**Paper 117-31**

# Don't Just Tell Us – Show Us!:
## Performance-Based Testing and the SAS® Certified Professional Program
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## ABSTRACT
Since its inception 7 years ago, the SAS Certified Professional Program has delivered robust certification examinations in a multiple-choice format. To date, more than 10,000 SAS certification examinations have been delivered to a global audience.

In our efforts for continuous improvement, the SAS Certified Professional Program is now developing performance-based tests. What are performance-based tests, and how do they differ from multiple-choice exams? Why and how did SAS decide to develop performance-based tests? How valid are these examinations? How can you prepare for the examinations?

This paper answers these questions.

## INTRODUCTION
The competitive world of information technology (IT) is growing in complexity as new technology emerges at a rapid rate. The demand for qualified, knowledgeable technology professionals is also escalating. As a result, certification programs have gained dramatically in popularity and credibility within the IT industry.

As the strategic value of SAS applications being implemented at SAS customer sites continues to intensify, the need to distinguish between individuals who have mastered a specified level of competence in their use of SAS technology versus those who have not becomes increasingly important.

While obtaining certification is typically a voluntary process, it is becoming more and more desirable for IT professionals to become certified to remain competitive in the job market. Employers perceive individuals with certification as being more competent and productive. In addition, individuals view certification as contributing to their professional credibility. Studies published by Gartner Consulting (2001), Foote Partners LLC (2002), and Certification Magazine (Sosbe 2002) indicate that certification benefits include improved job security and enhanced compensation for the individual employee, even in today's economy. For the employer, certified individuals typically provide a higher level of service and productivity; this can lead to a competitive advantage. In fact, these studies noted that IT certification now plays a progressively significant role for hiring managers in the industry.

The SAS Certified Professional Program has offered multiple-choice exams to validate SAS programming skills since 1999. Currently, we are in the process of developing exams to validate knowledge of SAS Business Intelligence applications, many of which utilize a graphical user interface (GUI). It is our belief that there is little value testing functional knowledge of a GUI-based/menu-driven application via a multiple-choice exam. For these applications, we view performance-based testing, or "testing by doing," as the way to measure true capability.

In support of performance-based testing, psychometrician Paul Jones of Thomson Prometric says, "Exams which require more authentic performance will increase the perceived value of their programs" (Mulkey 2001). This is not to suggest that traditional (multiple-choice) tests are no longer valid nor reliable assessment instruments. In fact, "multiple-choice testing has its place and is not going away" (Childers 2002).

## WHAT IS PERFORMANCE-BASED TESTING?
Performance-based testing (PBT) is a means to validate an individual's knowledge or predict that person's ability by having the person perform specific tasks. In performance-based tests (PBTs), candidates are assessed by having them perform tasks similar to what would be required 'on-the-job' rather than asking them a series of questions about those tasks and then inferring from their answers that they know how to do those tasks. The value of measuring actual performance was put into context by Dave Carlson of the California Department of Education's California Learning Assessment System, "If you want to see if someone can ride a bike, you don't give him a multiple-choice test" (Seal 1993).

Traditional tests can be thought of as "tell us what you know," that is, what is the knowledge in someone's head. PBTs can instead be thought of as "show us what you know by showing us what you *can do*," that is, the *application* of knowledge. Traditional testing measures the candidate's ability to articulate or recall knowledge; PBT is designed to assess whether the candidate can *put that knowledge to use*. According to industrial psychologist Ruth Clark, "To establish that a person can use a procedure, the person must be able to actually perform it" (Stolovitch and Keeps 1999).

PBTs are designed to emulate what an individual does on the job. As such, PBTs typically allow the individual to come up with the correct solution using different approaches. Says Jamie Mulkey of Caveon Test Security, "Because no one solves a problem exactly the same way every time, why should there be only one way to solve a problem when completing a performance test? The point is that performance-based testing allows for those different problem-solving approaches so that you, as the test-taker, can use some creativity in finding a resolution" (Mulkey 2001).

