An Overview of SAS Certification and the Test Development Process

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ABSTRACT

In 1999, SAS Institute launched the SAS Certified Professional Program. Today, there are over 3,500 SAS Certified Professionals around the world and interest in the program continues to grow. The intent of the Program has always been to provide a standardized measure to assess the knowledge and skills of SAS users. In order for this to occur, two items must be met. First, certification examinations must be valid and reliable instruments. Second, the examinations must map to credentials that meet the needs of SAS users and assess actual job roles and responsibilities within the SAS user community.

This paper will describe the rigid test development process used to develop SAS certification examinations. The paper will also provide an overview of recent enhancements made to the SAS Certified Professional Program along with information on how one can begin the journey to becoming a SAS Certified Professional.

INTRODUCTION

The world of statistical programming, application development, data management, and providing business solutions is competitive and continues to grow in complexity. As a result, the demand for qualified, knowledgeable professionals also increases. As the number of SAS users and consultants continues to grow, the need to distinguish those who have mastered a specified level of competence in their use of SAS products and/or solutions becomes increasingly important.

While obtaining certification is typically voluntary, it is becoming increasingly necessary for IT professionals to become certified to remain competitive in the job market. Employers perceive certified employees as being more competent and productive. Employees view certification as contributing to their professional credibility. (Network World, 1998)

Recent studies published by Gartner Consulting (2001), Foote Partners LLC (2002) and Certification Magazine (January, 2002) indicate the benefits of certification include improved job security and increased compensation for the individual employee, even in today's economy. For the employer, certified individuals typically provide a higher level of service and productivity, which can lead to a competitive advantage. In fact, IT certification now plays an increasingly important role for hiring managers in the industry.

In recent years, IT certification programs have dramatically increased in popularity and credibility. As part of this trend, SAS Institute launched a global certification program in 1999. New certification credentials and other enhancements to the program are now being announced and will be discussed in this paper.

However, before discussing the enhancements in the certification program, it is helpful to understand the process followed in developing the examinations within a specific credential.

As a result, this paper will contain two sections. The first section will focus on the 10 steps needed to produce a valid and reliable certification examination. The second section will provide an overview of the SAS Certified Professional Program.

SECTION 1: THE TEST DEVELOPMENT PROCESS

The development of a certification examination is a lengthy and involved process. The process needs to be strictly adhered to ensure that the examination is valid and reliable.

Validity is the ability of the test to measure that which it is intended to measure. For an examination to have content validity, it must demonstrate at least two qualities. First, the content of the examination must be job-related. Second, the examination should cover areas where lack of knowledge would result in inability to perform the job.

Another critical element of the quality of a certification examination concerns how reliable, or consistent, the examination is in measuring candidates' abilities. Reliability is the index of how accurately the examination measures the candidate's skills and is necessary to achieve exam validity.

An examination must be both valid and reliable to be considered a well-developed and defensible examination. By following the rigid standards of the test development process, these two qualities are likely to be met.

The test development process can be summarized into ten steps:

1. Conducting the Job Task Analysis
2. Developing the Test Blueprint
3. Developing Items
4. Reviewing the Items
5. Assembling and Delivering Beta Exams
6. Analyzing Beta Exam Results/Item Selection
7. Constructing Equivalent Exam Forms
8. Establishing the Passing Score
9. Administering/Scoring Operational Exams
10. Providing Ongoing Test Maintenance.

These ten steps were derived after a review of the professional literature on the standards necessary for a valid, reliable, and legally defensible examination.

SELECTING SUBJECT MATTER EXPERTS:

Before discussing the individual steps within the test development process, it is important to understand that exams are not written by the SAS Certification Program, but rather by subject matter experts (SMEs) whom the SAS Certification Program recruits for the test development steps. In fact, a common theme across the test development process is the use of SMEs. SMEs increase the validity of the certification examination as data are obtained directly from individuals who are the most knowledgeable about a job, rather than from those managing/administrating the program (Flaherty and Hogan, 1998).

