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Analytical procedure results as substantive evidence

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Analytical Procedure Results as Substantive Evidence*

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Generally Accepted Auditing Standards (GAAS) allow two basic types of evidence to satisfy the third standard of fieldwork. These are analytical procedure results and tests of details of transactions and balances. GAAS is clear that the third standard can be met with any combination of the two that the auditor deems to be appropriate and GAAS makes no qualitative or "competency" distinction between them. Yet, analytical procedure results are routinely subject to several biases not present in tests of details. In this paper we clarify conceptual differences that may lead to an overassessment of the competency or validity of evidence provided by analytical procedures.

Clarification of the biases inherent in analytical procedures is important given the increased emphasis on analytical procedures in professional standards (e.g., SAS No. 39, 47, and 56 and SAARS No. 1), and its increased use in practice [Tabor and Willis, 1985]. Auditors may be substituting inferior evidence for tests of details with an attendant increase in achieved audit risk.

Below we review the history of analytical procedures and their regulation, analyze the essential features and risks of analytical procedures, and demonstrate several sources of bias in their use as substantive evidence. Finally, we provide some suggestions for research on analytical procedures and a suggestion for a change in standards.

1. History of Analytical Procedures in Auditing

Essentially, analytical procedure results as substantive evidence are evaluations of the reasonableness of the assumption of no material misstatement in aggregate recorded amounts, given the auditor's other knowledge. Analytical procedures do not encompass examination of details supporting the validity of particular items comprising a recorded population. Thus, the substantive validity of any item or group of items is not determined directly.

The origin of analytical procedure results as substantive evidence is unclear. Stringer and Stewart [1986, p. 15] cite a Deloitte Haskins & Sells audit

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manual describing the use of analytical procedures in the 1930s and they had reason to believe that the manual merely codified existing practices. Deloitte & Touche provided us with a copy of Bulletin 302-1 from the 1939 edition of DH&S Technical Procedures Manual. It is reproduced in Figure 1. The Bulletin was a revision of the original 1935 version and was intended to eliminate any confusion about the use of analytical procedures. While the Bulletin may have fallen short of that goal, it provided a number of interesting points. For example, analytical procedures were regarded as "fundamental and indispensable" in audits involving an income statement "regardless of the existence or absence of internal control." Analytical procedures were intended as a substantive test since they were an "effort to prove its substantial correctness as far as is practicable without systematic audit of the transactions." Finally, in contrast to current professional standards, there is no mention of inquiry of management as an important source of an explanation for an unexpected material difference.

Figure 1

Technical Procedures Manual
Haskins & Sells
(1939 edition)

Bulletin 302-1

ANALYTIC REVIEW OF OPERATING ACCOUNTS

This is written with a view to clearing up any misunderstanding there may be regarding the reasons for and procedure of reviewing the accounts comprehended in and culminating in the net income or loss for a period, and as to when such procedure should be applied.

In a general audit we go no farther in systematic auditing than to test the original records, so that there is a considerable part of the period that is not covered by the systematic audit of transactions. It is therefore necessary to supplement the audit tests by review of the transactions for the entire period. As a matter of fact, it is more logical to regard the systematic audit tests as superimposed upon the general analytic review than to regard the review as supplementing the audit tests. At all events, the analytic review of operating accounts should be regarded as fundamental and indispensable, in any engagement where the report is to include, and the certificate to cover, a statement of income and surplus--or any of its variants--regardless of the existence or absence of internal control.

The procedure in making an analytic review of operating accounts can be outlined only generally. It involves subjecting each detail operating, income, profit and loss, and surplus account to rigid scrutiny, and to some extent to detailed analysis, in an effort to prove its substantial correctness as far as practicable without systematic audit of the transactions. Such review and analysis calls for the exercise of a high degree of judgment and discrimination. The remarks to follow should be regarded as only suggestive of the general course to be followed, subject to such amplification and adaptation as may be necessary to meet the peculiar needs of individual situations. It should be understood also that these remarks pertain only to the analytic review and do not purport to cover all the work to be done on the operating accounts in a general audit.

Each operating account (using the term in its generic sense) as it appears in the ledger or other record should be scrutinized in order to determine whether or not the entries have varied materially from month to month during the year under review, and any material variation should be investigated. In some cases, especially where businesses are seasonal, such monthly comparisons should be made with the corresponding months of the preceding year or two. A detailed statement of the operating accounts should be prepared for the year and for at least one preceding year (preferably two or three) in parallel columns, and the respective items for the respective years should be compared. If there are divisions or branches of the

business, the accounts for each should be considered separately and in relation to one another. All significant ratios and averages should be computed for the purpose of making comparisons. The ratios would include, for an industrial business, the ratio of returns, allowances, etc. to gross sales and the ratios to net sale of cost of goods sold and of each item, or appropriate group of items, of selling, administrative, and general expenses. For certain expenses such as purchasing and receiving (if kept separate), the ratio of purchases is a better standard of comparison than the ratio to sales. Every material difference as indicated by all these comparisons should be investigated to the point of determining, as nearly as practicable, that it is proper or improper. The working papers should show all matters investigated and the results of the investigations.

The cost of sales should be examined, and considered in relation to the sales, inventory, and accounts payable. The account for cost of sales, and its principal tributary accounts, such as cost of production, should be analyzed, as to essential features and important amounts, so that the composition of the accounts will be thoroughly understood. The method of determining charges for material, labor, and overhead should be critically investigated. The gross-profit ratios for the current and preceding periods should be computed. The inventory turnover rate should be computed, if practicable as to classes of goods (i.e., finished product, raw materials, etc.), for the current period and at least one preceding period, by dividing the cost of goods sold or used by the average inventory. If there is any indication that the cost does not bear the proper relationship to sales, or is otherwise incorrect, the various elements entering into the cost should be examined as exhaustively as may be necessary in order to determine the cause of the difference.