Why the effort to go beyond traditional tests? Experience is showing that knowing something and doing something are often not the same (PTC accessed January 23, 2006). For example, consider the following: How many people "know" how to eat a healthy diet? The answer is probably that most people know how to eat in a healthy manner. Now, how many people actually *do* eat this way? A similar analogy could be drawn with knowing the speed limit and actually driving at that speed.

Certifications are intended to measure job- or task-related skills and knowledge. PBTs put candidates in situations where they must use their knowledge, demonstrate their skills, solve common problems for their job role, and perform troubleshooting tasks to measure the kinds of things that employers care about (Tittel 2004). These include tasks and activities that occur on the job, especially those where specialized knowledge and skills are needed or where they can help speed up deployment, implementation and problem resolution, improve quality, increase productivity, reduce downtime, save costs, and so on.

According to Peter Childers, vice president of Global Learning Services at Red Hat, "Performance-based tests provide more meaningful, fair and direct measurement of competency than purely multiple-choice tests" (Childers 2002).

Adds Tom Berry of Galileo Systems, "One of the advantages of performance-based testing is the test developer (in our case, SAS) can *guarantee* that a test taker has performed a procedure once they pass the performance-based test for that procedure" (Childers 2002).

## A BRIEF HISTORY OF PERFORMANCE-BASED TESTING

The concept of PBT is not a new one. In fact, PBT is the norm in many professions. PBT has been used for many years for job roles such as firefighters, police, and airline pilots. For example, firefighters utilize burning facilities to assess and practice their skills in a controlled environment. Likewise, in today's environment of heightened security, law enforcement officials now conduct simulated disaster exercises to assess and practice emergency response readiness.

In fact, PBT has been used throughout history as part of the master/apprentice approach to learning a trade. But its use has also been limited because of the complexities associated with either observing the candidate on the job or with adequately simulating the work environment (Galileo Systems, LLC accessed January 23, 2006). Until recently, the technology infrastructure was not in place to create and widely distribute economically feasible PBTs, except for the most critical of jobs (such as airline pilots).

In the IT industry, PBT is emerging as a preferred method of skills assessment (Witnah 2004). PBT is becoming recognized as a more valid means of testing because the focus is on measuring performance, rather than testing on subject matter knowledge which might or might not be a prerequisite for acceptable job performance. Remember, the goal of PBT is to assess whether the person can actually complete the required tasks, not whether or not that individual can articulate concepts related to the tasks. Says Jonathan Hatcher of CompTIA, "The days of memorizing one fact, and looking for that one fact in one answer are really gone" (Hoffman 2006).

Think back to the emergency response evaluations. While it is certainly desirable that an individual is able to recite the prescribed ratio of breaths to chest compressions while performing cardio-pulmonary resuscitation (CPR) (as could be measured on a traditional exam), it is probably more advantageous to measure how that individual responds in an actual or simulated emergency situation (as could be measured by PBT).

Similarly, to assess a network administrator's performance, is it more valuable to have a person tell which system commands are needed to register a new user on a corporate network or to have that person actually create the new user account and permissions on a simulated network environment?

Karl Childs, certification architect, adds "In today's environment, it's experience that sets you apart. PBT actually proves your hands-on knowledge" (Childers 2002).

## WHY UTILIZE PERFORMANCE-BASED TESTS?

The validity of an exam is determined by how well it measures what it is intended to measure. To use a traditional exam as a means to measure performance, there must be an established correlation between exam outcome (score) and actual performance (Witnah 2004). In reality, the exam might be a better measure of the individual's recall or test-taking ability rather than true task performance. The intent of PBTs is to measure the *ability to execute*, not the ability to recite information. In performance-based testing, it shows right away if you don't know something (Zeise and Smith 1999).

In my world, a good example of this might be pole vaulting. Having participated in track and field during my high school and collegiate years, I think I could fairly well describe what an individual would need to do to perform successfully in this event. However, if the US Olympic Committee adopted a multiple-choice exam to select pole vaulters for the next Summer Olympic Games, my guess is they would be sorely disappointed (and embarrassed) to find that—despite my *knowledge* "on paper" of how to pole vault—my ability to *perform* would result in my clearing the bar set at a height of something in the vicinity of 6 feet (if that) instead of the 17 or 18 feet that they are probably looking for.