It is important to ensure that the group of SMEs selected is representative of the population for which the exam is intended. In fact, the test development process should not only include those who are experts and highly recognized within the profession, but it should include "entry-level" professionals to ensure that the subject matter identified reflects work situations which are commonly encountered by those achieving the certification (CLEAR, 1998). In

addition, it is critical to ensure that global representation is obtained since the exams are used globally. As a result, SAS has had active involvement from international SMEs throughout the test development process.

The recruiting for SMEs (both SAS employees and external participants from the Americas and International) in the test development process has included individuals from SAS Education, SAS MIS, SAS Professional Services, SAS Sales Support/Strategy, SAS World Wide Marketing, SAS Research and Development, and SAS Partners.

SAS is continually recruiting SMEs to participate in test development activities. If you are interested in becoming a SME for a particular exam, please email us at certification@sas.com.

STEP 1: CONDUCTING THE JOB TASK ANALYSIS

The content of the examination should be related to the job or role the individual is seeking to practice. The most widely used and accepted way of establishing job-relatedness is to conduct a job task analysis. This step of the test development process is the most complex. However, this step serves as the foundation for the examination.

The job task analysis is a systematic method of collecting data regarding the responsibilities, knowledge, and skills associated with acceptable performance within a profession. These data are then used to develop the blueprint for the examination. The job task analysis typically consists of two phases (Henderson, 1996):

1. Obtaining and describing the tasks necessary for competent performance of the job role
2. Validating the job tasks identified.

In obtaining and describing the job information, SAS invites 10-12 subject matter experts (SMEs) to a three day workshop in which the tasks needed to perform a particular job role are determined, along with the associated knowledge and skill set necessary for competent performance. These tasks become the basis for certification test objectives.

Once the full listing of tasks is determined, it is necessary to have this listing validated with a representative sample of individuals currently performing the job for which the certification is intended. This validation effort involves surveying a random sample of job incumbents. For each of our certification examinations, the survey is available on the SAS website for a minimum of one month and is actively promoted to ensure a representative sample of the population has the opportunity to respond.

The questions on the survey are in the form of a Likert rating scale (1-4) with each item corresponding to an exam objective. Each objective is rated on its importance to the specific job role and on the frequency by which the task/objective is typically performed. The results are then used for Step 2 of the test development process: Developing the Test Blueprint.

STEP 2: DEVELOPING THE TEST BLUEPRINT

The purpose of the test blueprint is to define the attributes of the examination. This blueprint is then used to ensure that the assembled examinations (test forms) are consistent from form to form in content. That is, if one candidate receives Form A of a particular exam and another receives Form B, they will be taking equivalent exams. Statistical analysis discussed later in this paper will explain how the exams are made statistically equivalent. At a minimum, the test blueprint includes:

- Purpose of the exam
- Description of the target audience
- Total number of items (questions) on the exam
- Number of items per domain/test objective
- Content outline
- Exam format and item types

The first three items in the above list are determined in Phase 1 of the job analysis. How the items are dispersed across the exam is determined using the empirical data from the job analysis survey. With these data, the objectives are prioritized and weighted. For example, objectives receiving higher importance ratings have more items allocated to them than objectives receiving lower importance ratings. Once the percentage of items has been determined, the test content outline is finalized.

While there are many different exam formats and item types, SAS uses the multiple-choice format; the most commonly used format within the IT certification industry. The decision to use the multiple-choice format was made after researching the advantages and disadvantages of this format vs. other exam types (Dungan, 1996; Osterlind, 1997; Haladyna, 1999). The number of exam items varies based on the examination and what can reasonably be measured in a two-hour examination period.

STEP 3: DEVELOPING ITEMS

Once the test blueprint is finalized, a pool of items is developed to measure each of the objectives. Each item is linked to the test blueprint. The number of items and the item content needed is determined from the test blueprint stage. To ensure that enough items survive the item technical review and beta test process, at least three times as many items as specified on the blueprint need to be written for each test objective.

The first step in item development is to assemble a group of SMEs to develop items. All involved SMEs must complete item writing training prior to writing items to ensure familiarity with psychometric processes and with the exam requirements. While there are many methods of accomplishing item writing, the most intensive training and writing method involves bringing the selected group of SMEs to an item development workshop lasting a minimum of two days (Dungan, 1996). SAS convenes a group of 10-15 item writers from around the globe to participate in a weeklong workshop in one central location, typically the SAS World Headquarters in Cary, North Carolina.