Among the other accounts which should be examined with respect to operations from month to month and period to period, and with respect to their relation to other accounts, such as sales or gross earnings, or in some cases, assets or liabilities, specific mention may be made of the following:

Sales and wages

Income from interest and dividends

Interest expense

Taxes

Income or expense for rents, royalties, and commissions

Depreciation, depletion, and amortization

Repairs and maintenance

Direct charges and credits to surplus

It is thought that the foregoing explains the analytic review of operating accounts sufficiently so that the underlying purpose of the review and the method of procedure will be understood, as applying not only to the accounts that have been mentioned specifically, but also to any other operating, income, profit or loss, and surplus accounts that may be encountered in practice.

December 1935 - Revised September 1939

We scanned the *Accountant's Index* and were unable to locate any specific references to analytical review in the practice or scholarly literature prior to 1961. Mautz and Sharaf [1961] discuss what might be called analytical procedures including the terms "analytical and comparative review," "interrelationships" and "correlations" among "related data" [Mautz and Sharaf, 1961, pp. 28, 86, 93, 100-101]. According to Mautz, these ideas were not new but reflected existing practices, at least at DH&S. Mautz was employed by DH&S for a time during the 1940s and was later a consultant on an analytical review project [private correspondence from Mautz, December 23, 1989].

The first official recognition of analytical (review) procedures in professional standards appeared in November 1972 with the issuance of Statement on Auditing Procedures No. 54 [AICPA, 1972]. This statement, entitled *The*

Auditor's Study and Evaluation of Internal Control, established that the evidential matter required by the third standard could be met through "analytical review of significant ratios and trends and resulting investigation of unusual fluctuations and questionable items" [para. 70]. Further, "Regardless of the extent of reliance on internal accounting control, the auditor's reliance on substantive tests may be derived from tests of details, from analytical review procedures, or from any combination of both that he considers appropriate in the circumstances" [para. 73]. This official guidance as to allowable proportions of substantive evidence has remained unchanged over two major revisions of analytical procedure guidance.

SAS No. 23 [AICPA, 1978], entitled *Analytical Review Procedures,* officially established guidance on the identification and investigation of significant "unusual fluctuations." It defined analytical procedures as "substantive tests of financial information made by a study and comparison of relationships among data" [para. 2]. SAS No. 56 [AICPA, 1988], entitled simply *Analytical Procedures,* provides a more precise definition as to what constitutes analytical procedures. Specifically, analytical procedures "consist of evaluations of financial information made by a study of plausible relationships among both financial and non-financial data." It continues the basic premise underlying the application of analytical procedures stated in SAS No. 23 that: "relationships among data may reasonably be expected by the auditor to exist and continue in the absence of known conditions to the contrary" [para. 2].

This basic premise is reasonable–if a prior relation observed, under conditions apparently free from material misstatement, continues in the audit period, then the current values are, probably, also free from material misstatement. The caveat "absence of known conditions to the contrary" provides for updating the auditor's model but doesn't establish a standard for how the auditor is to "know" about conditions to the contrary. Must the auditor search for or test for changes in prior relations or just be aware of known or possible changes that are more or less obvious to the casual observer? Is positive, rather than negative, assurance required for assessing possible changes?

SAS No. 56 focuses on unexpected differences (rather than fluctuations) and is explicit as to the role of expectations. It states:

> Analytical procedures involve comparisons of recorded amounts, or ratios developed from recorded amounts, to expectations developed by the auditor. The auditor develops such expectations by identifying and using plausible relationships that are reasonably expected to exist based on the auditor's understanding of the client and of the industry in which the client operates [para. 5].

In identifying differences that may require analytical investigation, SAS No. 56 [para. 11-12] lists three factors related to the diagnosticity of the procedures. These are: 1) the plausibility and predictability of the relations, 2) the availability and reliability of data on which the expectations are developed, and 3) the precision of the expectation. The first suggests a causal model rather than merely a "casual" association while the second requires that the auditor base expectations on data other than the recorded values themselves. Finally, the third makes it clear that the auditor should consider whether a

procedure could find an intolerably-in-error "needle" in a haystack [Kinney, 1987; Loebbecke and Steinbart, 1987].

As to investigation and evaluation of significant differences, SAS No. 56 allows a range of differences that can be accepted without further investigation and a range that should be investigated. In regard to investigation it states:

> The auditor should evaluate significant unexpected differences. *Reconsidering* the methods and factors used in developing the expectation and *inquiry of management* may assist the auditor in this regard. Management responses, however, *should ordinarily* be corroborated with other evidential matter. In those cases when an explanation for the difference *cannot* be obtained, the auditor should obtain sufficient evidence about the assertion by performing other audit procedures to satisfy himself as to whether the difference is a likely misstatement. In designing such other procedures, the auditor should consider that unexplained differences *may* indicate an increased risk of material misstatement [para. 21] (emphasis added).

This paragraph, especially the highlighted terms, provides much of the basis for our concerns about the comparative competence of analytical procedures and their tendency to understate achieved risk. We will return to it in the next section.

Passage of SAP No. 54 and SAS No. 23 was followed by practitioner and scholarly discussion of the reliability of analytical review. For example, *Montgomery's Auditing* (9th ed.) [Defliese, Johnson, and Macleod 1975, p. 145] championed the use of analytical review over tests of details under conditions of *weak* internal control while Cushing and Loebbecke [1983] took the opposite position. The latter view seems to have prevailed in that *Montgomery's Auditing* (10th edition) [Defliese, Jaenicke, Sullivan, and Gnospelius 1987, p. 341-42] discusses 100 percent reliance on analytical procedure results when controls are strong.

Even though SAP No. 54, SAS No. 23 and SAS No. 56 did not indicate that analytical evidence was in any way inferior to tests of details, there was such an indication from practitioners. Ernst and Whinney placed restrictions on the reliance that can be placed on analytical procedures [Grobstein and Craig, 1984, p. 14]. Montgomery's Auditing stated that analytical procedures produced a "subjective, deductive type of audit evidence" rather than the "objective type of evidence showing 'it is there or not there' which results from the other auditing procedures" [Defliese et al., 1975, p. 145].[1] The tenth edition of Montgomery's Auditing stated that, relative to analytical procedures, tests of details are less efficient, but tests of details "commonly provide a *higher* level of assurance with respect to an audit objective" [Defliese 1987, p. 340] (emphasis added). Blocher and Willingham [1985] were even more explicit about the relative assurance. They stated:

> To evaluate the strength of the evidence from analytical review, we must consider that analytical review provides a *negative-type* as-

[1] The same source later defines evidence as "objective if it requires little judgment to evaluate its accuracy" [Defliese et al. 1987, p. 158].

surance rather than a positive one. That is, though analytical review can be a useful technique for detecting a material misstatement, it cannot be relied upon to confirm with positive assurance that a misstatement is not present. *Positive assurance* comes only from the proper application of the appropriate detail tests procedures. Thus, the auditor can never rely exclusively on analytical review when risk or materiality is high [p. 10][2] (emphasis added).