As a final example of the value of testing performance instead of recall ability, think of when you are asked for someone's phone number. How often is it hard to recall what the number is, but sit in front of a telephone and touch those buttons and the number comes right back to you? Ultimately, it probably doesn't matter whether or not you can always recall the phone number but that you can dial it when you need to.

## VALIDITY AND PREDICTIVE ABILITY

PBTs attempt to increase the validity and predictive ability of an exam by recreating actual tasks and requiring real responses or solutions to those tasks.

Two characteristics of PBTs lend these exams to being more valid than traditional exams (Witnah 2004):

- Authenticity. Rather than asking candidates to select an answer from a predefined list of alternative answers (for instance, A, B, C, or D) to demonstrate knowledge, the candidates must complete tasks using methods similar to those used in the "real world."

- Relevance. Traditional exams often present scenarios in an effort to measure *knowledge* of a specific task. However, well-constructed PBTs evaluate an individual's ability to *successfully complete* realistic real-world tasks.

Think about it. To get a driver's license, you probably had to complete a road test in addition to a written exam. The road (performance) test adds validity to the written exam. PBT works in much the same way, except that the candidate is likely "driving" a computer instead of a car.

According to Thomson Prometric's Jones, "In multiple-choice you have four or five (options) from which to choose. But in a performance-based item (question), you have free play in an environment that looks like the real world. What performance-based testing adds is the components of self-management, monitoring, problem solving and planning a solution—which gives the testing program enhanced validity" (Microsoft PressPass 2005).

While traditional exams by their nature typically focus on discrete knowledge and skills for each test question, PBTs are often designed to measure the successful completion of a series of tasks. States Jim Olsen, psychometrician and Chief Scientist at Alpine Testing Corp., "In real-life scenarios, you don't see job elements happening by themselves, so why should we test that way?" (Mulkey 2001)

Given each of these characteristics, it is becoming an increasingly held belief that PBT is a more reliable predictor of an individual's job performance than what can be measured in a traditional exam (Childers 2002).

**EXAM INTEGRITY AND FEEDBACK**

PBTs also help address exam integrity; that is, exam security issues. It has been estimated that popular certification exams can become obsolete within 30 days of release, simply due to test piracy options available on the Internet. But cheating is actually quite hard to do on well-designed PBTs. With PBTs, even if information about an exam is shared, an individual still must be able to perform specific tasks under test conditions in order to pass (Mulkey 2001). Adds Wallace Judd, Test Development Manager for ARDMS, "Is performance testing an improvement in test security? It's a substantial improvement" (Nagel 2004). Of course, care should still be taken to prevent candidates from merely memorizing keystrokes.

At a presentation to the Performance Testing Council in May 2005, Randy Russell, director of curriculum and certification at Red Hat, supported this by saying, "We tell people what is going to be on our exams. That way they go out and practice. And you know what? In the process, they are learning to use the technology and perform the tasks they will need to perform on-the-job. They still have to be able to demonstrate these skills in order to pass the test."

One criticism that has been associated with traditional exams is the availability of preparation options that "teach to the test" (Joss 2001). What the industry is now discovering with well-designed PBTs that are valid reflections of actual job skills, "teaching to the test" is in reality "teaching to the job" (Galileo Systems, LLC accessed January 23, 2006). And isn't this the ultimate goal of training in the first place?

Additionally, test candidates provide positive feedback after sitting for PBTs. According to Jim Adair, the late Worldwide Manager of Certification Exam Development for Lotus Corp., "A look beneath the surface reveals that people who *do* the job prefer performance exams. People who have just studied the material prefer multiple-choice exams" (Mulkey 2001).

