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To:
Phoebe W. Brown, Secretary
Office of the Secretary
Public Company Accounting Oversight Board
1666 K Street, NW
Washington, DC 20006-2803

Dear Ms. Brown,

we would like to thank you for the opportunity to respond to the PCAOB's Proposed Auditing Standard – Designing and Performing Substantive Analytical Procedures and the PCAOB Release No. 2024-006 dated June 12, 2024.

We generally support the stated objective to rework AS 2305. The “advancements in technology” through “technology-assisted analysis” need to be reflected. The worldwide standards on analytical procedures (APs) date back to concepts from the 1970s where compromises had to be made as computers were not broadly available. The biggest compromise was to establish a non-statistical, judgmental concept for APs. The adverse effects from these compromises with regards to both under-auditing and over-auditing seemed acceptable these days. We agree with the concerns of the PCAOB regarding the application of judgmental APs. Reflecting the continuing challenges for auditors in applying judgmental APs raises the question if the time was right to guide the profession towards robust and re-performable statistical-based analysis. A big step ahead would already be if auditors would apply simple regression and time series techniques appropriately.

The principles of APs – comparing a book-value to an estimate – are key for any integration of statistical methods into the audit risk model.

We do not disagree that the sharpened requirements will lead to a decrease in usage of APs. However, we disagree with the conclusion that there will be no impact on audit quality due to a replacement with tests of details (ToDs). The persuasiveness of well-designed APs can be far higher compared to random ToDs. Historically, the audit sample sizes for ToDs were designed to cover a remaining risk. They were not meant to be the sole basis of the audit opinion. Therefore, APs are essential for every audit. Most often, APs are the only appropriate method to address the completeness assertion. Specifically limiting the acceptable variation to tolerable error will not lead to better APs. It will lead to auditors over-relying on weak APs.

There needs to be a clear analysis of the few known root causes, why auditors continue to struggle with performing APs. Requirements need to be written and explained in a way that in the long run they enable objective and re-performable APs. One root cause is the confusing use of statistical vocabulary (precision, reliability) in completely different meanings. Words like “predictability” and “plausibility” are hard to operationalize. For non-native speakers, e.g., auditors of US-components, it is almost impossible.

Respectfully we recommend to challenge the limitation of the investigation threshold to the value of performance materiality. This limitation violates statistical fundamentals and will not lead to cautiousness but to overreliance on weak APs.

We appreciate the opportunity to comment below on selected questions in Release No. 2024-006 to substantiate our view and highlight opportunities for improvements. Our observations are based on approx. 3,000 applications of statistical APs in audits around the globe – ranging from the biggest companies in the world to small local entities. Up to our knowledge this is the only empirical study on appropriately performed APs. We are very happy to discuss and demonstrate as there is a big opportunity to move the profession forward.



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holds a global senior management role in one of the biggest transformation projects of an audit firm. Her PhD was recently published on Process Mining in auditing, giving an uncompromisable view on the profession’s readiness for emerging technologies.

1. Does the description of current audit practice accurately depict the state of practice? If not, what clarifications should be made? Are there other aspects of current audit practice that we should consider?

The description of current practice focuses on non-statistical (judgmental) applications of APs, which is the current state of practice in most audit firms. In our view, “non-statistical” applications also include applications of “business intelligence” and “data analytics”. In “business intelligence” and “data analytics” setups, descriptive techniques for visualization of data, summarizations of data and pivot tabling are applied. The complex conclusion process of APs is fully left to the auditor’s judgment – in contrary to a statistical application. We believe it is remarkable that techniques that are fundamental to most academic disciplines such as functional regression and time series regression receive so little attention in auditing. We believe the reasons are incorrect calculations in the literature of the 1970s. These incorrect formulas found their way into regression and time series computer tools of big audit firms until they were decommissioned due to poor usage. Once these formulas are corrected, auditors are able to apply statistical APs without the need to become statistic experts:



Figure 1

The picture shows a screenshot from a regression application for a consumer business. Auditors select those variables that are expected to relate to the sales of the 300 supermarkets analyzed. 99% of the variance of supermarket sales is explained. The residual plot shows one supermarket with unexplainable high sales. The reliability achieved is 86%. The interface to the audit risk model guides auditors if further ToDs are necessary.