Two recent behavioral studies of practicing auditors are consistent with this view. Both Biggs, et al. [1989] and Cohen and Kida [1989] found that auditors are reluctant to reduce tests of details even when analytical procedure results seem to support a reduction.

The large CPA firms have different histories and different degrees of reliance on analytical procedures. As mentioned above, the first reference to analytical procedures as evidence came from DH&S. SAP No. 54 was chaired by Kenneth Stringer of DH&S and his firm was an early champion of statistical analytical procedures as substantive evidence. Stringer [1975], and Stringer and Stewart [1986] described a system entitled Statistical Techniques for Analytical Review in Auditing. It used time series and cross sectional regression models to identify likely-to-be-in-error segments of an account or transaction class. Stringer [1975] also discussed the importance of the auditor's "analytical investigation" to determine the likely cause of a deviation. Some other firms have also used regression analysis (e.g., Price Waterhouse, [Akresh and Wallace, 1982, and Walker and Pierce, 1988] and Arthur Andersen [Koster, 1981]).

Statistical analytical procedures have had less usage in most firms, even including one (Peat Marwick) that is highly structured [Wright and Ashton, 1989, p. 722-723 and Elliott, 1984]. Also, analytical procedures of various types are used for different purposes. For example, Ernst & Whinney uses different analytical procedures for understanding the client's business, for inherent risk assessment and as substantive evidence [Grobstein and Craig, 1984]. Finally, in contrast to the DH&S regression-based approach to analyzing an account, *Montgomery's Auditing* (Coopers & Lybrand) seems to define the focus of analytical procedures to be on "ratio and trend analysis" [Defliese, et al. 1987 p. 156] and is unclear about the extent to which the results provide substantive evidence.

Thus, a variety of analytical procedures have been used to meet various objectives. Because of these differences, we will try to be very specific as to procedures and their usage in the comparative competency assessment that follows.

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[2]SAARS No. 1 [AICPA, 1978] and other AICPA-sanctioned review reports seem to provide at least implicit support for this view. These reports are characterized as providing only "limited" assurance that is expressed in negative form. The distinction is relevant since the review reports are based on only analytical procedures and inquiry of management.

2. Comparative Competency of Analytical Procedures vs. Tests of Details

For the purpose of comparing reliability (or competency or validity) of tests of details and analytical procedures results as substantive evidence, assume that audit sampling is used for tests of details, that a single account regression analysis is used to identify differences for analytical procedures, and that both tests are for overstatement. Figure 2 shows the aggregate audited account balance Y (say, sales) expressed as (1) the sum of N error free y's or sales amounts per sales invoices, and as (2) a function of the true relation between Y and an independently obtained explanatory variable X (say, industry sales), and a random unexplained portion, e.[3]

Figure 2

Example Upper Confidence Limit Formulations

	Analytical Procedures[1)]	Tests of Details
Actual (error free) balance	$Y = \alpha + \beta X + e$	$Y = \Sigma y$
Estimated Audited balance	$\hat{Y} = \hat{\alpha} + \hat{\beta} X$	$\hat{Y} = N\bar{y}$
Estimated error	$\hat{E} = Y_b - \hat{Y}$	$\hat{E} = Y_b - \hat{Y}$
Upper Confidence Limit:	$UCL = \hat{E} + Z_{APR}\ se\ (pred)$	$UCL = \hat{E} + Z_{TDR}\ s/\sqrt{n}$

1) Y = audited balance for the year t
y = audited balance of account or transaction class element in year t
$\bar{y}$ = average y for a random sample of n < N items
X = "causal" variable value for year t
E = error for year t
^ = estimated
Y_t = recorded or "book" amount
APR = risk of incorrect acceptance using analytical procedures
TDR = risk of incorrect acceptance using tests of details

[3]Although in practice there would likely be a partitioning of Y by plant, by product line or by subperiod of time, we will use a single estimate for simplicity. Also, for simplicity we will assume that simple random sampling is used and that a single causal variable X is considered in the auditor's model.

Figure 2 also shows the estimate of Y ($\hat{Y}$) given audited values of a randomly selected sample of n items and an independent estimate of Y given X and the auditor's estimates of α and β. Again, for the purpose of comparison, imagine a case in which the two techniques yield the same point estimate of error and that the standard error of the estimate in tests of details ($s/\sqrt{n}$) is equal to the standard error of the regression prediction (se(pred)). Thus, the two procedures yield the same upper confidence level (UCL) on error. If the UCL is just under the minimum intolerable error (MIE), which procedure do you think yields more reliable or more competent evidence?