**WHO HAS IMPLEMENTED PERFORMANCE-BASED TESTS?**

PBT is becoming increasingly popular and important in the IT industry. In fact, four of the five largest IT certification programs based on exam volume—Microsoft, Cisco, Novell, CompTIA, and Oracle—(and a growing number of other vendors) now include PBTs in their certification programs. (Today, CompTIA is the lone holdout from the above group, likely due to the vendor-neutral focus of CompTIA exams). These four programs all mention that PBT has taken on increased importance and that they expect PBT to continue to grow. In fact, Novell indicates that *all* of its certification exams will be PBTs by 2007. And all four of these vendors cite enhanced exam integrity and the ability to test for real skills and knowledge as the primary reasons to adopt PBTs (Tittel 2004).

Consistent with this, the Performance Testing Council (www.performancetest.org) has a stated goal for the testing industry to adopt PBTs as the standard means of assessment by March 2007.

**PREPARATION**

Practice, practice, practice. The best way to feel the most confident going into PBTs is having performed real skills multiple times using the actual technology prior to sitting for the exam.

"Your best 'cram session' is using the application, system or hardware itself to get 'flight time' executing actual job tasks," says Mike Reid, manager of Cisco's CCIE certification program (Childers 2002).

The testing industry has come to realize that knowledge does not always equal capability. Many "boot camps" teach individuals how to pass a test but not necessarily how to perform in the real world. Says Amir Elahi, president of Computer Analytics Inc., "Something is broken when the individual feels compelled to cram for an exam rather than learn the actual technology and product skills" (Joss 2001).

PBTs resolve this by testing real-world skills. PBTs require candidates to complete tasks to accomplish a goal. Candidates have to prepare by truly using and understanding the technology. Memorization doesn't cut it.

Let's again consider the driver's license scenario. When you learned to drive a car, you likely didn't just read a book; you got behind the wheel and practiced. Most of us probably didn't have our own car to practice with, so what did we do? We took classes (driver's education), we found people who could mentor us (parents, family members, older friends), and we pursued this learning seriously. PBTs are no different; you need that hands-on experience with the technology.

Vendors typically offer classes that help you learn about their products and give you an opportunity to gain hands-on experience using the technology. These training classes are often designed to support the knowledge required for associated certification exams. Many vendors offer e-learning options, which can be very effective if they include exercises that give you additional experience using the technology. Some vendors also now offer "learning editions" of their products—real technology that is designed for you to learn how to use it, but is limited in certain ways so it cannot be used as a production system. Learning editions can be an affordable and a realistic means to learning and understanding how to use the products.

If you have access to the technology at work or elsewhere, you have a head start. Ask a mentor or system administrator to help you establish a practice environment. See if he or she can help you design scenarios that reflect the test objectives. (As mentioned above, vendors are more inclined to give you details about what will be tested on PBTs; it certainly is in their interest to have people practicing on, and learning how to use, their products.) Consider working with your peers to "test each other" by coming up with problems for each other to solve.

If you don't have access to the technology, a local community college can be a good option. Unlike vendor classes, community college courses tend to span a number of weeks and often give you access to labs where you can get ongoing hands-on experience with the technology.

Remember, you probably spent many weeks or months learning how to drive a car. You shouldn't expect to pass a valid performance-based test without putting in real effort. After all, we're talking about acquiring real, credible skills that employers are willing to pay for!

Adair, a proponent of PBT, stated, "The last thing we want is for someone to pass an exam just through study. The basic premise is that we hire someone to *do* something, not because they *know how* to do something" (Mulkey 2001).

So, roll up your sleeves and get experience using the technology. Attend training; work with mentors; review the test objectives; get experience using practice systems. And then go out and show us what you can do!

## COMPARING TRADITIONAL AND PERFORMANCE-BASED ITEMS

Let's take a look at an example of a traditional test item and what a comparable PBT item might look like:

**TRADITIONAL ITEM**

> In the SAS PRINT procedure, which of the following selects variables
> that appear in a report and determines their order?
>      A.   the VAR function
>      B.   the VAR keyword
>      C.   the VAR option
>      D.   the VAR statement

Here, unless the test candidate has to teach the concept, is it important that the individual know the exact terminology? Perhaps, but likely what is important is that the individual be able to *perform* the necessary tasks to *achieve the desired result*.

