETAILS OF BALANCES AND FOR TESTS OF CONTROLS AND SUBSTANTIVE TESTS OF TRANSACTIONS

OBJECTIVE 17-1

Differentiate audit sampling for tests of details of balances and for tests of controls and substantive tests of transactions.

Most of the sampling concepts for tests of controls and substantive tests of transactions, which were discussed in Chapter 15, apply equally to sampling for tests of details of balances. In both cases, an auditor wants to make inferences about the entire population based on a sample. Both sampling and nonsampling risks are therefore important for tests of controls, substantive tests of transactions, and tests of details of balances. To address sampling risk, auditors can use either nonstatistical or statistical methods for all three types of tests.

The main differences among tests of controls, substantive tests of transactions, and tests of details of balances are in what the auditor wants to measure.

Type of Test	What it Measures
Tests of controls	• The operating effectiveness of internal controls
Substantive tests of transactions	• The operating effectiveness of internal controls • The monetary correctness of transactions in the accounting system
Tests of details of balances	• Whether the dollar amounts of account balances are materially misstated

Auditors perform tests of controls and substantive tests of transactions:

- To determine whether the exception rate in the population is sufficiently low
- To reduce assessed control risk and thereby reduce tests of details of balances
- For larger public companies, to conclude that the control is operating effectively for purposes of auditing internal control over financial reporting

Unlike for tests of controls and substantive tests of transactions, auditors rarely use rate of occurrence tests in tests of details of balances. Instead, auditors use sampling methods that provide results in *dollar* terms. There are three primary types of sampling methods used for calculating dollar misstatements in account balances addressed in this chapter: nonstatistical sampling, monetary unit sampling, and variables sampling.

NONSTATISTICAL SAMPLING

OBJECTIVE 17-2

Apply nonstatistical sampling to tests of details of balances.

Audit sampling for tests of details of balances is similar to audit sampling for tests of controls and substantive tests of transactions, although the objectives differ. The steps involved parallel those used for sampling for tests of controls and substantive tests of transactions. The primary differences in applying audit sampling for tests of details of balances are indicated in italics.

Steps—Audit Sampling for Tests of Details of Balances

Plan the Sample

1. State the objectives of the audit test.
2. Decide whether audit sampling applies.
3. *Define a misstatement.*
4. Define the population.
5. Define the sampling unit.
6. *Specify tolerable misstatement.*
7. *Specify acceptable risk of incorrect acceptance.*
8. *Estimate misstatements in the population.*
9. Determine the initial sample size.

Select the Sample and Perform the Audit Procedures

10. Select the sample.
11. Perform the audit procedures.

Evaluate the Results

12. Generalize from the sample to the population.
13. *Analyze the misstatements.*
14. Decide the acceptability of the population.

Steps—Audit Sampling for Tests of Controls and Substantive Tests of Transactions (see p. 502)

Plan the Sample

1. State the objectives of the audit test.
2. Decide whether audit sampling applies.
3. Define attributes and exception conditions.
4. Define the population.
5. Define the sampling unit.
6. Specify the tolerable exception rate.
7. Specify acceptable risk of overreliance.
8. Estimate the population exception rate.
9. Determine the initial sample size.

Select the Sample and Perform the Audit Procedures

10. Select the sample.
11. Perform the audit procedures.

Evaluate the Results

12. Generalize from the sample to the population.
13. Analyze the exceptions.
14. Decide the acceptability of the population.

State the Objectives of the Audit Test

Auditors sample for tests of details of balances to determine whether the account balance being audited is fairly stated. The population of 40 accounts receivable in Table 17-1 (p. 578), totaling $207,295, illustrates the application of nonstatistical sampling. An auditor will do tests of details of balances to determine whether the balance of $207,295 is materially misstated.

Decide Whether Audit Sampling Applies

As stated in Chapter 15, "Audit sampling applies whenever the auditor plans to reach conclusions about a population based on a sample." Although auditors commonly sample in many accounts, in some situations sampling does not apply. For the population in Table 17-1, the auditor may decide to audit only items over $5,000 and ignore all others because the total of the smaller items is immaterial. Similarly, if the auditor is verifying fixed asset additions and finds many small additions and one extremely large purchase of a building, the auditor may decide to ignore the small items entirely. In either case, the auditor has not sampled.

Define a Misstatement

Because audit sampling for tests of details of balances measures monetary misstatements, a misstatement exists whenever a sample item is misstated. In auditing

TABLE 17-1 Illustrative Accounts Receivable Population

Population Item	Recorded Amount	Population Item (cont.)	Recorded Amount (cont.)
1	$ 1,410	21	$ 4,865
2	9,130	22	770
3	660	23	2,305
4	3,355	24	2,665
5	5,725	25	1,000
6	8,210	26	6,225
7	580	27	3,675
8	44,110	28	6,250
9	825	29	1,890
10	1,155	30	27,705
11	2,270	31	935
12	50	32	5,595
13	5,785	33	930
14	940	34	4,045
15	1,820	35	9,480
16	3,380	36	360
17	530	37	1,145
18	955	38	6,400
19	4,490	39	100
20	17,140	40	8,435
			$207,295

accounts receivable, any client misstatement in a customer balance included in the auditor's sample is a misstatement.

Define the Population

In tests of details of balances, the population is defined as the items making up the *recorded dollar population*. The recorded population of accounts receivable in Table 17-1 consists of 40 accounts totaling $207,295. Most accounting populations that auditors sample will, of course, include far more items totaling a much larger dollar amount. The auditor will evaluate whether the recorded population is overstated or understated.

Stratified Sampling For many populations, auditors separate the population into two or more subpopulations before applying audit sampling. This is called **stratified sampling**, where each subpopulation is a called a stratum. Stratification enables the auditor to emphasize certain population items and deemphasize others. In most audit sampling situations, including confirming accounts receivable, auditors want to emphasize the larger recorded dollar values, so they define each stratum on the basis of the size of recorded dollar values.

By examining the population in Table 17-1, you can see that there are different ways to stratify the population. Assume that the auditor decided to stratify as follows:

Stratum	Stratum Criteria	No. in Population	Dollars in Population
1	>$15,000	3	$ 88,955
2	$5,000–$15,000	10	71,235
3	<$5,000	27	47,105
		40	$207,295

There are many alternative ways to stratify this population. One example is to have four strata (make stratum 3 items between $2,000 and $5,000, and add a fourth stratum for items less than $2,000).

Define the Sampling Unit

For nonstatistical audit sampling in tests of details of balances, the sampling unit is almost always the items making up the account balance. For example, for the accounts receivable in Table 17-1 the sampling unit will be the customer number. Auditors can use the items making up the recorded population as the sampling unit for testing all audit objectives except completeness. If auditors are concerned about the completeness objective they should select the sample from a different source, such as customers or vendors with zero balances. Accordingly, the sampling unit for a completeness test will be customers with zero balances.

Specify Tolerable Misstatement

Tolerable misstatement is the application of performance materiality to a particular sampling procedure. Performance materiality was defined in Chapter 9 and is an amount set less than materiality for the financial statements as a whole and applied to audit segments to reduce to an appropriately low level the probability that the aggregate of uncorrected and undetected misstatements exceeds materiality for the financial statements as a whole. Tolerable misstatement may be the same amount as performance materiality, or may be lower if the population from which the sample is selected is smaller than the account balance. Auditors seek an appropriate level of assurance that the actual misstatements in the population do not exceed tolerable misstatement. The required sample size increases as tolerable misstatement decreases for the sampling procedure.

Specify Acceptable Risk of Incorrect Acceptance

For all statistical and nonstatistical sampling applications, auditors risk making incorrect quantitative conclusions about the population. This is always true unless the auditor tests 100 percent of the population.

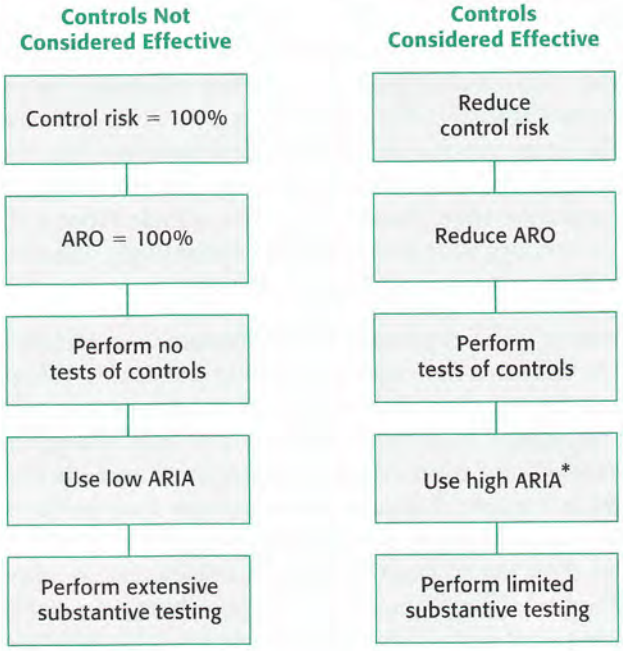
Acceptable risk of incorrect acceptance (ARIA) is the risk that the sample supports the conclusion that the recorded account balance is not materially misstated when it is materially misstated. ARIA measures the auditor's desired assurance for an account balance. For greater assurance in auditing a balance, auditors will set ARIA lower. Note that ARIA is the equivalent term to ARO (acceptable risk of overreliance) for tests of controls and substantive tests of transactions. Like for ARO, ARIA can be set quantitatively (such as 5% or 10%), or qualitatively (such as low, medium, or high).

There is an inverse relationship between ARIA and required sample size. If, for example, an auditor decides to reduce ARIA from 10 percent to 5 percent, the required sample size will increase. Stated differently, if the auditor is less willing to take risk, a larger sample size is needed.

An important factor affecting the auditor's decision about ARIA is assessed control risk in the audit risk model. When internal controls are effective, control risk can be reduced, permitting the auditor to increase ARIA. This, in turn, reduces the sample size required for the test of details of the related account balance.

You need to understand how ARO and ARIA interact to affect evidence accumulation. You already know from earlier chapters that tests of details of balances for monetary misstatements can be reduced if auditors find internal controls effective after assessing control risk and performing tests of controls. The effects of ARO and ARIA are consistent with that conclusion. If the auditor concludes that internal controls are likely to be effective, preliminary control risk can be reduced. A lower control risk requires a lower ARO in testing the controls, which requires a larger sample size. If controls are found to be effective, control risk can remain low, which permits the auditor to increase ARIA (through use of the audit risk model), thereby requiring a smaller sample size in the related substantive tests of details of balances. Figure 17-1 (p. 580) shows the effect of ARO and ARIA on substantive testing when controls are not considered effective and when they are considered effective.

FIGURE 17-1 **Effect of ARO and ARIA on Substantive Testing**



*Assumes tests of controls results were satisfactory, which permits control risk to remain low.

In addition to control risk, ARIA is directly affected by acceptable audit risk and inversely affected by other substantive tests already performed (or planned) for the account balance. If auditors reduce acceptable audit risk, they should also reduce ARIA. If analytical procedures indicate that the account balance is likely to be fairly stated, ARIA can be increased. In other words, analytical procedures are evidence supporting the account balance, meaning auditors require smaller sample sizes in tests of details of balances to achieve the desired acceptable audit risk. The same conclusion is appropriate for the relationship among substantive tests of transactions, ARIA, and sample size for tests of details of balances. The various relationships affecting ARIA are summarized in Table 17-2.