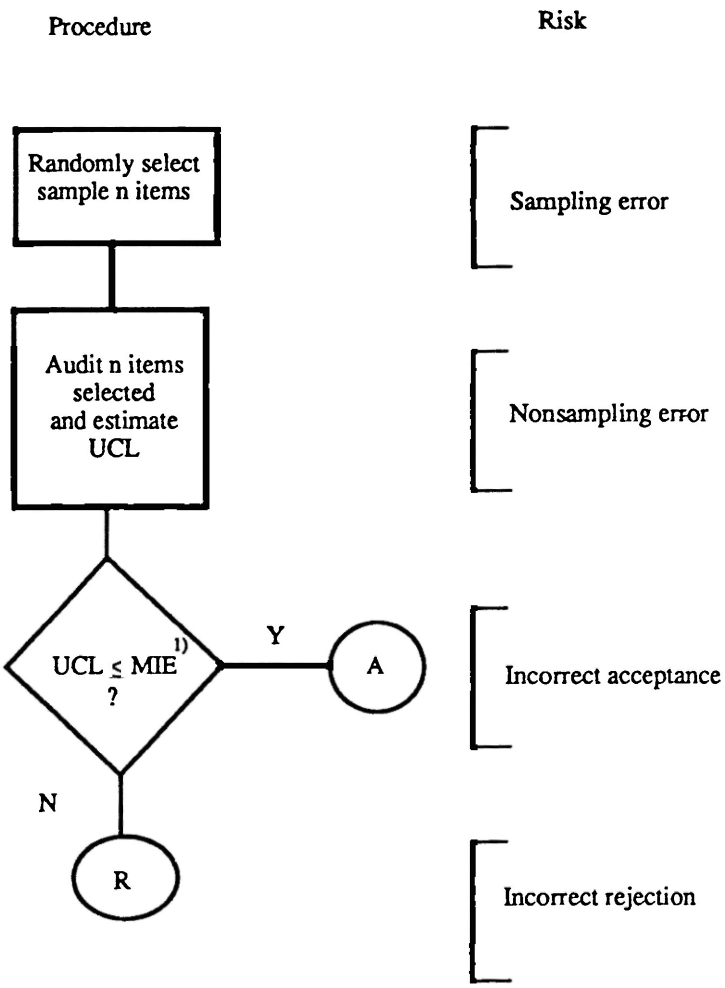
Figures 3 (tests of details) and 4 (analytical procedures) show that each of the procedures has two general failure points; that is, points at which the auditor can be led incorrectly to accept a balance that is "intolerably" in error. For tests of details (audit sampling), the points are: (1) the selection of a sample which has smaller book values and/or contains proportionately less error than what exists in the population as a whole (sampling error), and (2) error in selecting or applying the auditing procedure such as selections from recorded amounts to test the completeness assertion or failing to note an error in a sampled item (non-sampling error). The first risk can be measured within the limits of sampling error, and auditing standards assume that the second can be made negligible by quality control procedures [SAS No. 39, para. 11 and SAS No. 47, para. 20].

For analytical procedures, the two points of potential failure are (1) the identification, estimation and refinement of the expectations model, and (2) the analytical investigation of differences from the resulting expectations. For the first, the auditor may incorrectly specify the causal relations between independent variables and the account under audit, may misestimate the coefficients or the allowable range of deviation, or may fail to note changes in the relations or may incorrectly revise the model based on management's suggested explanation. For the second, the auditor may incorrectly accept a non-error explanation and revise the expectation sufficiently to yield UCL < MIE when the account is intolerably overstated. Figure 5 presents a numerical example of how the second step can inflate the achieved audit risk. The first stage is based on achieving a risk of incorrect acceptance of .05. In the example, the second stage adds .15 to that amount for an achieved audit risk of .20 over a number of audits (see Kinney, [1989] for an elaboration of the need for sequential analysis in auditing).

In the paragraphs to follow, we discuss a series of potential and likely biases that lead us to conclude that the application of analytical procedures is likely to understate the risk of incorrect acceptance. The basic causes of the biases are both statistical and behavioral, and are, in part, induced by professional standards themselves.

A fundamental competency advantage of tests of details is that for sampled items (and absent non-sampling error), misstatement is ruled out or conversely, "correctness" or validity of each recorded y is *positively* established. The test can lead to incorrect acceptance only through sampling variation or sampling error. For analytical procedures, the correctness of an item or group of items is *not* positively established, by definition. Thus, a second in-

Figure 3
Risks of Failure Using Test of Details



1) MIE = minimum intolerable error for the assertions being tested for overstatement
A = accept recorded value as not intolerably overstated.
R = reject recorded values as possibly intolerably overstated.