So, a PBT item designed to test similar skills might specify the desired (target) outcome, and then ask the individual to perform a task or series of tasks to achieve that desired outcome.

**PERFORMANCE-BASED ITEM**

> Use the SAS PRINT procedure to create a report of employee NAME,
> ID, TITLE, and SALARY from the EMPLOYEES data set.

This example presents how "the proof is in the doing" in PBT. Of course, please accept that this is a very simple example, meant only to illustrate the concept.

## PERFORMANCE-BASED TESTING METHODS

Three means of testing performance are widely used today: lab, live application, and simulation. Each of these is an alternative to the most authentic means of measuring performance--on-the-job evaluation. Since exams can be used as a pre-hiring criterion in many instances, on-the-job evaluations are not always feasible.

### LAB

A lab setting might be appropriate for certain IT tasks, such as implementing a complex system or solution. In the lab environment, the individual is presented with the requisite hardware, software, and a series of tasks to perform, likely approximating the on-the-job environment very closely. Given the physical requirements of the lab settings, they are often expensive and complex to maintain and are typically not as widely available to candidates as the live application and simulation exams. In addition, lab-based exams are often graded by humans; this can open them up to questions about consistent and objective scoring.

### LIVE APPLICATION

In the world of IT testing, a live application exam has the individual interact with the actual software and/or hardware (often in isolated environments, to prevent impacting production systems) to perform a series of required tasks. Deploying a live application requires that the software application is hosted somewhere and is accessible on demand to test candidates, such as via a virtual machine environment that can be surfaced in a web browser. Today, there are limits to how widely this test format can be delivered, as many of the large test delivery vendors are not yet willing or able to interact with external applications in their testing systems.

### SIMULATION

Rather than have an individual actually interact with software, a simulation approximates the live application environment--often by presenting the candidate with a series of screen captures that are surfaced in response to that person's keystrokes/mouse clicks, thereby giving the appearance of actual interaction with the software. Simulations typically do not approximate the entire functionality of a live application, but a well-designed exam will present simulated functionality for the most common paths in the software. Further, simulations are often readily deployable to a wider audience as they do not require the same system resources as are needed to host a live application.

### PBT CONSIDERATIONS FOR THE SAS CERTIFIED PROFESSIONAL PROGRAM

Because the SAS Certified Professional Program has been historically focused on certifying SAS users as opposed to SAS System implementers, we decided to narrow our decision to simulations or live application at this time. We value the fact that each of these delivery formats allows for machine scoring and that each format can realistically be hosted and delivered by external vendors, because SAS' core competency is not in delivering exams.

### LIVE APPLICATION VS. SIMULATION

In the live application, the primary disadvantage seems to be the limited availability of resources to deliver these exams. However, assuming a test delivery network is available, live applications do have some advantages. First, the test candidate experiences a real environment, interacting with a fully functional version of the software. Next, since the software research and development organization has already built the environment, deploying a live application exam means that environment does not need to be recreated, as in a simulation. Finally, should subsequent releases of the software result in functionality and/or interface changes, a new copy of the application needs to be loaded at the site hosting the application, but a new series of simulation screen shots will not need to be captured. These factors tend to reduce the exam maintenance and administration effort required by the test sponsor (for example, SAS).

As mentioned above, simulations have certain advantages—primarily that they require fewer system resources because the full software application is not launched at the start of the exam and also that today there is a more readily available network to support delivery of simulation exams. However, because simulations are essentially a series of screen shots of the software application at a point in time, they can be significantly impacted by changes to the underlying software application. This can result in a large maintenance/update effort for the test sponsor. For instance, if a simulation is created based on a current release of a software product and then a subsequent release changes functionality and/or the user interface layout, all of the impacted screen shots might need to be recaptured and the exam republished. Further, the scoring logic associated with each of these scenarios would likely also need to be updated. Yet, high-fidelity simulations can be produced which closely approximate most key features of live systems. Very few conditions exist that make simulations technologically impossible. And simulations today are best suited for certification exams that have a large pool of potential test candidates dispersed over a wide geographic area, as is the case with candidates for SAS certification exams.