TABLE 17-2 **Relationship Among Factors Affecting ARIA, Effect on ARIA, and Required Sample Size for Audit Sampling**

Factor Affecting ARIA	Example	Effect on ARIA	Effect on Sample Size
Effectiveness of internal controls (control risk)	Internal controls are effective (reduced control risk).	Increase	Decrease
Substantive tests of transactions	No exceptions were found in substantive tests of transactions.	Increase	Decrease
Acceptable audit risk	Likelihood of bankruptcy is low (increased acceptable audit risk).	Increase	Decrease
Analytical procedures	Analytical procedures are performed with no indications of likely misstatements.	Increase	Decrease

TABLE 17-3 Factors Influencing Sample Sizes for Tests of Details of Balances

Factor	Conditions Leading to Smaller Sample Size	Conditions Leading to Larger Sample Size
Inherent risk—Affects acceptable risk of incorrect acceptance	Low inherent risk	High inherent risk
Control risk (ARO)—Affects acceptable risk of incorrect acceptance	Low control risk	High control risk
Results of other substantive procedures related to the same assertion (including analytical procedures and other relevant substantive tests)—Affect acceptable risk of incorrect acceptance	Satisfactory results in other related substantive procedures	Unsatisfactory results in other related substantive procedures
Tolerable misstatement for a specific account	Larger tolerable misstatement	Smaller tolerable misstatement
Expected size and frequency of misstatements—Affect estimated misstatements in the population	Smaller misstatements or lower frequency	Larger misstatements or higher frequency
Dollar amount of population	Smaller account balance	Larger account balance
Number of items in the population	Almost no effect on sample size unless population is very small	Almost no effect on sample size unless population is very small

Estimate Misstatements in the Population

The auditor typically makes this estimate based on prior experience with the client and by assessing inherent risk, considering the results of tests of controls, substantive tests of transactions, and analytical procedures already performed. The planned sample size increases as the amount of misstatements expected in the population approaches tolerable misstatement.

Determine the Initial Sample Size

When using nonstatistical sampling, auditors determine the initial sample size by considering the factors we've discussed so far. Table 17-3 summarizes these factors, including the effect of changing each factor on sample size. It shouldn't be surprising that considering all of these factors requires considerable judgment. Sample sizes between nonstatistical and statistical sampling should be similar. Accordingly, the auditor may determine the sample size for nonstatistical sampling using monetary unit sampling tables, which is discussed in the next section. Figure 17-2 (p. 582) presents a simple formula for computing sample size based on the AICPA *Audit Sampling* Audit Guide.

Assume an auditor applied this formula to the population in Table 17-1 (p. 578) and that tolerable misstatement is $15,000. The auditor decided to eliminate from the recorded population the three items making up the first stratum because they exceed tolerable misstatement. These three individually material accounts will be tested separately. The remaining population to be sampled is $118,340, which is the combined amount of stratum 2 and 3. Further, assume that the combined assessed inherent and control risk is moderate and that there is a moderate risk that substantive tests of transactions and substantive analytical procedures will not detect a material misstatement. Considering these factors, the auditor determined that a 14% risk of incorrect acceptance (86% assurance) was appropriate. Using the table in Figure 17-2, the auditor applied a confidence factor of 2, and the computed sample size is 16 [($118,340/$15,000) x 2 = 15.8].

When auditors use stratified sampling, they must allocate sample size among the strata, typically allocating a higher portion of the sample items to larger population items. In the example from Table 17-1, the auditor must test all items in stratum 1, which is not audit sampling. They decided to allocate the sample size of 16 to nine from stratum 2 and seven from stratum 3.

FIGURE 17-2 **Formula for Computing Nonstatistical Tests of Details of Balances Sample Size Based on AICPA Audit Sampling Formula**

$$\text{Sample size} = \frac{\text{Population Recorded Amount* x Confidence Factor}}{\text{Tolerable misstatement}}$$

Risk of Incorrect Acceptance	Confidence of Sample	Confidence Factor
37%	63%	1
14%	86%	2
5%	95%	3

*High risk items and individual items exceeding tolerable misstatement are often removed from the population and selected for 100 percent examination.

Select the Sample

For nonstatistical sampling, auditing standards permit the auditor to use any of the selection methods discussed in Chapter 15. The auditor will make the decision after considering the advantages and disadvantages of each method, including cost considerations.

For stratified sampling, the auditor selects samples independently from each stratum. In our example from Table 17-1 (p. 578), the auditor will select nine sample items from the 10 population items in stratum 2 and seven of the 27 items in stratum 3.

Perform the Audit Procedures

To perform the audit procedures, the auditor applies the appropriate audit procedures to each item in the sample to determine whether it contains a misstatement. In the confirmation of accounts receivable, auditors send the sample of positive confirmations in the manner described in Chapter 16 and determine the amount of misstatement in each account confirmed. For nonresponses, they use alternative procedures to determine the misstatements.

Referring to our example from Table 17-1 again, assume an auditor sends first and second requests for confirmations and performs alternative procedures. Also assume the auditor reaches the following conclusions about the sample after reconciling all timing differences:

		Dollars Audited		
Stratum	Sample Size	Recorded Value	Audited Value	Client Misstatement
1	3	$ 88,955	$ 91,695	$ (2,740)
2	9	43,995	43,024	971
3	7	13,105	10,947	2,158
Total	19	$ 146,055	$ 145,666	$ 389

Generalize from the Sample to the Population and Decide the Acceptability of the Population

The auditor must generalize from the sample to the population by (1) projecting misstatements from the sample results to the population and (2) considering sampling error and sampling risk (ARIA). In our example, will the auditor conclude that accounts receivable is overstated by $389? No, the auditor is interested in the *population* results, not those of the sample. It is therefore necessary to project from the sample to the population to estimate the population misstatement.

The first step is to calculate a **point estimate**. The point estimate can be calculated in different ways, but a common approach is to assume that misstatements in the unaudited population are proportional to the misstatements in the sample. That calculation must be done for each stratum and then totaled, rather than combining the total misstatements in the sample. In our example, the point estimate of the misstatement is calculated by using a weighted-average method, as shown next.

Stratum	Client Misstatement ÷ Recorded Value of the Sample	x	Recorded Book Value for the Stratum	=	Point Estimate of Misstatement
1	$ (2,740)/$88,955		$ 88,955		$ (2,740)
2	$ 971 /$43,995		71,235		1,572
3	$ 2,158 /$13,105		47,105		7,757
Total					$ 6,589

The point estimate of the misstatement in the population is $6,589, indicating an overstatement. The point estimate, by itself, is not an adequate measure of the population misstatement, however, because of sampling error. In other words, because the estimate is based on a sample, it will be close to the true population misstatement, but it is unlikely to be exactly the same. Whenever the point estimate ($6,589 in the example) is less than tolerable misstatement ($15,000 in the example), the auditor must consider the possibility that the true population misstatement is greater than the amount of misstatement that is tolerable in the circumstances. This must be done for both statistical and nonstatistical samples.

An auditor using nonstatistical sampling cannot formally measure sampling error and therefore must subjectively consider the possibility that the true population misstatement exceeds a tolerable amount. Auditors do this by considering:

1. The difference between the point estimate and tolerable misstatement (this is called calculated sampling error)
2. The extent to which items in the population have been audited 100 percent
3. Whether misstatements tend to be offsetting or in only one direction
4. The amounts of individual misstatements
5. The sample size

In our example, suppose that tolerable misstatement is $40,000. In that case, the auditor may conclude it is unlikely, given the point estimate of $6,589, that the true population misstatement exceeds the tolerable amount (calculated sampling error is $33,411).

Suppose that tolerable misstatement is $15,000 (as it was in the example), only $8,411 greater than the point estimate. In that case, the auditor will consider other factors. If the larger items in the population were audited 100 percent (as was done here), any unidentified misstatements will be restricted to smaller items. If the misstatements tend to be offsetting and are relatively small in size, the auditor may conclude that the true population misstatement is likely to be less than the tolerable amount. Also, the larger the sample size, the more confident the auditor can be that the point estimate is close to the true population value. In this example, when sample size is considered large, auditors will be more willing to accept that the true population misstatement is less than tolerable misstatement. However, if one or more of these other conditions differs, auditors may judge the chance of a misstatement in excess of the tolerable amount to be high and the recorded population unacceptable.

Even if the amount of likely misstatement is not considered material, the auditor must wait to make a final evaluation until the entire audit is completed. The estimated total misstatement and estimated sampling error in accounts receivable must be combined with estimates of misstatements in all other parts of the audit to evaluate the effect of all misstatements on the financial statements as a whole. However, regardless of whether the sample results support the conclusion that the account is not materially misstated, the auditor should request that the client record an adjustment for the factual misstatements, unless they are clearly trivial.

Analyze the Misstatements

It is essential for auditors to evaluate the nature and cause of each misstatement found in tests of details of balances. For example, suppose that when the auditor confirmed accounts receivable, all misstatements resulted from the client's failure

to record returned goods. The auditor will determine why that type of misstatement occurred so often, the implications of the misstatements on other audit areas, the potential impact on the financial statements, and its effect on company operations. The same approach is followed for all misstatements.

The auditor must do misstatement analysis to decide whether any modification of the audit risk model is needed. In the preceding paragraph, if the auditor concluded that the failure to record the returns resulted from a breakdown of internal controls, it might be necessary to reassess control risk. That in turn will probably cause the auditor to reduce ARIA, which will increase planned sample size. As we discussed in Chapter 9, revisions of the audit risk model must be done with extreme care because the model is intended primarily for planning, not evaluating results.

Action When a Population Is Rejected

When the auditor concludes that the misstatement in a population may be larger than tolerable misstatement after considering sampling error, the population is not considered acceptable. At that point, an auditor has several possible courses of action.

Take No Action Until Tests of Other Audit Areas Are Completed Ultimately, the auditor must evaluate whether the financial statements taken as a whole are materially misstated. If offsetting misstatements are found in other parts of the audit, such as in inventory, the auditor may conclude that the estimated misstatements in accounts receivable are acceptable. Of course, before the audit is finalized, the auditor must evaluate whether a misstatement in one account may make the financial statements misleading even if there are offsetting misstatements.

Perform Expanded Audit Tests in Specific Areas If an analysis of the misstatements indicates that most of the misstatements are of a specific type, it may be desirable to restrict the additional audit effort to the problem area. For example, if an analysis of the misstatements in confirmations indicates that most of the misstatements result from failure to record sales returns, the auditor can make an extended search of returned goods to make sure that they have been recorded. However, care must be taken to evaluate

PARTNER CHARGED WITH FAILURE TO ADEQUATELY PROJECT AND EVALUATE SAMPLE ERRORS

Anicom was a national distributor of wire and cable products. Anicom officers and employees engaged in improper earnings management techniques that inflated Anicom's revenues by over $38 million and net income by over $20 million from the first quarter of 1998 through the first quarter of 2000, including extensive improper revenue recognition. Anicom recognized over 66 fictitious sales transactions to at least 38 different customers. Most of the fictitious sales transactions were created just prior to quarter-end, when it was clear that Anicom would not meet its revenue goals. These end-of-the-quarter sales transactions were either entirely fictitious or potential orders disguised as sales.

The partner on the engagement assessed Anicom as high-risk because of cash-flow problems, potential violations of debt covenants, and allegations of improper billing practices. Despite being aware of these red flags, the partner did not design audit procedures to test Anicom's accounts receivable more extensively than originally planned.

The audit firm's testing of Anicom's accounts receivable included confirming the existence and accuracy of 20 customer balances totaling $14,354,505 out of $98,182,737 in accounts receivable. The audit team could not confirm $1,152,965 of the $14,354,505 tested, resulting in an error rate of 8%. Projecting this error rate over the entire accounts receivable population indicates a potential misstatement of $7,854,619, which was material to Anicom's financial statements. However, the audit partner did not expand the confirmation procedures or subject the potentially misstated accounts receivable balances to further testing. Further, the audit firm performed alternative procedures for 17 of the 20 balances for which confirmation responses were not received. The auditors tested only $2,746,487, or 28% of the $9,817,038 in subsequent cash payments purportedly made by customers toward their balances.

Anicom was delisted by Nasdaq in 2000 and filed for bankruptcy in January 2001. The engagement audit partner was charged with improper professional conduct and violations of the Securities Exchange Act of 1934 and prohibited from practicing before the SEC.

Source: Securities and Exchange Commission Accounting and Auditing Enforcement Release No. 20678, August 11, 2004 (www.sec.gov).

the cause of all misstatements in the sample before a conclusion is reached about the proper emphasis in the expanded tests. Problems may exist in more than one area.

When auditors analyze a problem area and correct it by proposing an adjustment to the client's records, the sample items that led to isolating the problem area can then be shown as "correct." The point estimate can now be recalculated without the misstatements that have been "corrected." (This is only true when the error can be isolated to a specific area. Errors must generally be projected to the population being sampled, even if the client adjusts for the error.) With the new facts in hand, the auditor will also have to reconsider sampling error and the acceptability of the population.

Increase the Sample Size When the auditor increases the sample size, sampling error is reduced if the rate of misstatements in the expanded sample, their dollar amounts, and their direction are similar to those in the original sample. Therefore, increasing the sample size may satisfy the auditor's tolerable misstatement requirements.