During this workshop, item writers receive formal training in item writing and then generate items in small groups. When developing items, writers must ensure that the items generated:

- are significant (i.e., important to measure)
- discriminate between knowledgeable and unknowledgeable candidates
- match the intended objective as described on the blueprint
- do not provide any unintended source of difficulty or answer cues for any items on the exam.

Item writers should also be aware of the cognitive level of the items they are writing. A well-known approach to classifying objectives by cognitive levels is the Bloom taxonomy (Bloom, Engelhart, Furst, Hill & Kratwohl, 1956). SAS categorizes items based on three cognitive levels:

1. Basic - the recall and assessment of facts and knowledge
2. Intermediate - the understanding and application of knowledge
3. Advanced - the ability to synthesize information to arrive at a conclusion.

Item writers are strongly encouraged to minimize the use of simple knowledge-level items and strive to develop items that measure higher levels of cognitive understanding, as these items will better

distinguish between knowledgeable and unknowledgeable candidates.

Initial Item Review: Once the first draft of the item is written, the SMEs review the items as a group and validate each item according to what SAS calls the CIRCA rules:

C - Is the item congruent to the objective it is measuring?
I - Is the item important to know for someone at this level?
R - Is the item relevant to the job role being certified?
C - Is the item clear (including non-native English speakers)?
A - Is the item accurate (Is there only one correct answer)?

STEP 4: REVIEWING THE ITEMS

Once the items have passed the initial review, a psychometric/editing team at SAS reviews the items to ensure they meet standard, accepted psychometric properties and any specific SAS standards. Non-content edits may be made to the items at this point. These items are then reviewed by a set of SMEs during a weeklong technical review workshop. SAS currently conducts these workshops using web and video conferencing to minimize travel time and associated costs.

During this stage, each item is thoroughly reviewed for technical accuracy, relevance, and clarity. All responses are reviewed to ensure that the incorrect choices are plausible but unquestionably incorrect. SAS programs are executed to validate answers and reference material is researched and documented. The item is reviewed to ensure that there is only one appropriate answer. Final consensus on all technical issues and whether this item belongs in the item pool is reached. Final approval of the item as it is to appear in its beta tested format is also reached.

STEP 5: ASSEMBLING AND DELIVERING BETA EXAMS

Once approved, items are placed in the item pool - a depository of all items that are viable for inclusion on the examination. These items are then field tested during a beta testing period. Beta examinations are conducted during a limited time period, dependent upon how many candidates are anticipated to test within the given period. However, more important than the number of candidates is that the beta candidates are a representative sample of the target population for the exam.

SAS uses the data collected from the beta exams to assess how each item performs; this also provides a chance for unforeseen problems to be resolved prior to the development of the operational examination. Given the increasing popularity of SAS certification exams, SAS typically publishes multiple exams forms for each credential to help ensure exam security. SAS uses the beta information to ensure the development of pre-equated test forms. While there are various equating techniques (Kolen, 1995), SAS has opted to use pre-equated test forms so that scores on operational forms can be provided to candidates immediately upon completing the exam.

Beta exams consist of more test items than defined in the test blueprint to account for the items that do not perform well, as these items will not be used in the calculation of a candidate's exam score. By making the exams longer, SAS is guaranteed enough items by which a candidate's score can be determined.

Examinees taking a beta exam cannot receive their scores immediately. Instead they must wait until all analysis of the beta exams is completed, the items that will comprise their examination form are selected, and the passing score has been determined. The benefit for the candidates is that they have the opportunity to achieve certification earlier than if they wait for the production exam. In addition, beta examinations are typically offered at a reduced cost. Some candidates enjoy the beta exam as it provides them a unique opportunity to provide feedback on which items ultimately make the production/operational form.

The beta examinations are administered using the same administration procedures, directions, security, and amount of time per item as the operational examination.