In our experience, auditors do not struggle with applying the appropriate statistical concepts if those concepts are tool-enabled.

2. Are there other areas of concern relating to auditors’ use of substantive analytical procedures that are not described above? If so, what are the areas of concern and what changes should be made to address them?

The non-statistical use of APs is an overall concern causing many of the challenges described in the PCAOB’s release. There needs to be a discussion if the objectives of an AP can be achieved judgmentally at all. Judgmental applications cannot be independently verified even with best supporting documentation. This missing objectivity does not contribute to trust in the audit opinion.

Auditors struggle with the use of vocabulary (precision, reliability) in totally different meanings compared to natural sciences and statistics. The introduction of further vocabulary such as “reasons for plausibility” will most likely confuse auditors even more. We recommend aligning the wording closer to the statistical concepts behind APs and internationally agreed vocabulary on metrology or statistical auditing.

Auditors struggle to understand the differentiation between “planning analytical procedures” and “substantive analytical procedures”. We believe that APs may have different purposes when used for planning vs. execution or conclusion. But the technique itself is not different in the different phases of the audit. We understand that the differentiation was made to lower the hurdles for APs in an early phase where the auditor does not have an expectation. However, when applying appropriate methods, there is no particular hurdle for proper expectations during audit planning. Therefore, we do not understand why the proposed standard (including the title) needs to be limited to “substantive analytical procedures”.

Auditors struggle to aggregate the results of different APs. Typically, this can only be achieved mathematically by aggregating confidence intervals. It may be considered if the aggregation needs to be addressed, since audit firms have developed own judgmental guidance in absence of rules.

Beyond, the standard may more explicitly describe that APs can be performed statistically and non-statistically. That would help audit firms to better operationalize and make APs more robust and objective. We experience confusion and mental resistance of many auditors if APs involve statistics *at all*. We believe that judgmental APs should be avoided if a statistical alternative is feasible. At least (in analogy to ToDs) judgmental and statistical applications should lead to the same result.

3./4. Does the proposal adequately describe how advancements in technology changed the extent and frequency of auditors’ use of substantive analytical procedures? Please provide details, including any information on the use of technology-based tools and the increase in the availability of data to perform substantive analytical procedures.

We would like to recommend examining the literature and applications of functional regression and time series regression. These are archetypes of APs developed in the 1970s. Availability of data and computer tools will give new relevance to these methods once audit firms go beyond descriptive methods of “business intelligence” and “data analytics”. From 3,000 statistical based analyses we know that (1) auditors and reviewers underestimate the assurance level (reliability) that could be obtained from an AP, however (2) the estimated assurance level varies significantly, demonstrating the subjectivity of applying analytical procedures judgmentally. If properly and user-friendly implemented, technology is a booster for APs. A diagnostic method such as APs should be bias-free and re-performable like audit sampling. We are happy to demonstrate the applications we have built to achieve that.

5. Are the introduction and objective sections of the proposed standard clear and appropriate? If not, how should they be clarified?

As described in our response to question 2, we struggle to understand the need to limit the standard to substantive APs only. APs applied during planning and risk assessment can be even more powerful compared to applying during execution: During planning, APs can indicate risks the auditor was not aware of. During execution they are only applied to address the few risks already identified. The use of APs during planning should be strengthened.

We recommend challenging the wording “plausible and predictable”. Auditors struggle to operationalize those. The objective for APs is to identify correlations and prove causation. These two criteria together form a relationship that represents an expectation that is more or less close to the book value.

6./7. Are the factors that affect precision clear and appropriate? If not, how should they be clarified? Are there other factors upon which a substantive analytical procedure’s level of precision depends? If so, what are they?

The precision of an estimated expectation is the statistical variance of the estimation. The explained variance of the estimation is derived from the number and correlation of the variables used. Non-statistical techniques ignore the variance of the estimation which leads to the discussed challenges that auditors experience when building expectations without statistical support. Auditors need to understand that – due to individual standard error of the estimated expectation – there is no fixed reliability level that a specific AP generally can provide.