Figure 4

Risks of Failure Using Analytical Procedures

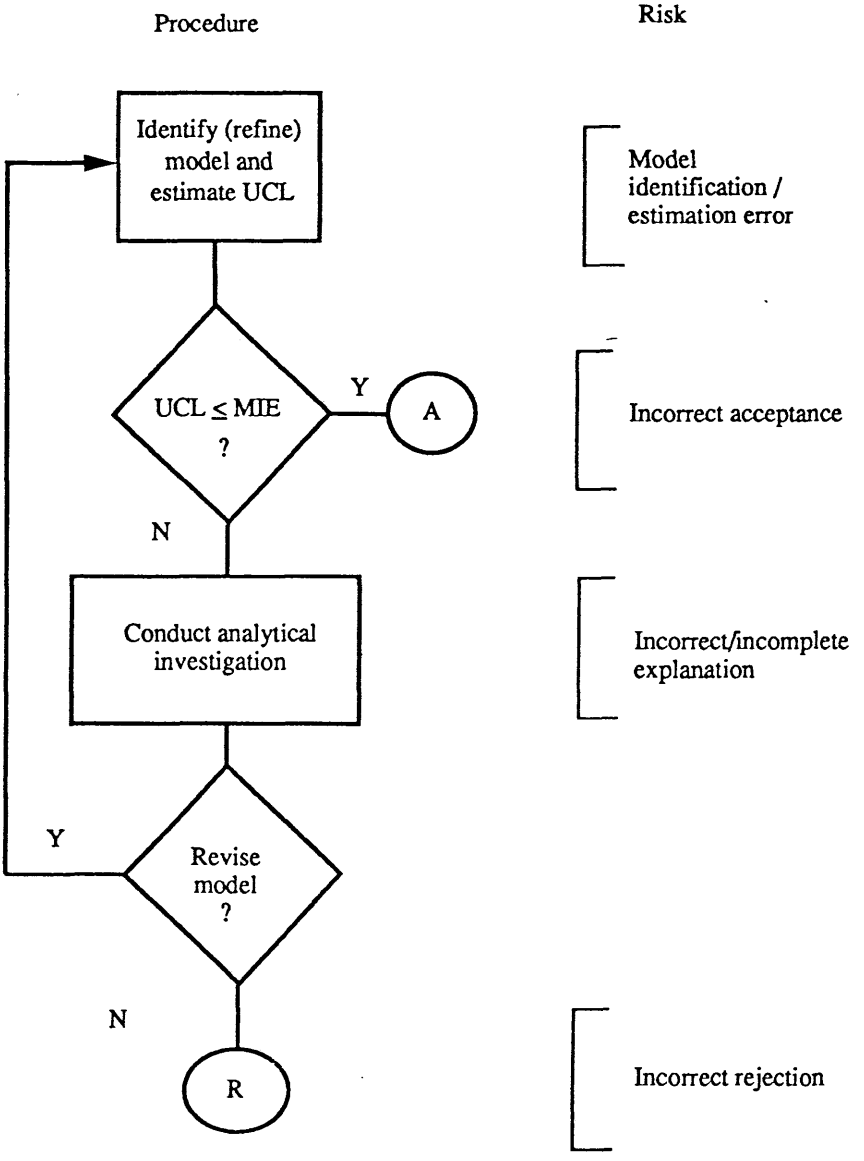


Figure 4

Risks of Failure Using Analytical Procedures

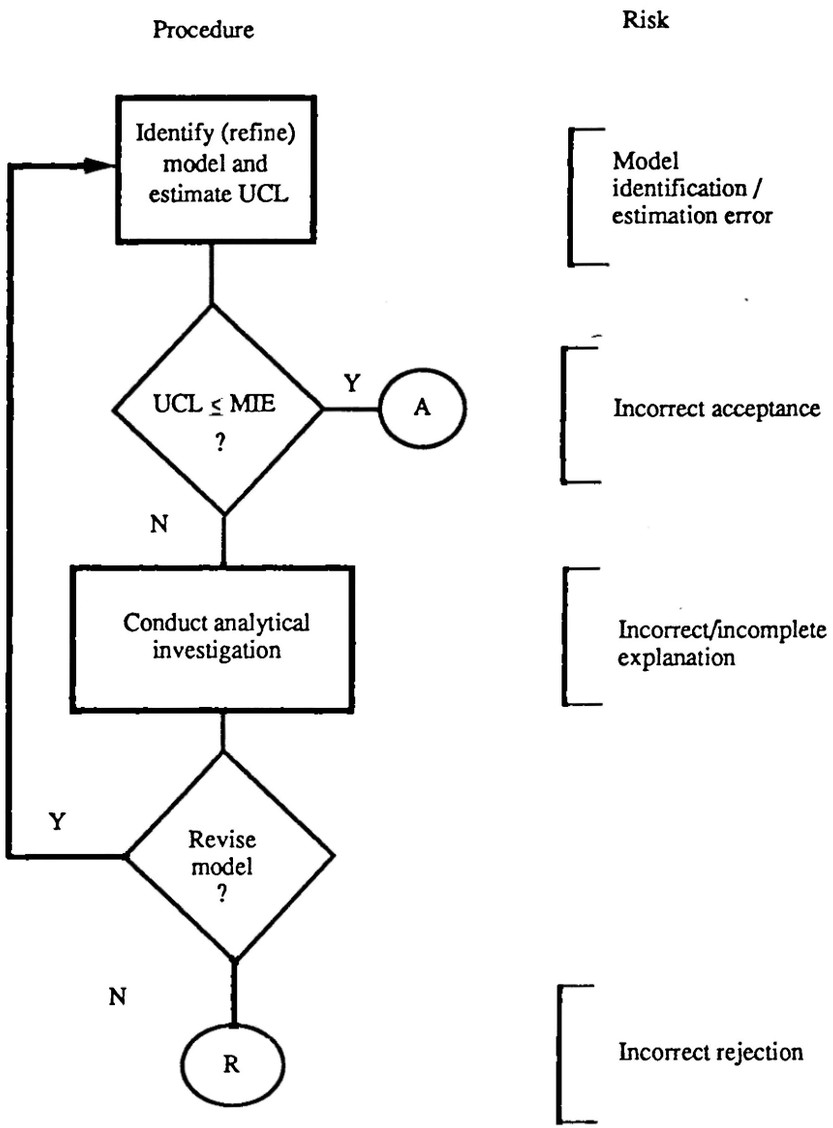
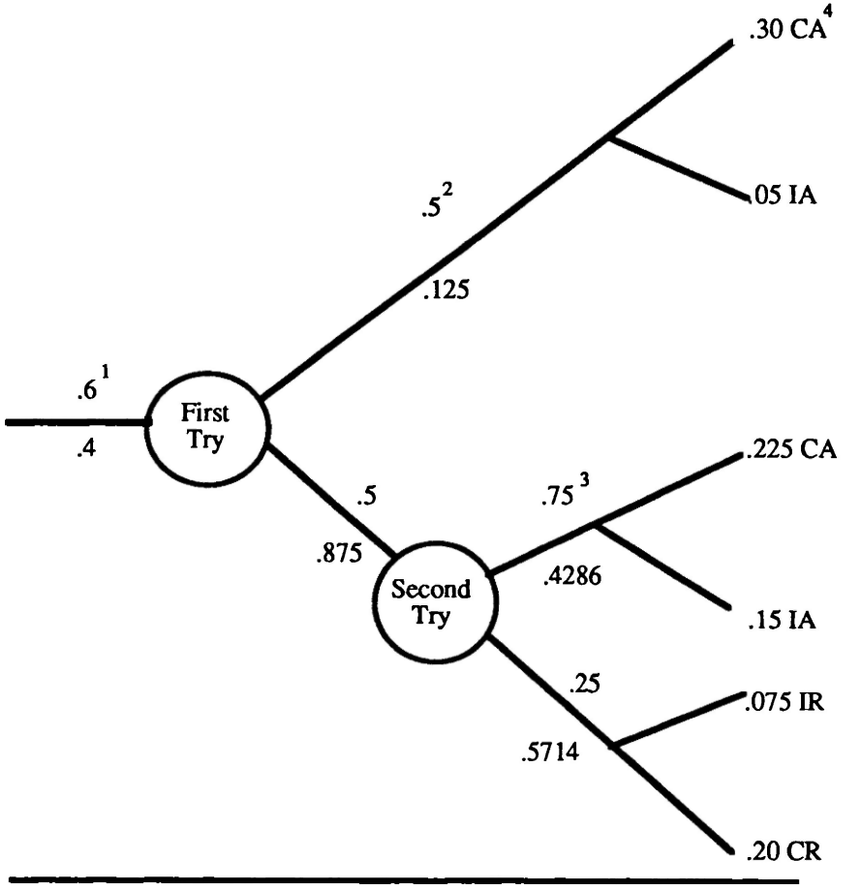


Figure 5

Example Calculation of Achieved Analytical Procedure Risk



[1] Assessed prior probability that E = 0 is .6
Assessed prior probability that E = MIE is .4.