Increasing the sample size enough to satisfy the auditor's tolerable misstatement standards is often costly, especially when the difference between tolerable misstatement and projected misstatement is small. Moreover, an increased sample size does not guarantee a satisfactory result. If the number, amount, and direction of the misstatements in the extended sample are proportionately greater or more variable than in the original sample, the results are still likely to be unacceptable.

For tests such as accounts receivable confirmation and inventory observation, it is often difficult to increase the sample size because of the practical problem of "reopening" those procedures once the initial work is done. By the time the auditor discovers that the sample was not large enough, several weeks have usually passed.

Despite these difficulties, sometimes the auditor must increase the sample size after the original testing is completed. It is much more common to increase sample size in audit areas other than confirmations and inventory observation, but it is occasionally necessary to do so even for these two areas. When stratified sampling is used, increased samples usually focus on the strata containing larger amounts, unless misstatements appear to be concentrated in some other strata.

Adjust the Account Balance When the auditor concludes that an account balance is materially misstated, the client may be willing to adjust the book value based on the sample results. In the preceding example, assume the client is willing to reduce book value by the amount of the point estimate ($6,589) to adjust for the estimate of the misstatement. The auditor's estimate of the misstatement is now zero, but it is still necessary to consider sampling error. Again, assuming a tolerable misstatement of $15,000, the auditor must now assess whether sampling error exceeds $15,000, not the $8,411 originally considered. If the auditor believes sampling error is $15,000 or less, accounts receivable is acceptable after the adjustment. If the auditor believes it is more than $15,000, adjusting the account balance is not a practical option.

Request the Client to Correct the Population In some cases, the client's records are so inadequate that a correction of the entire population is required before the audit can be completed. For example, in accounts receivable, the client may be asked to correct the accounts receivable records and prepare the accounts receivable listing again if the auditor concludes that it has significant misstatements. When the client changes the valuation of some items in the population, the results must be audited again.

Refuse to Give an Unqualified Opinion If the auditor believes that the recorded amount in an account is not fairly stated, it is necessary to follow at least one of the preceding alternatives or to qualify the audit report in an appropriate manner. If the auditor believes that there is a reasonable chance that the financial statements are materially misstated, it would be a serious breach of auditing standards to issue an unqualified opinion. For purposes of reporting on internal control, the material misstatement should be considered a potential indicator of a material weakness in internal control over financial reporting.

MONETARY UNIT SAMPLING

OBJECTIVE 17-3

Apply monetary unit sampling.

Now that we have discussed nonstatistical sampling, we will move on to statistical sampling, starting with monetary unit sampling, which is a statistical sampling methodology developed specifically for use by auditors. **Monetary unit sampling (MUS)** is the most commonly used statistical method of sampling for tests of details of balances because it has the statistical simplicity of attributes sampling yet provides a statistical result expressed in dollars (or another appropriate currency). MUS is also called dollar unit sampling, cumulative monetary amount sampling, and sampling with probability proportional to size.

Differences Between MUS and Nonstatistical Sampling

MUS is similar to using nonstatistical sampling. All 14 of the steps must also be performed for MUS, although some are done differently. Understanding those differences is the key to understanding MUS. Let's examine these differences in detail.

The Definition of the Sampling Unit Is an Individual Dollar A critical feature of MUS is the definition of the sampling unit as an individual dollar in an account balance. The name of the statistical method, monetary unit sampling, results from this distinctive feature. For example, in the population in Table 17-1 (p. 578), the sampling unit is 1 dollar and the population size is 207,295 dollars, not the 40 physical units discussed earlier. (A physical unit is an accounts receivable customer balance, an inventory item in an inventory listing, and other such identifiable units in a listing.)

By focusing on the individual dollar as the sampling unit, MUS automatically emphasizes physical units with larger recorded balances. Because the sample is selected on the basis of individual dollars, an account with a large balance has a greater chance of being included than an account with a small balance. For example, in accounts receivable confirmation, an account with a $5,000 balance has a 10 times greater probability of selection than one with a $500 balance, as it contains 10 times as many dollar units. As a result, stratified sampling is unnecessary with MUS. Stratification occurs automatically.

The Population Size Is the Recorded Dollar Population For example, the population of accounts receivable in Table 17-1 consists of 207,295 dollars, which is the population size, not the 40 accounts receivable balances. This is the recorded dollar amount of accounts receivable.

Because of the method of sample selection in MUS, which is discussed later, it is not possible to evaluate the likelihood of unrecorded items in the population. Assume, for example, that MUS is used to evaluate whether inventory is fairly stated. MUS cannot be used to evaluate whether certain inventory items exist but have not been counted. If the completeness objective is important in the audit test, and it usually is, that objective must be satisfied separately from the MUS tests.

Sample Size Is Determined Using a Formula We illustrate the calculation of sample sizes after we have discussed the 14 sampling steps for MUS.

Sample Selection Is Done Using PPS Monetary unit samples are samples selected with **probability proportional to size sample selection (PPS)**. PPS samples can be obtained by using computer software or systematic sampling techniques. Table 17-4 provides an illustration of an accounts receivable population, including cumulative totals that will be used to demonstrate selecting a sample.

Assume that the auditor wants to select a PPS sample of four accounts from the population in Table 17-4. Because the sampling unit is defined as an individual dollar, the population size is 7,376. Auditors often use fixed interval systematic sampling because all items greater than the sampling interval will be automatically selected for testing. However, as discussed earlier in the section on nonstatistical sampling, the auditor may choose to examine all the individually material times that are greater than tolerable misstatement, and sample the remaining items.

TABLE 17-4 Accounts Receivable Population

Population Item (Physical Unit)	Recorded Amount	Cumulative Total (Dollar Unit)
1	$ 357	$ 357
2	1,281	1,638
3	60	1,698
4	573	2,271
5	691	2,962
6	143	3,105
7	2,125	5,230
8	278	5,508
9	242	5,750
10	826	6,576
11	404	6,980
12	396	7,376

Using systematic selection, the sampling interval is 1,844 (7,376 ÷ 4) and the auditor then chooses a random start between 1 and 1,844 (the length of the sampling interval). Assume the auditor randomly selects a start of 822. The sample dollars selected for testing are 822; 2,666 (822 + 1,844); 4,510 (2,666 + 1,844); and 6,354 (4,510 + 1,844).

The population physical unit items that contain these random dollars are determined by reference to the cumulative total column. Looking again at Table 17-4, the items selected are items 2 (containing 358 through 1,638), 5 (dollars 2,272 through 2,962), 7 (dollars 3,106 through 5,230), and 10 (dollars 5,751 through 6,576). Note that item 7 is larger than the sampling interval and was therefore included in the sample using systematic selection. If a population item is several times larger than the sampling interval, it may be included in the sample more than once. Therefore, the actual number of units selected for testing may be less than the computed sample size.

The auditor may also use random selection of dollars, rather than systematic selection. Assume the auditor uses a computer program to generate four random numbers from between 1 and 7,376 to generate the sample and generates numbers 6,586; 1,756; 850; and 6,599. Referring again to Table 17-4, the items selected are items 11 (containing dollars 6,577 through 6,980), 4 (dollars 1,699 through 2,271), 2 (dollars 358 through 1,638), and 11 (dollars 6,577 through 6,599). These accounts will be audited because the cumulative total associated with these accounts includes the random dollars selected. Item 11 was treated as two sample items because it was randomly selected twice, even though the recorded balance of the account of $404 is much smaller than the sampling interval using systematic selection.

One problem using PPS selection is that population items with a zero recorded balance have no chance of being selected with PPS sample selection, even though they may be misstated. Similarly, small balances that are significantly understated have little chance of being included in the sample. This problem can be overcome by doing specific audit tests for zero- and small-balance items, assuming that they are of concern.

Another problem with PPS is its inability to include negative balances, such as credit balances in accounts receivable, in the PPS (monetary unit) sample. It is possible to ignore negative balances for PPS selection and test those amounts by some other means. An alternative is to treat them as positive balances and add them to the total number of monetary units being tested. However, this complicates the evaluation process.

The Auditor Generalizes from the Sample to the Population Using MUS Techniques Regardless of the sampling method selected, the auditor must generalize from the sample to the population by (1) projecting misstatements from the sample results to the population and (2) determining the related sampling error. The statistical result when MUS is used is called a **misstatement bound.** The misstatement bound is an estimate of the likely maximum overstatement at a given ARIA. The discussion and example that follow are limited to overstatements because MUS is designed primarily to test for overstatements. Calculation of misstatement bounds is usually done using audit software or computer templates. We illustrate the calculation of the projected misstatement and misstatement bound in the next section after we discuss the 14 sampling steps for MUS.

Decide the Acceptability of the Population Using MUS

The auditor compares the calculated misstatement bound to tolerable misstatement. If the bound exceeds tolerable misstatement, the population is not considered acceptable. The options available to the auditor when the population is rejected are the same ones already discussed for nonstatistical sampling on pages 584–585.

Now that we have discussed the differences between MUS and nonstatistical sampling for tests of details of balances, we examine the determination of sample sizes and calculation of misstatement bounds in further detail.

Determining Sample Sizes Using MUS

We illustrate the formula for computing sample sizes using MUS based on the AICPA *Audit Sampling* Audit Guide. We first discuss the factors used in computing sample size.

Acceptable Risk of Incorrect Acceptance ARIA is an auditor judgment of the level assurance required for the sampling application. As illustrated in Figure 17-1 and Table 17-2 (both on page 580), ARIA depends on audit risk model factors and the amount of assurance provide by analytical procedures and other substantive tests. For this example, we will assume that the auditor concluded an ARIA of 10 percent was appropriate.

Recorded Population Value The dollar value of the population is taken from the client's records. For this example, it is $5 million.

Tolerable Misstatement Tolerable misstatement is generally the same as performance materiality, but the auditor may decrease the amount of tolerable misstatement if less than 100 percent of the population is tested. For this example, tolerable misstatement is $150,000.

Tolerable Misstatement as a Percentage of Population Value The auditor computes tolerable misstatement as a percentage of the population recorded value. This equals .03 ($150,000 ÷ $5,000,000) based on the example tolerable misstatement and population value.

Estimated Population Misstatement MUS is most often used when no or few misstatements are expected. The estimated population misstatement is usually based on the sample results for the prior year. For this example, a $15,000 overstatement is expected.

Ratio of Estimated Population Misstatement to Tolerable Misstatement The auditor computes the ratio of estimated misstatement to tolerable misstatement. The ratio equals .10 ($15,000 ÷ $150,000) for this example.

Confidence Factor The auditor uses Table 17-5 to determine an appropriate confidence factor based on the auditor's judgment of ARIA and the ratio of expected misstatement to tolerable misstatement. Based on an ARIA of 10 percent and a ratio of expected to tolerable misstatement of .10, the appropriate confidence factor is 2.77.

Sample Size The appropriate sample size is then calculated as the confidence factor divided by the tolerable misstatement as a percentage of the population value.