Reliability measures the frequency (probability) with which the difference between estimated expectation and book value does not exceed the precision (confidence interval).

In ISA 520 as well as AS 2305 the term “reliability” is used differently – namely as a qualitative indicator for the input information used in an AP. However, which information (and information source) to use in an AP is a yes/no decision on the appropriateness of the procedure for the assertion. It does not scale in terms of more/less reliable leading to more/less persuasive evidence.

As described in our response to question 2, auditors struggle with these terms.

8. Are the requirements for evaluating the relevance and reliability of information used in a substantive analytical procedure in accordance with AS 1105 clear and appropriate? If not, how should they be clarified?

The terms “reliability”, “precision”, “plausibility” and “predictability” are used inconsistently with the underlying statistical concepts of APs. Plausibility and predictability are non-statistical terms that describe the quality of a correlation. The consistency of terms will be key for proper integration of techniques. If auditors and statisticians do not use the same language, misapplications are the logical consequence.



Figure 2

The picture shows the planning screen of a regression application. For all variables, auditors can check various measures to make sure that the data is complete and accurate. The solar correlation map shows (in a simplified but comprehensive form) the correlation of variables to sales and the intercorrelation of variables. The map is the basis for the auditor to form his expectation.

9. Are there specific considerations related to evaluating the relevance and reliability of information used in a substantive analytical procedure, beyond those in AS 1105, that should be included in the proposed standard? If so, what are those considerations and how should they be incorporated in the proposed standard?

We see that external information from publicly available curated sources such as the Federal Reserve Economic Database and European Bureau of Statistics already provide most of what auditors need for appropriate APs. We could imagine, however, that auditors are required to obtain that information directly from quality-controlled sources and not through the client. This would strengthen professional skepticism and would make audit procedures less foreseeable – therefore appropriate for fraud detection as well.

The risk for “circular auditing” when using company-internal non-financial information exists. The risk is manageable when auditors apply well-known managerial relationships and consider nature, source and type of data. Statistical measures help to prevent misapplications, e.g., when 100% correlation is in place since one variable is a proportion of the other. The risk for “circular auditing” decreases if multiple variables are applied. Models with multiple variables are only feasible when applying statistical techniques. Here is where judgment definitively ends.

10. Is the proposed requirement that the auditor identify the relationship or relationships to use in the substantive analytical procedure and determine whether each such relationship is sufficiently plausible and predictable clear and appropriate? If not, how should it be clarified?

We believe auditors will struggle to operationalize criteria such as “sufficient plausible” and “predictable”. Auditors need to identify correlations and prove causation. This is a widely understood concept. Each variable used in a relationship needs consideration of causation. In a statistical model using multiple variables, additional considerations are necessary to address intercorrelation and

overfitting. When machine learning techniques are applied, various quality measures may need to be reflected. We believe the proposed requirement is oversimplifying the problem. We recommend a paragraph on “appropriateness of a procedure” or link into AS 1105.

We believe that the requirement to no limit determining a relationship is obsolete. If a relationship exists, it will be proven when performing the AP, no risk of bias. It is more important to emphasize in para. 06 that the relationships and expectations come from the auditor’s understanding of the business and need to be rationalized. Another reason to not limit the standard to substantive applications of APs (as described in our response to question 2).

13./14. Is the proposed change specifying that the auditor may not develop the expectation using the company’s amount or information that is based on the company’s amount clear and appropriate? If not, what changes should be made?

The requirement in para. 07 “The auditor may not develop the expectation using the company’s amount or information that is based on the company’s amount.” is misleading. It reads like limiting APs to external information. We would like to emphasize that when building a model, all information can be relevant. Internal, external, financial, and non-financial. Some models can be built on current year data, primarily functional regression models. Here, prior year information is even less relevant. Other models require information from one or more prior years, specifically time series models. Models can be combined as well. Models do not need to come from the past.

Avoiding circular auditing is a question of making sure that variables forming a relationship need to be independent. Independence of variables is an inherent requirement to all statistical models and part of the appropriateness of the procedure. “Independence” could be added to para. 05 as a requirement for the relationship. In complex applications, graph theoretical diagrams can help to clarify independence.