## SAS' PLANS FOR PERFORMANCE-BASED TESTING

During 2005, SAS began serious exploration of PBT and found that the technology and infrastructure are now in place to make PBT feasible and practical for the SAS Certified Professional Program.

As part of our commitment to developing valid, reliable, high-quality PBTs, SAS joined the Performance Testing Council (PTC) during 2005. The author of this paper is now the Chair of the PTC's Design and Delivery committee. As a member of the PTC, SAS is joining with our certification program peers as thought leaders in designing and delivering PBTs and will effectively extend the SAS Certification Program into the PBT arena.

As previously mentioned, SAS has begun development of Business Intelligence certification exams, much of which is centered on GUI-based/menu-driven technology (such as SAS® Enterprise Guide®) and which is generally not well-suited for traditional exams.

Based on the criteria above, we have decided to focus on simulations, largely due to the general availability of testing centers that support the delivery of simulation exams. The SAS Certified Professional Program currently utilizes Thomson Prometric (www.prometric.com) to administer and deliver our exams. The Thomson Prometric Test Center network boasts more than 3000 locations across the globe. This physical presence is a significant advantage to you, our loyal SAS users, when you are ready to access a SAS certification exam.

Other IT vendors that offer live application certification exams often require that users travel to the vendor's training centers to attempt the exam. Although SAS does have a substantial physical presence around the world, we do not compare to the availability of Thomson Prometric's facilities. Nor is certification test delivery a core competency for SAS.

Providing simulation PBTs will enable SAS to offer robust computer-based tests that are widely available around the globe and that are machine-scored in a consistent and objective manner. It will also allow us to leverage Thomson Prometric's competence in test delivery and permit us to focus our efforts on developing the highest-quality software and certification exams for our users.

Our goal is to begin introducing PBTs by late 2006. These initial PBTs will focus on our GUI-based technologies. Eventually, we plan to convert existing multiple-choice exams to the PBT format, thereby allowing all SAS certification candidates to *show* us what they know by showing us what they *can do*.

The role of SAS professionals in their organizations is often strategic and complex. It is imperative for employers to validate the skills of these individuals and to be confident of what they can *do*. As Berry of Galileo Systems says, "When doing a job is more important than knowing about a job, that job is a candidate for performance-based testing" (Childers 2002).

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Please visit support.sas.com/certification to learn more about the SAS Certified Professional Program, including available certification tracks/exams, suggested preparation options, exam pricing, and instructions on how to register for and access a SAS certification exam.

## CONCLUSION

PBT is a realistic approach to measuring an individual's performance ability. Certification programs that incorporate PBTs are gaining popularity because they deliver results. "Certification programs are responding to the perception that exams which require more authentic performance will increase the perceived value of their programs," says Jones of Thomson Prometric (Mulkey 2001). Adds Computer Analytics' Elahi, "Public and private employers as well as service providers are hungry for IT certifications that truly *guarantee* competencies" (Joss 2001).

There are many forms of certification exams offered today and multiple-choice tests remain the most common (Hoffman 2006). SAS will continue to offer multiple-choice exams focused on our traditional technologies for the foreseeable future.

However, when it comes to measuring an individual's ability to perform, PBTs offer several advantages over traditional, multiple-choice exams, including:

- PBTs require individuals to actually execute tasks, rather than simply answering questions about them.

- PBTs are designed to approximate actual work environments, to better reflect the individual's problem-solving ability in the real world.

- PBTs are typically designed to measure the individual's ability to achieve the correct result rather than focusing on the path to get there.

A look at the IT certification industry reveals that there's more PBT going on than ever before (Tittel 2004). Says Randy Trask, vice president of Market Development for Pearson VUE, "Demonstrating that you can complete tasks offers a level of assurance we believe IT managers will welcome with open arms" (Microsoft PressPass 2005). The proof is in the doing in PBT and that's what the IT industry likes about it.

During 2006, the SAS Certified Professional Program will introduce PBTs focused on our GUI-based technology. For these applications, PBT—or "testing by doing"—is the way to measure true capability.

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