TABLE 17-5 Confidence Factors for Monetary Unit Sample Size Design*

Ratio of Expected to Tolerable Misstatement	Risk of Incorrect Acceptance							
	5%	10%	15%	20%	25%	30%	35%	50%
0.00	3.00	2.31	1.90	1.61	1.39	1.21	1.05	0.70
0.05	3.31	2.52	2.06	1.74	1.49	1.29	1.12	0.73
0.10	3.68	2.77	2.25	1.89	1.61	1.39	1.20	0.77
0.15	4.11	3.07	2.47	2.06	1.74	1.49	1.28	0.82
0.20	4.63	3.41	2.73	2.26	1.90	1.62	1.38	0.87
0.25	5.24	3.83	3.04	2.49	2.09	1.76	1.50	0.92
0.30	6.00	4.33	3.41	2.77	2.30	1.93	1.63	0.99
0.35	6.92	4.95	3.86	3.12	2.57	2.14	1.79	1.06
0.40	8.09	5.72	4.42	3.54	2.89	2.39	1.99	1.14
0.45	9.59	6.71	5.13	4.07	3.29	2.70	2.22	1.25
0.50	11.54	7.99	6.04	4.75	3.80	3.08	2.51	1.37
0.55	14.18	9.70	7.26	5.64	4.47	3.58	2.89	1.52
0.60	17.85	12.07	8.93	6.86	5.37	4.25	3.38	1.70

*Source: Data from AICPA *Audit Sampling* Audit Guide, March 1, 2012 (www.aicpa.org).

$$\text{Sample Size} = \frac{\text{Confidence Factor (2.77)}}{\text{Tolerable Misstatement as Percentage of Population Value (.03)}} = 93 \text{ (rounded up)}$$

Sampling Interval The appropriate sampling interval can now be computed as the population recorded amount of $5 million divided by the sample size of 93.

$$\text{Sampling Interval} = \$5{,}000{,}000 \div 93 = \$53{,}763$$

TABLE 17-6 Summary of Steps to Calculate Sample Size in MUS

Steps to Calculate Sample Size	Amount	Source or Calculation
1. Determine ARIA	10%	Determined based on factors in Table 17-2 (p. 580)
2. Population recorded value	$5,000,000	–
3. Tolerable misstatement	$150,000	–
4. Tolerable misstatement as percentage of population value	3%	$150,000 ÷ $5,000,000
5. Estimated population misstatement	$15,000	Based on prior year results
6. Ratio of estimated population misstatement to tolerable misstatement	.10	$15,000 ÷ $150,000
7. Confidence factor	2.77	Table 17-5 based on ARIA of 10% and ratio of expected to tolerable misstatement of .10
8. Calculate sample size	93	2.77 ÷ .03 (confidence factor divided by tolerable misstatement as a percentage of population value)
9. Calculate sampling interval	$53,763	$5,000,000 ÷ 93

The steps involved in calculating the sample size are illustrated in Table 17-6 (p. 589). The formula method is just one method of determining sample size using MUS. The *Audit Sampling* Audit Guide also provides tables to determine sample size based on ARIA, the tolerable misstatement as a percentage of the population, and ratio of expected to tolerable misstatement. Because MUS is based on attribute theory, the attribute sampling tables in Table 15-8 (p. 522) can also be used. ARIA is used instead of ARO, the tolerable misstatement as a percentage of the population value is used for the tolerable exception rate, and the ratio of estimated population misstatement to tolerable misstatement is used for the estimated population exception rate.

Generalizing From the Sample to the Population When No Misstatements are Found Using MUS

After performing tests on the sample items, the auditor projects the sample misstatements to the population and calculates an allowance for sampling risk when using MUS. If the entire sample is audited and no misstatements are found in the sample, the auditor may conclude without making additional calculations that the recorded amount of the population is not overstated by more than tolerable misstatement at the specified risk of incorrect acceptance. The upper limit when no misstatements are found is the confidence factor for no misstatements multiplied by the length of the sampling interval.

Suppose that the auditor is confirming a population of accounts receivable for monetary correctness. The population totals $1,200,000, and a sample of 100 confirmations is obtained. Upon audit, no misstatements are uncovered in the sample. Assuming an ARIA of 5%, the confidence factor from Table 17-7 is 3.0. Applied to a sampling interval of $12,000 (population of $1,200,000 ÷ 100 sample items = $12,000 sampling interval) the upper misstatement bound is calculated as:

$$\text{Upper misstatement bound} = \$12{,}000 \times 3.0 = \$36{,}000$$

The upper limit when no misstatements are found is also referred to as **basic precision**, and represents the minimum allowance for sampling risk inherent in the sample. For this example, because no misstatements were found, the projected misstatement is zero, and the allowance for sampling risk equals the upper limit on misstatement of $36,000.

TABLE 17-7 Confidence Factors for Monetary Unit Sample Size Evaluation*

Number of Overstatement Misstatements	Risk of Incorrect Acceptance							
	5%	10%	15%	20%	25%	30%	35%	50%
0	3.00	2.31	1.90	1.61	1.39	1.21	1.05	0.70
1	4.75	3.89	3.38	3.00	2.70	2.44	2.22	1.68
2	6.30	5.33	4.73	4.28	3.93	3.62	3.35	2.68
3	7.76	6.69	6.02	5.52	5.11	4.77	4.46	3.68
4	9.16	8.00	7.27	6.73	6.28	5.90	5.55	4.68
5	10.52	9.28	8.50	7.91	7.43	7.01	6.64	5.68
6	11.85	10.54	9.71	9.08	8.56	8.12	7.72	6.67
7	13.15	11.78	10.90	10.24	9.69	9.21	8.79	7.67
8	14.44	13.00	12.08	11.38	10.81	10.31	9.85	8.67
9	15.71	14.21	13.25	12.52	11.92	11.39	10.92	9.67
10	16.97	15.41	14.42	13.66	13.02	12.47	11.98	10.67

*Source: Data from AICPA *Audit Sampling* Audit Guide, March 1, 2012 (www.aicpa.org). Misstatements greater than 10 not illustrated.

TABLE 17-8 Taintings – Percent of Misstatement

Customer No.	Recorded Accounts Receivable Amount	Audited Accounts Receivable Amount	Factual Misstatement	Tainting = Misstatement ÷ Recorded Amount
2073	$ 6,200	$ 6,100	$ 100	.016
5111	12,910	12,000	910	N/A (1)
9816	8,947	2,947	$6,000	.671

(1) Tainting is N/A because recorded amount is greater than the sampling interval. In this situation, the projected misstatement equals the actual misstatement.

Generalizing From the Sample to the Population When Misstatements are Found Using MUS

Assume that the auditor tested the sample and found the three overstatements included in Table 17-8. Calculating the upper misstatement bound involves three steps.

1. Calculate the percentage misstatement for each misstatement.
2. Project the sample misstatements by multiplying the percentage misstatement by the length of the sampling interval.
3. Add an allowance for sampling risk based on the confidence factors for the actual number of misstatements and acceptable risk of incorrect acceptance.

Calculate Percentage Misstatement Assumption (Tainting) When misstatements are found, the auditor calculates a projected misstatement and an allowance for sampling risk. The percent of misstatement in the sampling unit represents the percentage of misstatement or tainting for the entire sampling interval, which is calculated by dividing the misstatement by the recorded amount. Table 17-8 indicates the taintings for the three misstatements found in the sample. The misstatements are ranked by percentage tainting for calculation of the allowance for sampling risk.

Project Sample Misstatements The projected misstatement is the percentage misstatement times the sampling interval, since the percentage of misstatement or tainting is for the whole sampling interval. For example, if the sampling interval is $10,000 and a recorded amount of $100 has an audited value of $75, the projected misstatement is $2,500 ($25 misstatement is 25% of the recorded amount x $10,000 sampling interval). If the recorded amount of the sample item is greater than the

TABLE 17-9 Calculation of Projected Misstatement and Allowance for Sampling Risk

A	B	C	D	E	F	G	H
Recorded Amount	Audit Amount	Factual Misstatement (A - B)	Tainting (C ÷ A)	Sampling Interval	Projected Misstatement (D × E)	(see Table 17-10 on page 592) Incremental Change in Confidence Factor	Projected Misstatement Plus Incremental Allowance for Sampling Risk (F × G)
$12,910	$12,000	$ 910	N/A (1)	N/A (1)	$ 910	N/A	$ 910
8,947	2,947	6,000	67.1%	12,000	8,052	1.75	14,091
6,200	6,100	100	1.6%	12,000	192	1.55	298
Totals		$7,010			$9,154		$15,299
Add basic precision							36,000
Upper misstatement bound							$51,299

(1) Tainting is N/A because recorded amount is greater than the sampling interval. In this situation, the projected misstatement equals the actual misstatement.

TABLE 17-10	Incremental Changes in Confidence Factor—Five Percent Risk of Incorrect Acceptance	
Number of Overstatements	**Confidence Factor**	**Incremental Changes in Factor**
0	3.00	–
1	4.75	1.75
2	6.30	1.55
3	7.76	1.46
4	9.16	1.40
5	10.52	1.36

sampling interval, then the projected misstatement equals the actual sample misstatement. Table 17-9 (p. 591) indicates the calculation of projected misstatement for the three actual sample misstatements.

Calculate the Allowance for Sampling Risk The projected misstatement is increased by the allowance for sampling risk, which is calculated as basic precision plus an incremental allowance for sampling risk for each misstatement found in sampling units that are smaller than the sampling interval. There is no incremental allowance for sampling risk in sampling units that are greater than the sampling interval since all of the monetary units in the sampling interval were examined.

A conservative approach is to rank the misstatements by percentage tainting. The misstatements are then multiplied by the incremental change in the confidence factor to compute the projected misstatement plus the incremental allowance for sampling risk. Table 17-10 provides an example of the incremental changes in the confidence factor for five misstatements and a 5% ARIA.

The last two columns of Table 17-9 show the incremental changes in the confidence factor, and projected misstatement plus the incremental allowance for sampling risk. Including the basic precision of $36,000, the upper misstatement bound is $51,299. Therefore, based on an ARIA of 5%, the auditor can state that there is a 5 percent risk that the recorded amount is overstated by more than $51,299.

The sample results can be summarized as follows:

- The sample contains factual misstatements of $7,010.
- The total factual and projected misstatement is $9,154.
- The upper misstatement bound representing the total factual and projected misstatement plus an allowance for sampling risk is $51,299.
- The allowance for sampling risk representing basic precision and the incremental allowance for sampling risk is $42,145 [$36,000 basic precision + $6,145 incremental allowance for sampling risk ($15,299 – $9,154)].

The results are considered acceptable if the upper misstatement bound of $51,299 is less than tolerable misstatement. If the upper misstatement bound exceeds tolerable misstatement, the population is not acceptable based on the results of the sample, and the auditor will take one or more of the actions discussed on pages 584–585.

Relationship of the Audit Risk Model to Sample Size for MUS The audit risk model for planning was introduced in Chapter 9 and covered in subsequent chapters as:

$$PDR = \frac{AAR}{IR \times CR}$$

(See pages 279–281 for description of the terms.)

Chapter 16 discussed how the auditor reduces detection risk to the planned level by performing substantive tests of transactions, substantive analytical procedures,

and tests of details of balances. MUS is used in performing tests of details of balances. Therefore, auditors need to understand the relationship of the three independent factors in the audit risk model, plus analytical procedures and substantive tests of transactions, to sample size for tests of details of balances.

Table 17-2 on page 580 shows that four of these five factors (control risk, substantive tests of transactions, acceptable audit risk, and substantive analytical procedures) affect ARIA. ARIA in turn determines the planned sample size. The other factor, inherent risk, affects the estimated population exception rate directly.

Audit Uses of Monetary Unit Sampling

MUS appeals to auditors for at least four reasons:

1. MUS automatically increases the likelihood of selecting high dollar items from the population being audited. Auditors make a practice of concentrating on these items because they generally represent the greatest risk of material misstatements. Stratified sampling can also be used for this purpose, but MUS is often easier to apply.
2. MUS often reduces the cost of doing the audit testing because several sample items are tested at once. For example, if one large item makes up 10 percent of the total recorded dollar value of the population and the sample size is 100, the PPS sample selection method is likely to result in approximately 10 percent of the sample items from that one large population item. Naturally, that item needs to be audited only once, but it counts as a sample of 10. If the item is misstated, it is also counted as 10 misstatements. Larger population items may be eliminated from the sampled population by auditing them 100 percent and evaluating them separately, if the auditor so desires.
3. MUS is easy to apply. Monetary unit samples can be evaluated by the application of simple tables. It is easy to teach and to supervise the use of MUS techniques. Firms that utilize MUS extensively use audit software or other computer programs that streamline sample size determination and evaluation even further than shown in this chapter.
4. MUS provides a statistical conclusion rather than a nonstatistical one. Many auditors believe that statistical sampling aids them in making better and more defensible conclusions.

There are two main disadvantages of MUS.

1. The total misstatement bounds resulting when misstatements are found may be too high to be useful to the auditor. This is because these evaluation methods are inherently conservative when misstatements are found and often produce bounds far in excess of materiality. To overcome this problem, large samples may be required.
2. It may be cumbersome to select PPS samples from large populations without computer assistance.

For all these reasons, auditors commonly use MUS when zero or few misstatements are expected, a dollar result is desired, and the population data are maintained on computer files.

VARIABLES SAMPLING

OBJECTIVE 17-4

Describe variables sampling.

Variables sampling, like MUS, is a statistical method that auditors use. Variables sampling and nonstatistical sampling for tests of details of balances have the same objective—to measure the misstatement in an account balance. As with nonstatistical sampling, when auditors determine that the misstatement amount exceeds the tolerable amount, they reject the population and take additional actions.