16. Is the proposed requirement that the auditor determine a threshold to evaluate the difference between the auditor’s expectation and the company’s amount clear and appropriate? If not, what changes should be made?

In statistical terms, the overall objective of an audit is to form an audit opinion at a reliability above 90% and a precision set to materiality. Performance materiality is set at a value below materiality to have a buffer for error aggregation risk and the risk of the undetected error. Precision and reliability interrelate, e.g., when increasing performance materiality (decreasing precision) the risk of non-detection of a difference bigger than performance materiality is lowered. Ceteris paribus, a higher precision is less reliable and a less precise difference between expectation and book value is more reliable.

In concrete applications of APs, the auditor’s (estimated) expectation is compared with the book-value using a confidence interval.

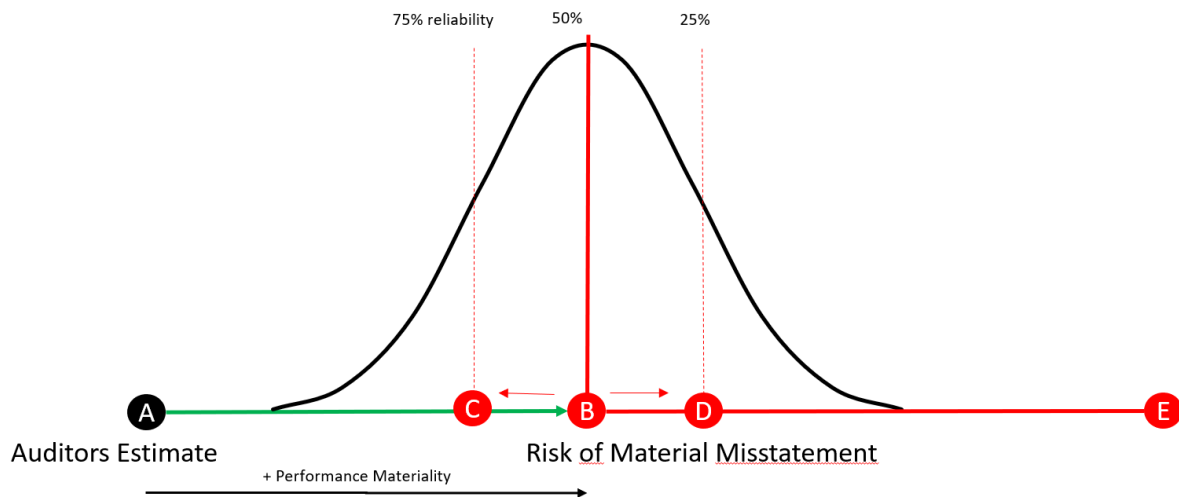


Figure 3

Let the auditor's expectation value be point A. It could be a selected point of a regression line or the mean of a sufficient large sample. The purpose of the AP is to determine the so-called "betaRisk" (Risk of not detecting a material deviation from the expectation), that a book value is overstated by more than performance materiality (point B in Figure 3). Therefore, the variance of the auditor's expectation (represented by the bell curve) is built around point B. If the book value is depicted as point C, the betaRisk is below 50%, depending on the fluctuation, e.g., at 25%. Reliability is therefore $(1 - \text{betaRisk}) = 75\%$. If, on the other hand, the book value is higher than performance materiality, in other words, if the book value is located like point D in Figure 3, the betaRisk is higher and the reliability smaller than before. In this case, the reliability that the book value is materially misstated is only 25% and the corresponding $\text{betaRisk} = 1 - 25\% = 75\%$.

If the audit risk model for a specific account requires only 25% reliability (acceptable remaining detection risk is in this case 75%), point D can be accepted without further investigation. If more than 75% reliability is needed, even point C cannot be accepted without further investigation. This demonstrates that the acceptable amount of difference between expectation and book value varies. This difference changes based on several factors, primarily when auditor's risk assessment changes and – more importantly – it changes due to the fluctuation of the auditor's estimated expectation. In any case, a requirement that the threshold cannot or may not exceed performance materiality is technically wrong.