STEP 6: ANALYZING BETA EXAM RESULTS & ITEM SELECTION

As mentioned earlier, the main purpose of beta testing is to field test items. SAS then uses the item data to determine if the items performed as intended. At a minimum, the following item statistics are considered when selecting items from the beta pool for the operational examination:

- item difficulty
- item discrimination**.**

Item Difficulty: The item difficulty (p-value) is defined as the proportion of candidates who answer the item correctly. In general, the correct response option for an item should be chosen more frequently than the incorrect options. Difficult items will have a lower p-value. For standard single answer, four option multiple-choice items, p-values less than .30 (a value slightly higher than the chance for guessing it correctly) should be flagged for review, as these items may be too difficult. Many times low p-values are used to find items whose wording are not clear. Similarly, items having a p-value greater than .95 may be too easy. Since 95% of the candidates are answering this item correct, this item cannot provide distinguishing information between candidates who are knowledgeable on the content versus those who are not. SAS generally uses items with p-values between .30 and .90.

Item Discrimination: Regardless of the difficulty level, an item must also be able to distinguish between low scoring candidates and high scoring candidates. If low scoring candidates are getting a particular item correct, while the high scoring candidates are missing the item, there may be a problem with the item. For example, perhaps the wording of the item results in higher scoring candidates misinterpreting the item and selecting the incorrect response option, while lower performing candidates answered the item correctly. This case is called negative discrimination. In some cases, low and high scoring candidates may perform the same on the item. This situation is called no or zero discrimination. The goal is to have positive discrimination. With positive discrimination, higher performing candidates answer the item correctly while lower performing candidates miss the item. As a result, this item has predictive ability of total exam performance. Item discrimination can be thought of as the correlation of scores on the item with examinees' total scores. This correlation is known as the point-biserial and is referred to as the discrimination index. If the discrimination index is less than .25, then the item is flagged for review.

The numeric values provided for item difficulty and discrimination are guidelines. While SAS makes statistical recommendations on the item, it is ultimately a group of SMEs who decide whether or not to keep an item on the operational form.

In addition, an item with excellent statistics may still not be a good item. For example, an item may have a p-value of .60 and a discrimination index of .80. Statistically, it appears that this item is performing well. However, upon further review, one might discover that candidates were only selecting options A and B. Thus, the single answer, four-option multiple-choice item has in a sense become a true-false item with a 50% chance of getting the item correct. In this case, SAS may select to flag the item for further revision and allow the SMEs to make the final decision.

Storing/Maintaining Acceptable Items: Throughout the process, SAS maintains a record of the items written and beta tested. All items not accepted should be flagged so that they are not used in any exam forms. As part of the item pool, SAS maintains for each item the following information:

- Unique item identifier
- Objective number from test blueprint
- Beta information (e.g. form, date of administration)

- Number of candidates who attempted the item
- Number of candidates who selected each option
- Number of candidates who omitted the item
- Discrimination index
- p-value
- Average time to answer the item
- Author of item
- Reference for answer verification
- Cognitive level (based on chosen taxonomy)
- "Enemy" items (they give away the answer to each other)
- Graphic link, if graphic is part of item
- Comments or special notes.

STEP 7: CONSTRUCTING EQUIVALENT EXAM FORMS

While designing the exam to meet the specifications of the test blueprint, SAS strives to maximize the reliability of the exam. This characteristic assures that the same results could be replicated if the same candidates were tested again under similar circumstances. SAS uses the KR (Kuder-Richardson) 20 coefficient, the most commonly used index to measure reliability of certification examinations. The KR20 coefficient value ranges from 0 to 1. The goal is to obtain the highest reliability estimate possible. The value of the KR20 coefficient is directly related to the number of items on the exam. The more items on the exam, the higher the reliability of the exam.

For many reasons (e.g. test security, repeat test takers), it is desirable to have multiple forms of an exam. If multiple forms are constructed, it is critical that the exams are operationally equivalent from a content and statistical perspective, as well as being reliable measures. As a result, SAS strives to create multiple exam forms for each exam.

The first step in establishing equivalence is to ensure that the exams align with the test blueprint. This provides content validity and ensures equivalence of content. Each form will have the same number of items on a particular topic.

The second step is to ensure statistical equivalence. Candidates should not be penalized for taking harder versions of an examination, nor rewarded for taking an easier version. SAS controls for statistical equivalence when constructing exams by using the beta test results and input from the SMEs to select items such that pre-equated tests forms are generated. In developing pre-equated forms, the items selected should yield, at a minimum, equivalent average p-values. It is also desirable to have equivalent point-biserials, time required to complete the items, mean scores, standard deviations, reliability, skewness, kurtosis, and standard error of measurement for all forms.