Several sampling techniques make up the general class of methods called variables sampling: difference estimation, ratio estimation, and mean-per-unit estimation. These are discussed later.

Differences Between Variables and Nonstatistical Sampling

The use of variables methods shares many similarities with nonstatistical sampling. All 14 steps we discussed for nonstatistical sampling must be performed for variables methods, and most are identical. Some of the differences between variables and nonstatistical sampling are examined after we discuss sampling distributions.

Sampling Distributions

To understand why and how auditors use variables sampling methods in auditing, it is useful to understand sampling distributions and how they affect auditors' statistical conclusions. The auditor does not know the mean value (average) of misstatements in the population, the distribution of the misstatement amounts, or the audited values. These population characteristics must be *estimated* from samples, which, of course, is the purpose of the audit test.

Assume that an auditor, as an experiment, took thousands of repeated samples of equal size from a population of accounting data having a mean value of $\overline{X}$. For each sample, the auditor calculates the mean value of the items in the sample as follows:

$$\bar{x} = \frac{\Sigma x_j}{n}$$

where:

$\bar{x}$ = mean value of the sample items

x_j = value of each individual sample item

n = sample size

After calculating ($\bar{x}$) for each sample, the auditor plots them into a frequency distribution. As long as the sample size is sufficient, the frequency distribution of the sample means will appear much like that shown in Figure 17-3.

A distribution of the sample means such as this is normal and has all the characteristics of the normal curve: (1) the curve is symmetrical, and (2) the sample means fall within known portions of the sampling distribution around the average or mean of those means, measured by the distance along the horizontal axis in terms of standard deviations.

Furthermore, the mean of the sample means (the midpoint of the sampling distribution) is equal to the population mean, and the standard deviation of the sampling distribution is equal to $SD/\sqrt{n}$, where SD is the population standard deviation and n is the sample size.

To illustrate, assume a population with a mean of $40 and a standard deviation of $15 ($\overline{X}$ = $40 and SD = $15), from which we elected to take many random samples of 100 items each. The standard deviation of our sampling distribution is $1.50 ($SD/\sqrt{n} = 15/\sqrt{100} = 1.50$). The reference to "standard deviation" of the population

FIGURE 17-3 **Frequency Distribution of Sample Means**

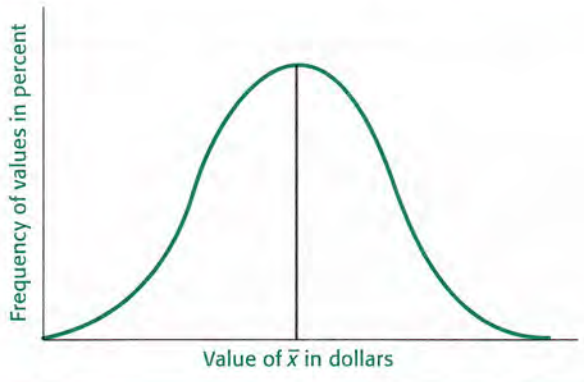


TABLE 17-11 **Calculated Sampling Distribution from a Population with a Known Mean and Standard Deviation**

(1) Number of Standard Errors of the Mean (Confidence Coefficient)	(2) Value [(1) × $1.50]	(3) Range Around $\bar{X}$ [$40 +/- (2)]	(4) Percent of Sample Means Included in Range
1	$1.50	$38.50 – $41.50	68.2
2	$3.00	$37.00 – $43.00	95.4
3	$4.50	$35.50 – $44.50	99.7
		(taken from table for normal curve)	

and to "standard deviation" of the sampling distribution is often confusing. To avoid confusion, remember that the standard deviation of the distribution of the sample means is often called the standard error of the mean (SE). With this information, auditors can make the tabulation of the sampling distribution, as shown in Table 17-11 above.

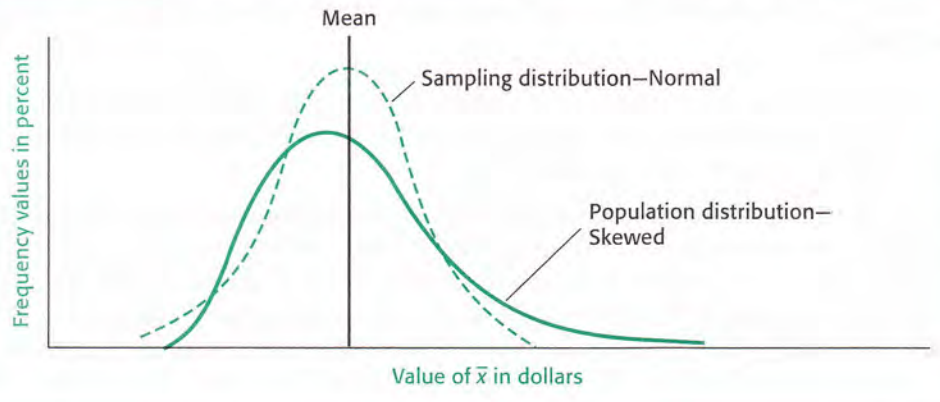
To summarize, three things shape the results of the experiment of taking a large number of samples from a known population:

1. The mean value of all the sample means is equal to the population mean ($\bar{X}$). A corollary is that the sample mean value ($\bar{x}$) with the highest frequency of occurrence is also equal to the population mean.
2. The shape of the frequency distribution of the sample means is that of a normal distribution (curve), as long as the sample size is sufficiently large, *regardless of the distribution of the population*, as illustrated in Figure 17-4.
3. The percentage of sample means between any two values of the sampling distribution is measurable. The percentage can be calculated by determining the number of standard errors between any two values and determining the percentage of sample means represented from a table for normal curves.

Statistical Inference

Naturally, when samples are taken from a population in an actual audit situation, the auditor does not know the population's characteristics and, ordinarily, only one sample is taken from the population. But the *knowledge of sampling distributions* enables auditors to draw statistical conclusions, or **statistical inferences**, about the

FIGURE 17-4 **Sampling Distribution for a Population Distribution**



population. For example, assume that the auditor takes a sample from a population and calculates ($\bar{x}$) as \$46 and SE at \$9. (We'll explain how SE is calculated later.) We can now calculate a confidence interval of the population mean using the logic gained from the study of sampling distributions. It is as follows:

$$CI_{\bar{x}} = \hat{\bar{X}} \pm Z \cdot SE$$

where: $CI_{\bar{x}}$ = confidence interval for the population mean

$\hat{\bar{X}}$ = point estimate of the population mean

Z = confidence coefficient { 1 = 68.2% confidence level; 2 = 95.4% confidence level; 3 = 99.7% confidence level }

SE = standard error of the mean

$Z \cdot SE$ = precision interval

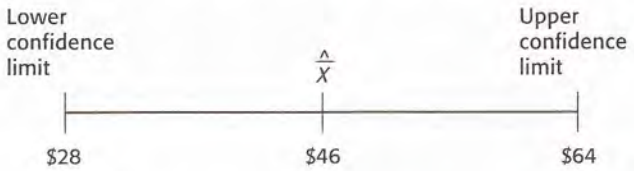
For the example:

$CI_{\bar{x}} = \$46 \pm 1(\$9) = \$46 \pm \$9$ at a 68.2% confidence level

$CI_{\bar{x}} = \$46 \pm 2(\$9) = \$46 \pm \$18$ at a 95.4% confidence level

$CI_{\bar{x}} = \$46 \pm 3(\$9) = \$46 \pm \$27$ at a 99.7% confidence level

The results can also be stated in terms of confidence limits ($CI_{\bar{x}}$). The upper confidence limit ($UCL_{\bar{x}}$) is $\hat{\bar{X}} + Z \cdot SE$ (\$46 + \$18 = \$64 at a 95 percent confidence level) and a lower confidence limit ($LCL_{\bar{x}}$) is $\hat{\bar{X}} - Z \cdot SE$ (\$46 – \$18 = \$28 at a 95 percent confidence level). Graphically, the results are as follows:



Auditors can state the conclusions drawn from a confidence interval using statistical inference in different ways. However, they must take care to avoid incorrect conclusions, remembering that the true population value is always unknown. There is always a possibility that the sample is not sufficiently representative of the population to provide a sample mean and/or standard deviation reasonably close to those of the population. The auditor can say, however, that the procedure used to obtain the sample and compute the confidence interval will provide an interval that will contain the true population mean value a given percent of the time. In short, the auditor knows the reliability of the statistical inference process that is used to draw conclusions.

Variables Methods

Auditors use the preceding statistical inference process for all the variables sampling methods. Each method is distinguished by what is being measured. Let's examine the three variables methods individually.

Difference Estimation Auditors use **difference estimation** to measure the estimated total misstatement amount in a population when both a recorded value and an audited value exist for each item in the sample, which is almost always the case in audits. For example, an auditor might confirm a sample of accounts receivable and determine the difference (misstatement) between the client's recorded amount and the amount the auditor considers correct for each selected account. The auditor makes

an estimate of the population misstatement based on the number of misstatements in the sample, average misstatement size, individual misstatements in the sample, and sample size. The result is stated as a point estimate of the population misstatement plus or minus a computed precision interval at a stated confidence level. Referring back to the discussion of sampling distributions, assume the auditor confirmed a random sample of 100 from a population of 1,000 accounts receivable and concluded that the confidence limits of the mean of the misstatement for accounts receivable were between $28 and $64 at a 95 percent confidence level. The estimate of the total population misstatement can also be easily calculated as being between $28,000 and $64,000 at a 95 percent confidence level (1,000 x $28 and 1,000 x $64). If the auditor's tolerable misstatement is $100,000, the population is clearly acceptable. If tolerable misstatement is $40,000, the population is not acceptable. An illustration using difference estimation is shown on pages 599–602.

Difference estimation frequently results in smaller sample sizes than any other method, and it is relatively easy to use. For that reason, difference estimation is often the preferred variables method.

Ratio Estimation **Ratio estimation** is similar to difference estimation except the auditor calculates the ratio between the misstatements and their recorded value and projects this to the population to estimate the total population misstatement. For example, assume that an auditor finds misstatements totaling $12,000 in a sample with a recorded value of $208,000. The misstatement ratio is .06 ($12,000/$208,000). If the total recorded value of the population is $1,040,000 the projected misstatement in the population is $62,400 ($1,040,000 x .06). The auditor can then calculate confidence limits of the total misstatement for ratio estimation with a calculation similar to the one shown for difference estimation. Ratio estimation can result in sample sizes even smaller than difference estimation if the size of the misstatements in the population is proportionate to the recorded value of the population items. If the size of the individual misstatements is independent of the recorded value, difference estimation results in smaller sample sizes. Most auditors prefer difference estimation because it is somewhat simpler to calculate confidence intervals.

Mean-per-Unit Estimation In **mean-per-unit estimation**, the auditor focuses on the audited value rather than the misstatement amount of each item in the sample. Except for the definition of what is being measured, the mean-per-unit estimate is calculated in exactly the same manner as the difference estimate. The point estimate of the audited value equals the average audited value of items in the sample times the population size. The computed precision interval is calculated on the basis of the audited value of the sample items rather than the misstatements. When auditors have computed the upper and lower confidence limits, they decide the acceptability of the population by comparing these amounts with the recorded book value. For example, assume the auditor takes a sample of 100 items from an inventory listing containing 3,000 items and a recorded value $265,000. If the mean value of the items sampled is $85, the estimated value of the inventory is $255,000 ($85 x 3,000). If the recorded value of $265,000 is within the upper confidence limit, the auditor would accept the population balance. Mean-per-unit-estimation is rarely used in practice because sample sizes are typically much larger than for the two previous methods.

Stratified Statistical Methods

As we discussed earlier in this chapter, stratified sampling is a method of sampling in which all the elements in the total population are divided into two or more subpopulations. Each subpopulation is then independently tested. The calculations are made for each stratum and then combined into one overall population estimate for a confidence interval of the entire population. The results are measured statistically. Stratification is applicable to difference, ratio, and mean-per-unit estimation, but is most commonly used with mean-per-unit estimation.