The issue with judgmental applications of APs is that the (statistical) variance of the auditor's expectation is not computed. As a result, audit firms provide tables with multiples of performance materiality and corresponding reliability levels. To compute these multiples, variance is set to 1 (standard normal distribution).

In statistical applications, the achieved precision (for low reliability applications) often does not exceed materiality. This finding seems to prove the appropriateness of the performance materiality concept, as the numerical difference between materiality and performance materiality is the buffer for the undetected misstatement.

If the PCAOB requires the acceptable variation to not exceed performance materiality, they will automatically require APs to be performed at 50% reliability. We believe this does not contribute to the objective to be mindful when performing APs. Auditors might possibly try to rationalize why a weak AP provides at least 50% reliability – even though it doesn't.

17. Are the proposed requirements for evaluating the difference between the auditor's expectation and the company's amount clear and appropriate? If not, what changes should be made?

In statistical and non-statistical setups, auditors have reported confusion on the extent of investigation necessary. One approach is to explain differences to an extent that the remaining difference is below the acceptable variance. The alternative is to investigate differences to the full extent they differ from expectations. We believe it would be sufficient to test differences until the remaining difference is below the threshold for a material difference.

18./19. Are there other requirements that should be included within the proposed standard regarding evaluating differences or when the auditor encounters the scenarios described in the standard?

Auditors struggle what procedures to perform, e.g., on a monthly value differing from the expectation by more than the acceptable amount. It needs to be highlighted that the full toolbox of procedures (further APs, any type of ToD) can be executed on this separated population of items.

20. Are there other requirements related to designing and performing substantive analytical procedures that should be included in the proposed standard? If so, what are they? For example, existing AS 2305 includes provisions related to documentation of a substantive analytical procedure. Are there specific considerations related to the documentation of a substantive analytical procedure that are not included in AS 1215 but should be included in the proposed standard?

Given the challenges when applying APs a general reference to AS 1215 will require enablement by audit firms. So far, AS 1215 does not include specific requirements for APs. Auditors will struggle to demonstrate compliance with the sharpened requirements without clear documentation guidance. Many aspects of an AP that require explicit documentation in a judgmental application are implicitly done in a statistical setup. E.g., the strength of a relationship being expressed by statistical values like R-squared. We believe auditors should document the statistical model leading to an expectation and the basis for conclusion.

22. The proposed amendment specifies that when substantive procedures are applied to accounts or disclosures that depend on information received by the company from external sources, such procedures should involve examining relevant information from the external sources. Is this proposed amendment clear and appropriate? If not, what changes should be made?

Our studies show that relevant external information auditors need is available from government-curated sources such as Eurostat (the statistical office of the European Union) or FRED (Federal Reserve Economic Data). Specifically for time series analysis there is a limited number of sources that covers most of auditor's needs. A big opportunity for audit firms to establish central quality control.

In case the auditor incorporates data at a different level of disaggregation (shops, business units, products, etc.) other types of data are needed that may not always be easily accessible. If these information are obtained using company resources (e.g., licenses for industry-sector data) the auditor

may determine the need to perform special procedures such as observing the download process or applying the principles of using the work of experts to the data provider.

Further considerations apply for company-produced non-financial information.

23. Are there examples where substantive procedures applied to accounts or disclosures that depend on information received by the company from external sources could be effective in addressing assessed risks of material misstatement by examining only information produced by the company? When providing examples, please provide as much detail as possible, including a brief description of the account, relevant assertion, design of the substantive procedure, and discussion of how the procedure addresses the specific likely source of potential misstatement.

Over the last five years we have seen massive fluctuations in the economies that increase the complexity when building expectations. Covid-19 triggered various effects that defer by region, industry sector and also individual companies. The war in Ukraine, the turnaround in interest rates, varying inflation and an upcoming depression. Our studies indicate that effects can be isolated and quantified when appropriate statistics are used. We recommend to auditors not to replace APs due to these challenges, since explaining effects plays an important role when auditing future information, corporate planning and management reports. Here it becomes obvious that APs have multiple purposes beyond the audit of a specific account. We therefore do not agree that a reduction in AP usage will not affect audit quality. It will reduce the auditor's ability to audit estimates, future values and further information relevant for stakeholders.