STEP 8: ESTABLISHING THE PASSING SCORE

After the exams are constructed, the passing score must be determined. In accordance with testing guidelines, SAS establishes the pass/fail standards in a manner that is generally accepted as being fair and reasonable, rather than arbitrarily set.

There are two broad categories of standard setting. Normative standards make pass/fail decisions based on how a candidate performs relative to the other candidates. The percentage of candidates that will pass is determined prior to the test administration. Candidates pass based on where their score is in comparison to the other candidates. An example is an exam used for scholarship purposes. The sponsors may know they can only provide scholarships to the top 10% of applicants.

Absolute standards, also called criterion-referenced standards, establish a specific level of performance that must be attained. Pass/fail decisions are made regardless of the number of candidates passing. Certification examinations typically use absolute standards, as their purpose is to ensure that a specified level of competency has been met.

SAS uses the criterion-referenced Angoff (1971) method for the determination of the passing point. This method is the most widely accepted method for establishing the passing score on certification examinations. (Sireci & Biskin, 1992).

The Angoff Method: The first step in the Angoff method is establishing the committee of SMEs, called judges. As with the earlier steps in the test development process, the group established should be representative of the profession and familiar with the level of knowledge for which the certification is intended. It is critical to include individuals at the level for which you are certifying in the standard setting process. The size of the standard setting group is not as important as the composition of the members. However, general practice recommends no less than five judges should be used.

The judges must first agree upon the definition of the minimally qualified candidate. The judges are then asked to think of a group of minimally qualified candidates and, for each item, independently determine "what is the probability that a minimally qualified candidate *will* get this question correct?" For each item, the judges determine the average Angoff rating. The average of the averages across all items is the Angoff passing score. The Angoff rating for each item should be recorded in the item bank.

If only 5 judges are used, all ratings should be used. As the number of judges increases, the highest and lowest ratings can be deleted if these ratings are outlier values (i.e., 20 points or more away from their closest neighboring rating).

The difficulty of the Angoff approach is in conceptualizing the definition of the 'minimally qualified' candidate. As a result, participants typically need to review the definition repeatedly during the process. Discussions among the judges, after their independent ratings, can be helpful to judges forming their final item ratings. In addition, review of the beta item statistics can also be helpful to the judges in conceptualizing the 'minimally qualified' candidate and providing a crosscheck of their ratings. Judges, however, must remember that the beta exam results reflect all candidates, not just the 'minimally qualified' candidates and must use these data with caution.

STEP 9: ADMINISTERING/SCORING OPERATIONAL EXAMS

Once the passing point is established for the exams, the exam is ready for administration. SAS certification exams are currently administered through Prometric, a recognized leader in the field of exam administration, with standardized testing locations.

The importance of standardized test administration is directly addressed in the *Standards for Educational and Psychological Testing* (American Educational Research Association, American Psychological Association, National Council on Measurement in Education, 1999). The testing environment should be reasonably comfortable and have minimal distracters. The test administrators must follow standardized procedures. The exams must be securely stored and the administration must be proctored to ensure the validity of the test scores.

With computerized testing, candidates are able to view their exam performance immediately upon completing the operational exam. In addition to the percentage of items the candidate answered correctly, the candidate receives section scores for each domain area on the examination. Computerized testing also provides candidates with increased flexibility with exam sites available during normal business hours across the globe.

Another issue regarding exam administration is repeat testing. It can be expected that not all candidates who take a certification examination will pass. Some may not pass due to lack of knowledge or readiness. Others may not pass due to situational reasons such as temporary illness or high test anxiety. While examinees deserve the chance to be retested, some guidelines should be established. Whenever examinees take an exam, they have 'practiced' taking the

exam. The more 'practices' a candidate has, the better chance for an increased test score. This increase in test scores is called a practice effect. Since certification examinations are designed to ensure that those achieving the credential possess the appropriate level of knowledge, the validity of the candidate's score will be compromised if the practice effect is high. As a result, the SAS retake policy requires candidates to wait at least two months between testing attempts, with a maximum of three testing opportunities within a twelve-month period.