TABLE 17-12 Confidence Coefficient for Confidence Levels, ARIAs, and ARIRs

Confidence Level (%)	ARIA (%)	ARIR (%)	Confidence Coefficient
99	.5	1	2.58
95	2.5	5	1.96
90	5	10	1.64
80	10	20	1.28
75	12.5	25	1.15
70	15	30	1.04
60	20	40	.84
50	25	50	.67
40	30	60	.52
30	35	70	.39
20	40	80	.25
10	45	90	.13
0	50	100	.0

Sampling Risks

We have discussed acceptable risk of incorrect acceptance (ARIA) for nonstatistical and MUS sampling. For variables sampling, auditors use ARIA as well as acceptable risk of incorrect rejection (ARIR). It is important to understand the distinctions between and uses of the two risks.

ARIA After auditors perform an audit test and calculate statistical results, they must conclude either that the population is or is not materially misstated. ARIA is the statistical risk that the auditor has accepted a population that is, in fact, materially misstated. ARIA is a serious concern to auditors because of the potential legal implications of concluding that an account balance is fairly stated when it is misstated by a material amount.

An account balance can be either overstated or understated, but not both; therefore, ARIA is a one-tailed statistical test. The confidence coefficients for ARIA are therefore different from the confidence level. (Confidence level = 1 – 2 x ARIA. So, if ARIA equals 10 percent, the confidence level is 80 percent.) The confidence coefficients for various ARIAs are shown in Table 17-12 together with confidence coefficients for the confidence level and ARIR.

ARIR **Acceptable risk of incorrect rejection (ARIR)** is the statistical risk that the auditor has concluded that a population is materially misstated when it is not. ARIR affects auditors' actions only when they conclude that a population is not fairly stated. When auditors find a balance not fairly stated, they typically increase the sample size or perform other tests. An increased sample size will usually lead the auditor to conclude that the balance is fairly stated if the account is, in fact, not materially misstated. While ARIA is always important, ARIR is important only when there is a high cost to increasing the sample size or performing other tests. Confidence coefficients for ARIR are also shown in Table 17-12.

TABLE 17-13 ARIA and ARIR

	Actual State of the Population	
Actual Audit Decision	Materially Misstated	Not Materially Misstated
Conclude that the population is materially misstated	Correct conclusion —no risk	Incorrect conclusion —risk is ARIR
Conclude that the population is not materially misstated	Incorrect conclusion —risk is ARIA	Correct conclusion —no risk

As you examine the summary of ARIA and ARIR in Table 17-13, you might conclude that auditors should attempt to minimize ARIA and ARIR. To accomplish that, auditors have to increase the sample size, thus minimizing the risks. However, the cost of that approach makes having reasonable ARIA and ARIR a more desirable goal.

ILLUSTRATION USING DIFFERENCE ESTIMATION

Plan the Sample and Calculate the Sample Size Using Difference Estimation

OBJECTIVE 17-5

Use difference estimation in tests of details of balances.

We illustrate the use of difference estimation in the audit of accounts receivable for Hart Lumber Company. Accounts receivable consists of 4,000 accounts listed on the aged trial balance with a recorded value of $600,000. Tolerable misstatement has been set at $21,000.

Specify Acceptable Risk The auditor specifies two risks:

1. *Acceptable risk of incorrect acceptance (ARIA).* It is the risk of accepting accounts receivable as correct if it is actually misstated by more than $21,000. ARIA is affected by acceptable audit risk, results of tests of controls and substantive tests of transactions, analytical procedures, and the relative significance of accounts receivable in the financial statements. For the Hart Lumber audit, assume an ARIA of 10 percent.
2. *Acceptable risk of incorrect rejection (ARIR).* It is the risk of rejecting accounts receivable as incorrect if it is not actually misstated by a material amount. ARIR is affected by the additional cost of resampling. Because it is fairly costly to confirm receivables a second time, assume an ARIR of 25 percent.

Estimate Misstatements in the Population This estimate has two parts:

1. *Estimate an expected point estimate.* Auditors need an advance estimate of the population point estimate for difference estimation, much as they need an estimated population exception rate for attributes sampling. The advance estimate is $1,500 (overstatement) for Hart Lumber, based on the previous year's audit tests.
2. *Make an advance population standard deviation estimate—variability of the population.* To determine the initial sample size, auditors need an advance estimate of the variation in the misstatements in the population as measured by the population standard deviation. (The calculation of the standard deviation is explained later, when audit results are evaluated.) For Hart Lumber, it is estimated to be $20 based on the previous year's audit tests.

Calculate the Initial Sample Size The initial sample size for Hart Lumber can be now calculated using the following formula:

$$n = \left[\frac{SD^*(Z_A + Z_R)N}{TM - E^*}\right]^2$$

where:
n = initial sample size
SD^* = advance estimate of the standard deviation
Z_A = confidence coefficient for ARIA (see Table 17-12)
Z_R = confidence coefficient for ARIR (see Table 17-12)
N = population size
TM = tolerable misstatement for the population (materiality)
E^* = estimated point estimate of the population misstatement

Applied to Hart Lumber, this equation yields:

$$n = \left[\frac{20(1.28 + 1.15)4{,}000}{21{,}000 - 1{,}500}\right]^2 = (9.97)^2 = 100$$

Evaluate the Results

Generalize from the Sample to the Population The auditor selects the sample, performs the testing, and identifies sample misstatements. The misstatements for Hart Lumber are shown in Table 17-14. The following four steps describe the calculation of

TABLE 17-14 Calculation of Confidence Limits

Step	Statistical Formula	Illustration for Hart Lumber
1. Take a random sample of size n.	n = sample size	100 accounts receivable are selected randomly from the aged trial balance containing 4,000 accounts.
2. Determine the value of each misstatement in the sample.		75 accounts are confirmed by customers, and 25 accounts are verified by alternative procedures. After reconciling timing differences and customer errors, the following 12 items were determined to be client errors (understatements) stated in dollars: 1. \$12.75 2. (69.46) 3. 85.28 4. 100.00 5. (27.30) 6. 41.06 7. (.87) 8. 24.32 9. 36.59 10. (102.16) 11. 54.71 12. 71.56 Sum = \$226.48
3. Compute the point estimate of the total misstatement.	$\bar{e} = \frac{\Sigma e_j}{n}$ $\hat{E} = N\bar{e}$ or $N\frac{\Sigma e_j}{n}$ where: $\bar{e}$ = average misstatement in the sample Σ = summation e_j = an individual misstatement in the sample n = sample size $\hat{E}$ = point estimate of the total misstatement N = population size	$\bar{e} = \frac{\$226.48}{100} = \$2.26$ $\hat{E} = 4{,}000\ (\$2.26) = \$9{,}040$ or $\hat{E} = 4{,}000\left(\frac{\$226.48}{100}\right) = \$9{,}040$
4. Compute the population standard deviation of the misstatements from the sample.	$SD = \sqrt{\frac{\Sigma(e_j)^2 - n(e)^2}{n-1}}$ where: SD = standard deviation e_j = an individual misstatement in the sample n = sample size $\bar{e}$ = average misstatement in sample	(rounded to nearest dollar) e_j / $(e_j)^2$ 1. \$ 13 / \$ 169 2. (69) / 4,761 3. 85 / 7,225 4. 100 / 10,000 5. (27) / 729 6. 41 / 1,681 7. (1) / 1 8. 24 / 576 9. 37 / 1,369 10. (102) / 10,404 11. 55 / 3,025 12. 72 / 5,184 \$228 / \$45,124 $SD = \sqrt{\frac{\$45{,}124 - 100\ (\$2.26)^2}{99}}$ SD = \$21.2

(continued on the following page)

TABLE 17-14 Calculation of Confidence Limits *(Cont.)*

Step	Statistical Formula	Illustration for Hart Lumber
5. Compute the precision interval for the estimate of the total population misstatement at the desired confidence level.	$CPI = NZ_A \frac{SD}{\sqrt{n}} \sqrt{\frac{N-n}{N}}$ where: CPI = computed precision interval N = population size Z_A = confidence coefficient for ARIA (see Table 17-12) SD = population standard deviation n = sample size $\sqrt{\frac{N-n}{N}}$ = finite correction factor	$CPI = 4{,}000 \cdot 1.28 \cdot \frac{\$21.2}{\sqrt{100}} \sqrt{\frac{4{,}000-100}{4{,}000}}$ $= 4{,}000 \cdot 1.28 \cdot \frac{\$21.2}{10} \cdot .99$ $= 4{,}000 \cdot 1.28 \cdot \$2.12 \cdot .99$ = $10,800 (rounded)
6. Compute the confidence limits at the CL desired.	$UCL = \hat{E} + CPI$ $LCL = \hat{E} - CPI$ where: UCL = computed upper confidence limit LCL = computed lower confidence limit $\hat{E}$ = point estimate of the total misstatement CPI = computed precision interval at desired CL	UCL = $9,040 + $10,800 = $19,840 LCL = $9,040 − $10,800 = $(1,760)

the confidence limits for Hart Lumber Company. (The calculations are illustrated in Table 17-14, Steps 3 through 6.)

1. *Compute the point estimate of the total misstatement.* The point estimate is a direct extrapolation from the misstatements in the sample to the misstatements in the population. The calculation of the point estimate for Hart Lumber is shown in Table 17-14, step 3.
2. *Compute an estimate of the population standard deviation.* The population standard deviation is a statistical measure of the variability in the values of the individual items in the population. If there is a large amount of variation in the values of population items, the standard deviation will be larger than when the variation is small.

   The standard deviation has a significant effect on the computed precision interval. The auditor can compute a reasonable estimate of the value of the population standard deviation by using the standard statistical formula shown in Table 17-14, step 4.
3. *Compute the precision interval.* The precision interval is calculated by a statistical formula. For the computed precision interval to have any meaning, it must be associated with ARIA. The formula to calculate the precision interval is shown in Table 17-14, step 5.
4. *Compute the confidence limits.* Auditors calculate the confidence limits, which define the confidence interval, by combining the point estimate of the total misstatements and the computed precision interval at the desired confidence level (point estimate ± computed precision interval). The formula to calculate the confidence limits is shown in Table 17-14, step 6.

The lower and upper confidence limits for Hart Lumber are ($1,760) and $19,840, respectively. There is a 10 percent statistical risk that the population is understated by more than $1,760, and the same risk that it is overstated by more than $19,840. (Remember, an ARIA of 10 percent is equivalent to a confidence level of 80 percent.) Since the confidence limits are less than tolerable misstatement, the auditor concludes that the population is not materially misstated.

SUMMARY

This chapter discussed nonstatistical and statistical audit sampling methods for tests of details of balances. In sampling for tests of balances, the auditor determines whether the dollar amount of an account balance is materially misstated. We then discussed the 14 steps in nonstatistical sampling for tests of balances. When performing nonstatistical audit sampling, the auditor uses judgment in generalizing from the sample to the population to determine whether it is acceptable. Monetary unit sampling is the most common statistical method for tests of balances. This method defines the sampling unit as individual dollars in the recorded account balance, and as a result, larger accounts are more likely to be included in the sample. Variables statistical sampling methods include difference estimation, ratio estimation, and mean-per-unit estimation. These methods compare audited sample values to recorded values to develop an estimate of the misstatement in the account value. Use of variables sampling was illustrated using difference estimation.

ESSENTIAL TERMS

Acceptable risk of incorrect acceptance (ARIA)—the risk that the auditor is willing to take of accepting a balance as correct when the true misstatement in the balance exceeds tolerable misstatement

Acceptable risk of incorrect rejection (ARIR)—the risk that the auditor is willing to take of rejecting a balance as incorrect when it is not misstated by a material amount

Basic precision—the minimum allowance for sampling risk inherent in the sample for MUS; it is equal to the allowance for sampling risk when no misstatements are found in the sample

Difference estimation—a method of variables sampling in which the auditor estimates the population misstatement by multiplying the average misstatement in the sample by the total number of population items and also calculates sampling risk

Mean-per-unit estimation—a method of variables sampling in which the auditor estimates the audited value of a population by multiplying the average audited value of the sample by the population size and also calculates sampling risk

Misstatement bound—an estimate of the largest likely overstatement in a population at a given ARIA, using monetary unit sampling

Monetary unit sampling (MUS)—a statistical sampling method that provides misstatement bounds expressed in monetary amounts; also referred to as dollar unit sampling, cumulative monetary amount sampling, and sampling with probability proportional to size

Point estimate—a method of projecting from the sample to the population to estimate the population misstatement, commonly by assuming that misstatements in the unaudited population are proportional to the misstatements found in the sample

Probability proportional to size sample selection (PPS)—sample selection of individual dollars in a population by the use of random or systematic sample selection

Ratio estimation—a method of variables sampling in which the auditor estimates the population misstatement by multiplying the portion of sample dollars misstated by the total recorded

population book value and also calculates sampling risk

Statistical inferences—statistical conclusions that the auditor draws from sample results based on knowledge of sampling distributions

Stratified sampling—a method of sampling in which all the elements in the total population are divided into two or more subpopulations that are independently tested and statistically measured

Tolerable misstatement—the application of performance materiality to a particular sampling procedure

Variables sampling—sampling techniques for tests of details of balances that use the statistical inference process

REVIEW QUESTIONS

17-1 (Objective 17-1) What major difference between (a) tests of controls and substantive tests of transactions and (b) tests of details of balances makes attributes sampling inappropriate for tests of details of balances?