[2] Based on the assumption that:
MIE = 1.15 se(pred) and
Decision rule is to accept if $\hat{E} < 0$

[3] Based on the assumption that P(accept|state) is proportional to the area between 0 and MIE.

[4] CA = correct acceptance
IR = incorrect rejection, etc.

ference is *always* required for analytical procedures. Specifically, if the unexplained differences are small, then intolerable error in the overall account balance is inferred to be negligible.

Statistical Biases

At the model identification, estimation and refinement stage, the auditor is developing a basis for expected audited values. The auditor faces several risks that increase the variance of outcomes and some that bias results toward incorrect acceptance. They relate to the model used and the data to which it is applied. Many of these difficulties are well known.

First, the auditor may fail to include variables that are causal. This risk can be reduced by auditor expertise in the client's industry. The auditor may also include Xs that are not causally related to Y. Here, the risk is over-identifying the model or including variables that are spuriously correlated with Y in the base period but are uncorrelated in the prediction period. Thus, variables which by chance have high correlation in the base period are inappropriately included for the prediction period. Finally, the auditor may fail to notice that the parameters of included variables have changed between the base and the prediction periods.

While these phenomena may lead to incorrect acceptance, they may also lead to incorrect rejection. There is no reason to expect a statistical bias. However, as described in the next subsection, the analytical investigation stage of the process can lead to a model building bias toward incorrect acceptance. Specifically, the identification of an unexpected difference can lead the auditor to search in a *biased* fashion for omitted non-error causal variables. That is, the auditor's search for omitted variables is caused by the identification of an unacceptable difference (UCL $\geq$ MIE) and the ensuing search for an explanation naturally leads to a higher probability of including a *non-error* cause that reduces the UCL. For example, suppose that the audit year cost of sales contains an unexpected increase in labor costs of $10, an unexpected decrease in materials cost of $10 and an inventory counting error of $10 that understates the expense. As a result, cost of sales is $10 less than expected and the auditor searching for an explanation would be more likely to detect the decrease in materials cost than to detect the increase in labor cost or the accounting error.[4] Thus, the biased search for an omitted causal explanation can lead to failure to detect misstatements.

Second, erroneous or irrelevant data also have both positive and negative aspects with respect to incorrect acceptance of accounts with intolerable total error. Bad data in the base period may prevent reliance on statistical analytical procedures. For example, random measurement error in the X variable for the base period will lead to estimates of β biased toward zero, and an inflation of the standard error of the regression (se) will cause the auditor not to rely on regression since the UCL will tend to be high. Thus, ran-

[4]SAS No. 56 [para. 18] warns that "offsetting factors may obscure misstatements," e.g., an unexpected nonerror understatement could hide an error-caused overstatement. Yet the auditor trying to explain a UCL $\geq$ MIE would have no reason to look for a non-error factor that would increase the UCL!

dom measurement error in the base period X values leads to an incorrect rejection or efficiency bias. Nonrandom measurement error leads to less predictable results. However, since the base period has been audited, there is reduced risk of bad data in the base period. The potential problem of intentionally misstated X data for the prediction period is one reason that Cushing and Loebbecke [1983] argued for strong internal controls as a requisite for reliance on analytical tests.

We have labeled this subsection "statistical" biases. However, the risks and biases apply to a non-statistically-based procedure as well as to statistically-based procedures. Subjectively or judgmentally failing to consider an important causal variable can bias one's judgment about the results to be expected. Also, a lack of quantification of estimates may lead to unrealistic assessments of effects and to systematic underestimates of the normal variation in expected values [Tversky and Kahneman, 1971]. The latter behavioral tendency will cause the UCL to be too low and lead to increased risk of incorrect acceptance. This inability to signal or "flag" intolerable (or even material) misstatements seems to be especially probable when considering ratios based on aggregate values.[5]

Behavioral Biases

At the stage of evaluating analytical procedure results, SAS No. 56 suggests several practices that are almost sure to lead to an increase in the risk of incorrect acceptance. For accounts for which the UCL equals or exceeds MIE, paragraph 21 of SAS No. 56 (reproduced earlier) provides guidance for follow-up. Specifically, it lists five ways in which the process is biased *toward* incorrect acceptance when an unexpected difference is noted. Rather than considering possible misstatement, the first suggestion in paragraph 21 is that the auditor "reconsider" the model used to develop the expectation ($\hat{Y}$) and, second, it indicates that "inquiry of management" may assist in this regard (is management likely to suggest fraud or error as the cause?). Third, as to corroborating management's suggested explanations, paragraph 21 states that they "should ordinarily be" corroborated (but not always?). Fourth, apparently only in those cases in which "an explanation for the difference cannot be obtained" the auditor should apply other procedures to rule out misstatement. Finally, in designing other procedures, the auditor should consider that "unexplained differences may indicate an increased risk of material misstatement." It seems clear that the risk of such misstatement *is* increased if, indeed, no non-misstatement explanation can be found for the difference. That is, if all other factors have been ruled out, then all that is left is chance or misstatement. Thus, paragraph 21 of SAS No. 56 focuses attention on non-error causes that may bias the auditor toward incorrect acceptance.