26. The Board requests comment generally on the need for rulemaking. Should we consider any additional arguments, academic studies, or data related to the need for rulemaking?

Given the findings highlighted and the insecurity in the practice, we believe rulemaking is necessary. However, we believe that this rulemaking needs to be based on empirical evidence. Similar to evidence-based medicine, where new methods undergo a rigorous review process to avoid side effects. We are open to provide and discuss the findings from our studies which are – to our knowledge – the only broad real-data studies using APs.

27. Are there additional potential benefits that should be considered? If so, what are they? Are the benefits quantifiable?

In judgmental applications of APs it is almost impossible to measure the benefits from a family of procedures. In statistical applications it is possible to measure in terms of contribution of a procedure to the acceptable remaining detection risk. Our studies prove that auditors underestimate the assurance obtained from APs – naturally as auditors are typically conservative. What has never been discussed is the multi-year effect from APs: A good AP with a robust statistical model can be carried forward and updated year on year and continuously improved. Any ToD (including tests of controls) is performed in the same random manner every year. The PCAOB should have an interest, supporting auditors in using technology for APs due to this mechanism.

31. The Board requests comment generally on the potential unintended consequences of the proposal. Are the responses to the potential unintended consequences discussed in the release adequate? Are there additional potential unintended consequences that the Board should consider? If so, what responses should be considered?

We will see two types of auditors: Many auditors will see APs as a “forbidden fruit”. These auditors will find rationales why the existing extent of detailed testing is already sufficient. Few auditors will continue using APs and document why they believe they comply with the sharpened requirements and the minimal required assurance level that is reached. We will see the opposite of the intended cautiousness.

32. Are there any other economic impacts we did not describe above that are relevant to the Board’s consideration?

We refer to question 27 on the multi-year effect of APs. We do not believe that replacing APs with ToDs will contribute to audit quality. Audit sampling is designed as the last resort when no directed meaningful tests can be performed. Samples only cover a remaining risk with very strong assumptions, such as no or few errors. We will probably see the discussion on sample sizes arising, which could result in undesired outcomes, since many assumptions made in the 1970s on sampling do not apply today.

35. Proposed AS 2305 does not change the existing requirements of AS 2301, that to address significant risks, including fraud risks, the auditor should perform tests of details specifically responsive to the assessed risk. Should changes be made to this existing requirement? If yes, what changes should be made and are there examples where a substantive analytical procedure would be just as or more effective than a test of details in addressing significant risks? When providing examples, please provide as much detail as possible, including a brief description of the account, relevant assertion, design of the substantive analytical procedure, and discuss how the procedure addresses the specific likely source of potential misstatement.

The purpose of the requirement in AS 2301 is to make sure the auditor obtains sufficient appropriate audit evidence in high-risk situations. The requirement however indicates that ToDs are generally better than APs. This cannot be generalized. The reliability of ToDs depends on extent or coverage. For APs on the numerous factors described. There are situations where APs are the only appropriate technique, e.g., to audit the completeness assertion in many income statement accounts. This also applies when there is a risk of document suppression or forgery. If APs do not provide sufficient reliability to address the risk of material misstatement, the audit risk model triggers the need to perform additional ToDs. If the PCAOB agrees to our view that differences to the auditor’s expectation are key items, these are to be investigated using ToDs as well. Overall, the mechanisms triggering ToDs in high-risk situations and poor APs already exist. We believe the requirement is obsolete.

36. Should proposed AS 2305 explicitly address aspects of the use of technology when designing and performing substantive analytical procedures, including situations where the use of technology might improve the quality of audit evidence obtained from such procedures? If so, how?

We believe it would be extremely helpful for auditors to make the use of technology explicit in the standard. Similar like for statistical and nonstatistical audit sampling in AS 2315 para. 03. We also believe the PCAOB may consider explicitly naming time series regression and functional regression since these techniques are archetypes for statistical APs. This would not make the standard outdated. But it would help audit firms to build a path towards more robust and refined statistical techniques – that would heavily contribute to audit quality.