17-2 (Objective 17-2) Jemina was asked by her supervisor to evaluate the revenue cycle. She divided all the invoices of the company into five strata, i.e. below $50, $51-$100, $101-$500, $501-$1000, and above $1000. She chose four invoices from each group to trace to the Accounts Receivables Ledger and to the stock records. Her sample covered 95% of the total revenue of the company. She was very happy with her results. However, her supervisor felt otherwise. He says she could still make incorrect quantitative conclusions about the capture of the revenue cycle in the company. Explain why he feels this way.

17-3 (Objective 17-2) Distinguish between the point estimate of the total misstatements and the true value of the misstatements in the population. How can each be determined?

17-4 (Objective 17-2) Your client owns the largest hard-disc plant in India. The factory is so large that it employs 12 accountants and 200 clerks to handle the various accounting functions. You are in charge of auditing the inventory cycle, while your colleague is in charge of auditing the revenue cycle. You found that there were a lot of late recordings of raw material received and finished goods shipped out. Your colleague found that the revenue cycle was in order. Your audit director thinks that your colleague needs to revisit his investigation after you have finished yours. Your colleague is furious with you. Why did your director issue the instruction?

17-5 (Objective 17-3) Define monetary unit sampling and explain its importance in auditing. How does it combine the features of attributes and variables sampling?

17-6 (Objectives 17-1, 17-2, 17-3, 17-4) Define what is meant by sampling risk. Does sampling risk apply to nonstatistical sampling, MUS, attributes sampling, and variables sampling? Explain.

17-7 (Objectives 17-1, 17-2) What are the major differences in the 14 steps used in nonstatistical sampling for tests of details of balances versus for tests of controls and substantive tests of transactions?

17-8 (Objective 17-3) MUS automatically increases the probability of selecting a high value item from the population. How does MUS not help the auditor detect material misstatements?

17-9 (Objective 17-3) Explain how the auditor determines tolerable misstatement for MUS.

17-10 (Objective 17-2) Explain what is meant by acceptable risk of incorrect acceptance. What are the major audit factors affecting ARIA?

17-11 (Objective 17-4) From the following scenarios, determine the extent of the population misstatement by the auditor:

a) The client has a tendency to forget to declare goods in transit. The auditor thinks that he cannot accept the value of finished goods presented in the client's Statement of Financial Position.
b) The auditor was not very familiar with the concept of consignment goods. He thought that goods sent to a hub were considered sold.
c) The client provides music downloads to its customers. The client will only bill the customer 7 days after he or she downloads a song. The auditor thinks that the sales figure of the client was under declared and must be adjusted.

17-12 (Objective 17-2) What is the relationship between ARIA and ARO for tests of controls?

17-13 (Objective 17-3) Explain what is meant by basic precision. How is it determined?

17-14 (Objective 17-3) An auditor is determining the appropriate sample size for testing inventory valuation using MUS. The population has 2,620 inventory items valued at $12,625,000. The tolerable misstatement is $500,000 at a 10% ARIA. No misstatements are expected in the population. Calculate the preliminary sample size.

17-15 (Objective 17-3) Assume that a sample of 100 units was obtained in sampling the inventory in Question 17-14. Assume further that the following three misstatements were found:

Misstatement	Recorded Value	Audited Value
1	$ 897.16	$ 609.16
2	47.02	0
3	1,621.68	1,522.68

Calculate the overstatement bound for the population. Draw audit conclusions based on the results.

17-16 (Objective 17-3) Why is it difficult to determine the appropriate sample size for MUS? How should the auditor determine the proper sample size?

17-17 (Objective 17-2) What alternative courses of action are appropriate when a population is rejected using nonstatistical sampling for tests of details of balances? When should each option be followed?

17-18 (Objective 17-4) Define what is meant by the population standard deviation and explain its importance in variables sampling. What is the relationship between the population standard deviation and the required sample size?

17-19 (Objective 17-5) In using difference estimation, an auditor took a random sample of 100 inventory items from a large population to test for proper pricing. Several of the inventory items were misstated, but the combined net amount of the sample misstatement was not material. In addition, a review of the individual misstatements indicated that no misstatement was by itself material. As a result, the auditor did not investigate the misstatements or make a statistical evaluation. Explain why this practice is improper.

17-20 (Objectives 17-3, 17-4) Your supervisor likes to use MUS when auditing the revenue cycle of a client. You are skeptical of his methods as he can still encounter the risk of material misstatements. Explain why.

17-21 (Objective 17-4) An essential step in difference estimation is the comparison of each computed confidence limit with tolerable misstatement. Why is this step so important, and what should the auditor do if one of the confidence limits is larger than the tolerable misstatement?

17-22 (Objective 17-4) Explain why difference estimation is commonly used by auditors.

17-23 (Objectives 17-3, 17-4) Give an example of the use of attributes sampling, MUS, and variables sampling in the form of an audit conclusion.

MULTIPLE CHOICE QUESTIONS FROM CPA AND CIA EXAMINATIONS

17-24 (Objective 17-2) Your client is a music company. You noted that the sales of CDs only amounted to 8% of total sales as compared to music downloads, which comprised the bulk of sales.

a. When determining the sample size for tests of details of the balances of inventory, you should have a
   (1) bigger sample as the balance of inventory is now bigger.
   (2) smaller sample as the balance of inventory is now bigger.
   (3) smaller sample as the balance of inventory is now smaller.
   (4) bigger sample as the balance of inventory is zero.

b. Your client sold 10% more vinyl records this year compared to last. However vinyl records only amounted to 0.5% of total music sales this year. There is
(1) no effect to the sample size of the revenue audit as the population is very small.
(2) a need for a bigger sample size of the revenue audits as the population is growing.
(3) a need to start auditing as in 10 years the client might only be selling vinyl.
(4) an effect on inventory as the population is getting bigger.

c. Last year, you found that the clerk who enters the invoices into the system is constantly making mistakes. Your client has replaced the clerk with an accounting graduate. You have yet to find any mistakes.

When designing your audit of the revenue cycle, you should
(1) decrease the sample size of invoices audited.
(2) increase the sample size of invoices audited.
(3) continue with the same sample size of invoices audited last year.
(4) continue with the same percentage of invoices audited last year.

17-25 (Objectives 17-2, 17-3) The following apply to evaluating results of audit sampling for tests of details of balances. For each one, select the best response.

a. While performing a substantive test of details during an audit, the auditor determined that the sample results supported the conclusion that the recorded account balance was materially misstated. It was, in fact, not materially misstated. This situation illustrates the risk of
(1) assessing control risk too high.
(2) assessing control risk too low.
(3) incorrect rejection.
(4) incorrect acceptance.

b. In an MUS sample with a sampling interval of $5,000, an auditor discovered that a selected accounts receivable with a recorded amount of $10,000 had an audit value of $8,000. If this is the only error discovered by the auditor, the projected error of the sample would be
(1) $1,000. (2) $2,000. (3) $4,000. (4) $5,000.

c. The accounting department reports the accounts receivable balance as $175,000. You are willing to accept that balance if it is within $15,000 of the actual balance. Using a variables sampling plan, you compute a 95% confidence interval of $173,000 to $187,000. You would therefore
(1) find it impossible to determine the acceptability of the balance.
(2) accept the balance but with a lower level of confidence.
(3) take a larger sample before rejecting the sample and requiring adjustments.
(4) accept the $175,000 balance because the confidence interval is within the materiality limits.

17-26 (Objectives 17-3, 17-4, 17-5) The following relate to the use of statistical sampling for tests of details of balances. For each one, select the best response.

a. When the auditor uses monetary unit statistical sampling to examine the total dollar value of invoices, each invoice
(1) has an equal probability of being selected.
(2) can be represented by no more than one monetary unit.
(3) has an unknown probability of being selected.
(4) has a probability proportional to its dollar value of being selected.

b. Which of the following would be an advantage of using variables sampling rather than probability-proportional-to-size (PPS) sampling?
(1) An estimate of the standard deviation of the population's recorded amount is not required.
(2) The auditor rarely needs the assistance of a computer program to design an efficient sample.
(3) The inclusion of zero and negative balances usually does not require special design considerations.
(4) Any amount that is individually significant is automatically identified and selected.

c. In applying variables sampling, an auditor attempts to
   (1) estimate a qualitative characteristic of interest.
   (2) determine various rates of occurrence for specified attributes.
   (3) discover at least one instance of a critical deviation.
   (4) predict a monetary population value within a range of precision.

DISCUSSION QUESTIONS AND PROBLEMS

17-27 (Objective 17-2) You are planning to use nonstatistical sampling to evaluate the results of accounts receivable confirmation for the Meridian Company. You have already performed tests of controls for sales, sales returns and allowances, and cash receipts, and they are considered excellent. Because of the quality of the controls, you decide to use an acceptable risk of incorrect acceptance of 10%. There are 3,000 accounts receivable with a gross value of $6,900,000. The accounts are similar in size and will be treated as a single stratum. An overstatement or understatement of more than $150,000 is considered material.

Required

a. Calculate the required sample size. Assume your firm uses the following nonstatistical formula to determine sample size:

$$\text{Sample size} = \frac{\text{Population Recorded Amount} \times \text{Confidence Factor}}{\text{Tolerable Misstatement}}$$

   A confidence factor of 2 is used for a 10% ARIA.

b. Assume that instead of good results, poor results were obtained for tests of controls and substantive tests of transactions for sales, sales returns and allowances, and cash receipts. How will this affect your required sample size? How will you use this information in your sample size determination?

c. Regardless of your answer to part a., assume you decide to select a sample of 100 accounts for testing. Indicate how you will select the accounts for testing using systematic selection.

d. Assume a total book value of $230,000 for the 100 accounts selected for testing. You uncover three overstatements totaling $1,500 in the sample. Evaluate whether the population is fairly stated.

17-28 (Objective 17-2) You are evaluating the results of a nonstatistical sample of 85 accounts receivable confirmations for the Bohrer Company. Information on the sample and population are included below. An overstatement or understatement of more than $100,000 is considered material.

		Sample		Population	
Stratum		# of Accounts	Recorded Value	# of Accounts	Recorded Value
1	>$75,000	8	$1,287,643	8	$1,287,643
2	$10,000–$74,999	40	1,349,678	257	4,348,268
3	<$10,000	25	94,637	712	947,682
		73	$2,731,958	977	$6,583,593

The confirmation responses were received without exception, other than the following items:

Acct. No.	Recorded Value	Confirmation Response	Auditor Follow-up
147	$ 24,692	$ 23,597	Customer was charged the wrong price.
228	183,219	157,216	$26,003 shipment recorded on December 30th; goods were not shipped until January 3rd.
278	7,546	5,546	Customer sent $2,000 payment on December 29th; received on January 2nd.
497	15,319	0	$17,443 shipment recorded on December 30th; goods were not shipped until January 2nd.

(continued on the following page)

Acct. No.	Recorded Value	Confirmation Response	Auditor Follow-up
564	8,397	7,858	Customer received less than the full quantity ordered.
653	32,687	19,328	$13,359 shipment recorded on December 30th; goods were not shipped until January 2nd.
830	5,286	0	$5,286 shipment made December 30th; goods were received by the customer on January 4th.

Required

a. Evaluate each of the confirmation exceptions to determine whether they represent misstatements.

b. Estimate the total amount of misstatement in the accounts receivable population. Ignore sampling risk in the calculation.

c. Is the population acceptable? If not, indicate what follow-up action(s) you consider appropriate in the circumstances.