In addition to the possible bias due to the official guidance, the psychology literature has identified several biases that decision makers often exhibit when making probabilistic judgments. Auditing is characterized by complex probabilistic judgments and much of behavioral auditing research has focused

[5]For further caveats about the problem of weak diagnosticity, see Grobstein and Craig [1984, p. 14], Loebbecke and Steinbart [1987] and Kinney [1987].

on auditors' biases in making such judgments. The research discussed below is a sample of the studies indicating possible behavioral biases that may result in an understatement of achieved audit risk through the application of analytical procedures as substantive tests. The biases are grouped according to whether they apply during the audit in determining a possible explanation of an unexpected difference (hypothesis generation), or in revising assessed probabilities of possible causes, or after the audit is completed and results are evaluated by others.

Hypothesis Generation

The availability bias refers to the tendency of a decision maker to judge the frequency of an event by the ease with which similar events come to mind [Tversky and Kahneman, 1973]. Events may be salient because they are sensational or vivid or because they have been experienced frequently. Libby [1985] asked auditors to hypothesize up to six errors that might explain unusual analytical review results and to rate the likelihood that each error caused the fluctuation. Results indicated that the likelihood of each error was affected by its perceived frequency, its actual frequency and the recency with which the error had been encountered by the auditors. These results for error causes are disturbing if analytical review is to be used as substantive evidence. We know of no archival data on non-error explanations of unexpected differences. However, if the auditor has frequently or recently encountered *non-error* causes when evaluating significant fluctuations in other clients' financial statements, he or she may be too easily persuaded that a currently observed fluctuation is also due to a *non-error* cause. As a result, achieved audit risk may be understated.

Output interference occurs when knowledge already retrieved from memory hinders the retrieval of additional items (see Nickerson [1984]). Frederick [1988] found experienced auditors to be affected by output interference. Auditors studied lists of internal controls and then were asked to recall the controls. Half of the auditors were presented with a partial list of previously learned internal controls; the other half received no cues. Auditors without the cues recalled more controls on the recall task than did those provided with the partial list.

Output interference may cause auditors to misdiagnose significant fluctuations in analytical review results. If the auditor asks client management to explain a deviation, the non-error reasons provided may interfere with retrieval of the auditor's own knowledge of possible error causes. If the auditor relies on his or her own experience, output interference combined with the availability heuristic may cause the auditor to focus on the causes most accessible in memory to the exclusion of an important error cause.[6]

Heiman [1990] studied auditors' spontaneous generation of explanations for unexpected differences. She found that auditors did not spontaneously generate as many alternative explanations for ratio fluctuations as they did

[6]Hock [1984] and Moser [1989] link output interference with availability to provide a mechanism by which judgments are biased.

when prompted to do so. Failure to generate or consider counter-explanations, together with belief perseverance (see next subsection) may cause the auditor to accept a non-error cause of analytical review deviations despite evidence to the contrary. If auditors receive from management a *non-error* cause for an unexpected difference and don't spontaneously generate possible error causes, the chances of incorrect acceptance are increased.

The anchoring and adjustment heuristic represents the decision maker's tendency to focus on an initial value (an anchor) and to subsequently update (adjust) inadequately the initial belief as new information is received. Behavioral research has shown that anchoring and adjustment can result in a judgmental bias since decision makers may rely on an irrelevant initial anchor, or may make insufficient adjustments with respect to the informativeness of the new data [Libby, 1981, pp. 162-163]. Kinney and Uecker [1982] reported results consistent with anchoring in an attention directing analytical review task. Auditors tended to anchor on book value to develop point estimates beyond which an analytical investigation of the book value was appropriate. Biggs and Wild [1985], and Heintz and White [1989] obtained similar results in extensions. This bias applies only to non-statistical procedures but is disturbing since it violates independence of expectations and book values.

Probability Revision

Revision of initially formed probability or risk assessments may also be biased. In some situations, decision makers may continue belief in an initial hypothesis even in light of subsequently received evidence to the contrary. That is, the initial belief "perseveres." Koonce [1990] investigated auditors' tendency to focus on initial beliefs in an analytical review setting and found results consistent with belief perseverance. Specifically, Koonce's results indicated that auditors who developed written non-error explanations for unusual analytical review results continued to accept the explanation as the most likely unless explicitly requested to develop counter-explanations.

After forming an initial hypothesis in a judgment task, decision makers often search for and place more importance on evidence that confirms the hypothesis than on disconfirming evidence [Fischhoff and Beyth-Marom, 1983; Klayman and Ha, 1987]. This "confirmation bias" is found in a variety of settings including complex problem-solving and probabilistic-judgment tasks similar to those found in auditing (e.g., Wason [1960], Wason and Johnson-Laird [1972] and Snyder and Swann [1978]). When auditing a reputable client, the auditor may have a strong initial belief that no material misstatements are present in the financial statements. Mautz and Sharaf [1961, p. 28] indicate that the idea of an initial hypothesis of no error is one of long standing. If errors or irregularities do exist, however, a confirmation bias may influence the auditor's assessment of subsequent evidence and counter-evidence and achieved audit risk may be higher than planned.

While confirmation bias is potentially important in evaluating analytical procedure results, behavioral research in auditing has found only mixed support for it. When evaluating a going-concern issue, Kida [1984] found that, in general, auditors place more importance on the factors indicating possi-

ble failure than on the factors indicating viability. Trotman and Sng [1989] extended Kida [1984] with essentially the same results in an internal control task. Ashton and Ashton [1988] found that auditors were influenced more by disconfirming evidence than by confirming evidence in an internal control task. Butt and Campbell [1989] also tested for confirmation bias in an internal control task and found that auditors did not seek confirming evidence unless specifically requested to do so. In a study of analytical procedures, the Biggs, Mock, and Watkins [1989] protocol analyses of four audit managers and seniors in an analytical review task suggested that, while the two managers were careful to guard against confirmation bias, the two audit seniors were less likely to do so. The authors concluded that experience might affect the auditor's ability to appropriately analyze analytical review results. However, Bonner's [1990] results indicate that experience differences play an important role in analytical review cue selection and weighting but are not important in evaluating internal control risk. This suggests that task-specific knowledge may mitigate confirmation bias.