17-29 (Objective 17-3) Below is the total monthly sales population for Jafar's Custom Candles. Cumulative amounts have been included to help you complete the problem. The population is somewhat smaller than is ordinarily the case for statistical sampling, but an entire population is useful to show how to select PPS samples.

Required

a. Select a random PPS sample of 10 items, using computer software.

b. Select a sample of 10 items using systematical PPS sampling using the same concepts discussed in Chapter 15 for systematic sampling. Use a starting point of 1857. Identify the physical units associated with the sample dollars. (*Hint*: The interval is 78,493÷10.)

c. Which sample items will always be included in the systematic PPS sample regardless of the starting point? Will that also be true of random PPS sampling?

d. Which method is preferable in terms of ease of selection in this case?

e. Why will an auditor use MUS?

Population Item	Recorded Amount	Cumulative Amount	Population Item *(cont.)*	Recorded Amount *(cont.)*	Cumulative Amount *(cont.)*
1	$ 2,493	$ 2,493	21	$ 973	$39,682
2	1,209	3,702	22	1,552	41,234
3	930	4,632	23	2,345	43,579
4	3,027	7,659	24	879	44,458
5	506	8,165	25	5,675	50,133
6	380	8,545	26	589	50,722
7	782	9,327	27	1,234	51,956
8	1,304	10,631	28	1,008	52,964
9	2,604	13,235	29	2,130	55,094
10	5,455	18,690	30	792	55,886
11	2,300	20,990	31	1,354	57,240
12	903	21,893	32	4,197	61,437
13	850	22,743	33	842	62,279
14	1,203	23,946	34	512	62,791
15	3,120	27,066	35	5,768	68,559
16	4,760	31,826	36	1,254	69,813
17	403	32,229	37	2,348	72,161
18	3,349	35,578	38	3,092	75,253
19	2,101	37,679	39	1,843	77,096
20	1,030	38,709	40	1,397	78,493

17-30 (Objective 17-3) In the audit of Rand Farm Products for the year ended September 30, the auditor set a tolerable misstatement of $50,000 at an ARIA of 10%. A PPS sample of 100 was selected from an accounts receivable population that had a recorded balance of $1,975,000. The following table shows the differences uncovered in the confirmation process:

	Accounts Receivable per Records	Accounts Receivable per Confirmation	Follow-up Comments by Auditor
1.	$2,728.00	$2,498.00	Pricing error on two invoices.
2.	$ 5,125.00	-0-	Customer mailed check 9/26; company received check 10/3.
3.	$3,890.00	$ 1,190.00	Merchandise returned 9/30 and counted in inventory; credit was issued 10/6.
4.	$ 815.00	$ 785.00	Footing error on an invoice.
5.	$ 548.00	-0-	Goods were shipped 9/28; customer received goods on 10/2; sale was recorded on 9/28.
6.	$ 3,215.00	$ 3,190.00	Pricing error on a credit memorandum.
7.	$1,540.00	-0-	Goods were shipped on 9/29; customer received goods 10/3; sale was recorded on 9/30.

Required

a. Calculate the upper misstatement bound on the basis of the client misstatements in the sample.

b. Is the population acceptable as stated? If not, what options are available to the auditor at this point? Which option should the auditor select? Explain.

17-31 (Objective 17-3) You intend to use MUS as a part of the audit of several accounts for Roynpower Manufacturing Company. You have done the audit for the past several years, and there has rarely been an adjusting entry of any kind. Your audit tests of all tests of controls and substantive tests of transactions cycles were completed at an interim date, and control risk has been assessed as low. You therefore decide to use an ARIA of 10% and a ratio of expected misstatement to tolerable misstatement of 0% for all tests of details of balances.

You intend to use MUS in the audit of the three most material asset balance sheet account balances: accounts receivable, inventory, and marketable securities. You feel justified in using the same ARIA for each audit area because of the low assessed control risk.

The recorded balances and related information for the three accounts are as follows:

	Recorded Value
Accounts receivable	$ 3,600,000
Inventory	4,800,000
Marketable securities	1,600,000
	$10,000,000

Net earnings before taxes for Roynpower are $2,000,000. You decide that a combined misstatement of $100,000 is allowable for the client.

The audit approach to be followed will be to determine the total sample size needed for all three accounts. A sample will be selected from all $10 million, and the appropriate testing for a sample item will depend on whether the item is a receivable, inventory, or marketable security. The audit conclusions will pertain to the entire $10 million, and no conclusion will be made about the three individual accounts unless significant misstatements are found in the sample.

Required

a. Evaluate the audit approach of testing all three account balances in one sample.

b. Calculate the required sample size for a combined sample of all three accounts. Use $100,000 as the measure of tolerable misstatement for the combined test.

c. Calculate the required sample size for each of the three accounts, assuming you decide that the tolerable misstatement in each account is $100,000.

d. Assume that you select the random sample using computer software. How will you identify which sample item in the population to audit for the number 4,627,871? What audit procedures will be performed?

e. Assume that you select a sample of 200 sample items for testing and you find one misstatement in inventory. The recorded value is $987.12 and the audit value is $887.12. Calculate the misstatement bounds for the three combined accounts and reach appropriate audit conclusions.

17-32 (Objectives 17-2, 17-3, 17-4, 17-5) An audit partner is developing an office training program to familiarize her professional staff with audit sampling decision models applicable to the audit of dollar-value balances. She wishes to demonstrate the relationship of sample sizes to population size and estimated population exception rate and the auditor's specifications as to tolerable misstatement and ARIA. The partner prepared the following table to show comparative population characteristics and audit specifications of the two populations:

	Characteristics of Population 1 Relative to Population 2		Audit Specifications as to a Sample from Population 1 Relative to a Sample from Population 2	
	Size	Estimated Population Exception Rate	Tolerable Misstatement	ARIA
Case 1	Equal	Equal	Equal	Lower
Case 2	Smaller	Smaller	Equal	Higher
Case 3	Larger	Equal	Equal	Lower
Case 4	Equal	Larger	Larger	Equal
Case 5	Larger	Equal	Smaller	Higher

Required

In items (1) through (5) you are to indicate for the specific case from the table the required sample size to be selected from population 1 relative to the sample from population 2.

(1) In case 1, the required sample size from population 1 is _____.
(2) In case 2, the required sample size from population 1 is _____.
(3) In case 3, the required sample size from population 1 is _____.
(4) In case 4, the required sample size from population 1 is _____.
(5) In case 5, the required sample size from population 1 is _____.

Your answer choice should be selected from the following responses:

a. Larger than the required sample size from population 2.
b. Equal to the required sample size from population 2.
c. Smaller than the required sample size from population 2.
d. Indeterminate relative to the required sample size from population 2.*

17-33 (Objective 17-5) In auditing the valuation of inventory, the auditor, Abbas Saleh, decided to use difference estimation. He decided to select an unrestricted random sample of 80 inventory items from a population of 1,840 that had a book value of $175,820. Saleh decided in advance that he was willing to accept a maximum misstatement in the population of $6,000 at an ARIA of 5 percent. There were eight misstatements in the sample, which were as follows:

	Audit Value	Book Value	Sample Misstatements
	$ 812.50	$ 740.50	$(72.00)
	12.50	78.20	65.70
	10.00	51.10	41.10
	25.40	61.50	36.10
	600.10	651.90	51.80
	.12	0	(.12)
	51.06	81.06	30.00
	83.11	104.22	21.11
Total	$1,594.79	$1,768.48	$173.69

Required

a. Calculate the point estimate, the computed precision interval, the confidence interval, and the confidence limits for the population. Label each calculation. Use a computer for this purpose (instructor's option).
b. Should Saleh accept the book value of the population? Explain.
c. What options are available to him at this point?

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CASES

17-34 (Objective 17-3) You are doing the audit of Mahsa Tire and Parts, a wholesale auto parts company. You have decided to use monetary unit sampling (MUS) for the audit of accounts receivable and inventory. The following are the recorded balances:

Accounts receivable	$12,000,000
Inventory	$23,000,000

You have already made the following judgments:

Performance materiality	$800,000
Acceptable audit risk	5%
Inherent risk:	
Accounts receivable	80%
Inventory	100%
Assessed control risk:	
Accounts receivable	50%
Inventory	80%

Analytical procedures have been planned for inventory, but not for accounts receivable. The analytical procedures for inventory are expected to have a 60% chance of detecting a material misstatement should one exist.

You have concluded that it will be difficult to alter sample size for accounts receivable confirmation once confirmations are sent and replies are received. However, inventory tests can be reopened without great difficulty.

After discussions with the client, you believe that the accounts are in about the same condition this year as they were last year. Last year no misstatements were found in the confirmation of accounts receivable. Inventory tests revealed an overstatement amount of about 1%.

For requirements a.–c., make any assumptions necessary in deciding the factors affecting sample size. If no table is available for the ARIA chosen, estimate sample size judgmentally.

Required

a. Plan the sample size for the confirmation of accounts receivable using MUS.

b. Plan the sample size for the test of pricing of inventories using MUS.

c. Plan the combined sample size for both the confirmation of accounts receivable and the price tests of inventory using MUS.

d. (Instructor's option) Using an electronic spreadsheet, generate a list of random dollars in generation order and in ascending order for the sample of accounts receivable items determined in part a.

17-35 (Objectives 17-2, 17-3) You have just completed the accounts receivable confirmation process in the audit of Danforth Paper Company, a paper supplier to retail shops and commercial users. Following are the data related to this process:

Accounts receivable recorded balance	$ 2,760,000
Number of accounts	7,320
A nonstatistical sample was taken as follows:	
All accounts over $10,000 (23 accounts)	$ 465,000
77 accounts under $10,000	$ 81,500
Tolerable misstatement for the confirmation test	$ 100,000
Inherent and control risk are both high	
No relevant analytical procedures were performed	

The following are the results of the confirmation procedures:

	Recorded Value	Audited Value
Items over $10,000	$ 465,000	$ 432,000
Items under $10,000	81,500	77,150

(continued on the following page)

	Recorded Value	Audited Value
Individual misstatements for items under $10,000:		
Item 12	5,120	4,820
Item 19	485	385
Item 33	1,250	250
Item 35	3,975	3,875
Item 51	1,850	1,825
Item 59	4,200	3,780
Item 74	2,405	0

Required

a. Evaluate the results of the nonstatistical sample. Consider both the direct implications of the misstatements found and the effect of using a sample.

b. Assume that the sample was a PPS sample. Evaluate the results using monetary unit sampling.

c. (Instructor's option) Do the preceding analyses using an electronic spreadsheet.

ACL PROBLEM

17-36 (Objective 17-3) This problem requires the use of ACL software, which is included in the CD attached to the text. Information about installing and using ACL and solving this problem can be found in Appendix, pages 850–854. You should read all of the reference material, especially the material on sampling, to answer questions a. through e. For this problem use the "Inventory" file in the "Inventory_Review" subfolder under tables in Sample_Project. Suggested commands, where applicable, are indicated at the end of the problem requirements.

Required

a. Calculate the sample size and sampling interval for an MUS sample based on inventory value at cost (Value). Use a confidence level of 90%, materiality of $40,000, and expected errors of $2,500. (Sampling/Calculate Sample Size; select "monetary" radio button)

b. What is the sampling size and sampling interval if you increase materiality to $50,000 and decrease expected errors to $1,000?

c. Select the sample based on the sampling interval determined in part a. (Sampling / Sample Records; select "Sample type" as MUS. For "Sample Parameters" select fixed interval and enter the interval from part a.; use a random start of 3179.)

d. How many items were selected for testing? Why is this number less than the sample size determined in part a.?

e. What is the largest item selected for testing? How many sample items are larger than the sampling interval? How many items are larger than the sampling interval in the population?

RESEARCH PROBLEM 17-1: MONETARY UNIT SAMPLING CONSIDERATIONS

Monetary unit sampling (MUS) is the most commonly used statistical method of sampling for tests of details because of its simplicity and its ability to provide statistical results in dollars. Read an article titled "Monetary-Unit Sampling Using Microsoft Excel" that appeared in the May 2005 issue of *The CPA Journal* (www.nysscpa.org/cpajournal/2005/505/essentials/p36.htm) to answer the following questions.

Required

a. The authors suggest that there are three critical steps in applying MUS. What are these steps?

b. How do the authors indicate that an MUS sample size is determined?

c. What two factors must be considered when evaluating the results of the sample?