According to Bayes' rule, the order in which information is presented should not affect the decision maker's belief revision process. However, the psychological literature has documented situations in which the order of evidence presentation affects revised beliefs. Hogarth and Einhorn [1989] have developed a belief-adjustment model that can explain primacy, recency or no order effects depending on complexity, length of the evidence series, and response mode. Ashton and Ashton [1988] used the Hogarth and Einhorn [1989] model and successfully predicted recency effects in auditors' internal control evaluations. Butt and Campbell [1989] also found support for the belief-adjustment model when auditors held weak initial beliefs about internal control reliability. With the exception of Koonce [1990], we are not aware of any studies of possible order effects in use of analytical procedures. However, order may be important, especially in light of the fact that the auditor may stop the investigation before contrary evidence is received or may resist consideration of subsequently received evidence to the contrary.

Post Audit Analysis

Decisions should be evaluated in light of the information available at the time the decision was made regardless of the ultimate outcome. Hindsight bias refers to the inability to evaluate past decisions without considering currently available information [Fischhoff, 1975]. While hindsight bias has not been studied in an auditing context [Ashton et al., 1988], the bias is particularly detrimental if analytical review procedures are used as substantive evidence since decisions are based on limited, aggregated information. If, after the auditor's report is issued, subsequent information reveals material misstatement and the auditor's work is challenged, the courts may determine that the auditor should have recognized the potential for misstatement using properly applied analytical procedures. The auditor should consider the potential effects of hindsight bias before choosing to rely on analytical procedures as substantive evidence. That is, ask, "How will others judge the credibility of my evidence if, indeed, material misstatement exists?" Thus, in

addition to consideration of his or her own biases, the auditor may need to consider biases of others who will have additional information.[7]

3. Concluding Remarks

In the paragraphs above, we have outlined the history and several potential limitations of the reliability of analytical procedure results used as substantive evidence. In contrast to substantive tests of details, we find that analytical procedure results are subject to several biases that may overstate their apparent competence.

With proper selection and application of audit procedures, tests of details will fail to detect extant intolerable error only if the auditor is unlucky—that is, only if the sample is not representative of the population. For analytical procedures, the auditor may fail due to chance fluctuations in the data. However, analytical procedures may also fail to detect error due to biases related to the way in which auditor's research question is posed—trying to determine that the recorded data might be *right* rather than trying to see whether it is *wrong*.

What, if anything, can be or should be done? We have some suggestions for researchers and for standards setters.

Researchers

There are several promising areas for further research into the reliability or competency of analytical procedures. There is need for analytical work as well as for statistical and behavioral studies. Our list is based on the thoughts expressed above and should not be interpreted as comprehensive for the entire area of analytical procedures.

From an analytical perspective, what is the essential mathematical nature of analytical procedures with respect to error and how they should be combined in revising prior probabilities of error? Is Bayes' Rule adequate? How does the second inference required for analytical procedures affect probability revision? How should the second order probability by accommodated?[8]

How reliable are the analytical procedures used in practice? How does their reliability differ across procedures or across accounts or across levels of expertise? What is their achieved risk? Statements that X percent of all errors detected by auditors were detected by analytical procedures (e.g., see Wright and Ashton [1989]), are one sided. The statement is not reversible into a positive statement that absence of an indication of misstatement means an absence of material error—the auditor may have been a victim of bias or simply may not have looked hard enough.

On the behavioral side, to what extent do the biases discussed above apply and how much do they affect achieved reliability of analytical procedures? Are auditors unduly influenced by management's suggestions of non-mis-

[7] Felix and Waller [1984] refer to the probability of evidence being judged adequate as a "second order" probability.

[8] See footnote 7.

statement explanations of unexpected differences? Or, do auditors systematically discount the results of analytical procedures as Biggs, et al. [1989] and Cohen and Kida [1989] suggest? Is the discounting a re ognition of some of the inherent limitations of analytic procedure results as evidence?

Standards Setters

As indicated above, SAS No. 56 is a considerable improvement in guidance to practitioners. It provides at least a partial conceptual basis for analytical procedures and many warnings of dangers in the application of analytical procedures. However, there is one rather simple modification to its guidance that could lead to substantive reduction in the biases discussed above.

The suggestion is to change the focus of SAS No. 56 paragraph 21 from a search for *non-misstatement* causes to a consideration of *misstatement* causes. Figure 6 presents possible wording. The suggestion is similar to the "conceptually logical approach" of SAP No. 54 [para. 65] to "consider the types of errors and irregularities that could occur" and then to consider which controls would prevent them. For analytical procedures, the approach would be to consider possible misstatements and then look for data that would be consistent with the misstatement.

Figure 6

Suggested Revision to SAS No. 56[1]

.21 The auditor should evaluate significant unexpected differences **and evaluate possible misstatements as the cause. For example, an unusual difference between recorded and expected cost of sales might be due to omitted credit purchases or a pricing error in the ending inventory. Consideration of related payables and inventory balances may help resolve the matter. After considering possible misstatement,** inquiry of management may assist the auditor in **revising the auditor's expectation.** Management responses, however, should ~~ordinarily~~ be corroborated with other evidential matter.

.21a In those cases when an explanation for the difference cannot be obtained, the auditor should obtain sufficient evidence about the assertion by performing other audit procedures to satisfy himself as to whether the difference is a likely misstatement.[2] In deciding such other procedures, the auditor should consider that unexplained differences ~~may~~ indicate an increased risk of material misstatement.

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[1] Additions are in bold and deletions in the original are lined.

Given an unexpected difference, the auditor would consider what error cause might explain it. Then the auditor would consider what other readily available data would be consistent with the error and determine whether the other data is consistent. For example, when recorded cost of sales is unexpectedly low, the auditor might hypothesize that it could be due to omitted credit purchases and then look to see whether ending payables are also lower than expected. Alternatively, he or she might consider possible overpricing of the ending inventory and look for unexpectedly high ending inventory. Note that if the auditor simply asks management (as SAS No. 56 discusses), management might suggest improved inventory planning and control or improved purchasing procedures as the explanation. The auditor might search for and find some evidence of such improvements and incorrectly attribute too large a dollar effect to the improvement and stop his or her search for error.

It seems to us that auditing standards should be designed to help reduce biases to which the auditor may fall victim—especially those that lead to incorrect acceptance. We believe that a change in the focus of paragraph 21 of SAS No. 56 could help.

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