STEP 10: PROVIDING ONGOING TEST MAINTENANCE

At defined intervals throughout the testing cycle, SAS reviews the item level and test form statistics for the exams. The operational data is compared to the beta statistics. Periodic review of the statistics also ensures that the answer keys are accurate and that the items are performing as intended. Similar patterns between the beta and operational examinations provide another measure of the exam's content validity. The final operational item statistics are also recorded in the item bank as part of the item history.

SAS also monitors the full exam statistics. Collection of these data allows SAS to monitor the consistency of test form statistics, candidate characteristics, and the passing rate over time. For example, suppose the passing rate suddenly increases from 60% to 90%. This should raise a flag. Perhaps a new training course is responsible for the increase, or perhaps the security of the exam has been compromised. SAS will also want to ensure that there is not an error in the answer key or scoring program.

SECTION 2: THE SAS CERTIFED PROFESSIONAL PROGRAM

WHAT'S NEW WITH THE PROGRAM?

The SAS Certified Professional Program is pleased to introduce a new program structure. This is the result of a Certification Global Summit that was attended by SAS executive management, including global representation from World Wide Marketing, Professional Services, Education, Research and Development, and Technical Support.

The outcome of the Global Summit recommended program changes that include the introduction of new versionless exams/exam tracks and the creation of job role-based exams.

SAS Certification exam tracks have been developed where one or more exams must be successfully completed to earn a specific credential. The number of exams varies by track and will be discussed later in this document.

The new versionless exams are not tied to a specific release of the SAS System. As such, SAS Certification candidates will not automatically need to sit for a new exam each time there is a new release of the SAS System. Each SAS Certification exam will be evaluated with each new release of SAS to determine if significant feature/functionality enhancements have been introduced and if changes in the SAS System require a new SAS Certification exam to be introduced.

Job role-based exams are intended to not only measure familiarity with SAS technologies, but also the application of SAS technologies to solving job role requirements. The value of certifying at the job role level was supported by research recently published by Certification Magazine (Moore, 2002).

To ensure currency of SAS System skills, SAS Certified Professionals are required to be re-certified every three years.

Below is a description of the new credentials offered as part of the SAS Certified Professional Program.

NEW SAS CERTIFIED PROFESSIONAL CREDENTIALS

New SAS credentials have been introduced to measure SAS competency across a number of functional areas, including:

SAS Certified Base Programmer
This credential is designed to assess knowledge of SAS programming essentials, including importing and exporting raw data files, manipulating and transforming data, combining SAS data sets, creating basic, detail and summary reports using SAS procedures, and identifying and correcting data, syntax and programming logic errors. Successful candidates for the SAS Certified Base Programmer certification should have at least one year of current SAS programming experience.

Exam Required: SAS Base Programming Exam

SAS Certified Advanced Programmer
This credential is designed to measure advanced SAS programming and data management fundamentals, including efficient SAS programming techniques. Successful candidates for the SAS Certified Advanced Programmer Certification should have a minimum of three years of experience in programming and data management using SAS. Candidates for this credential should be able to write efficient SAS code to solve complex problems in accordance with system specifications, while minimizing use of computing resources. Candidates should also be knowledgeable in using advanced DATA step programming statements and efficiency techniques to solve complex problems, writing and interpreting SAS SQL code, and creating and using the SAS MACRO facility.

Exams Required: SAS Base Programming Exam*
SAS Advanced Programming Exam

**The SAS V8 Core Concepts credential will satisfy the SAS Base Programming Exam prerequisite for this credential.*

SAS Certified webAF Developer: Server-side
This credential is intended to validate experience designing and developing advanced web-based information delivery applications using SAS Software. Successful candidates for this certification should have at least three years of experience designing and developing advanced web-based information delivery applications using SAS Software, including SAS webAF server-side technology. Successful candidates must understand object-oriented techniques and principles and be knowledgeable in the following SAS software components and procedures typically used to develop applications in SAS: Base SAS, the Output Delivery System, SAS Macro Language, SCL, SQL processing with SAS, DATA Step programming, SAS webAF, SAS Integration Technologies, DHTML, Java and the Java server-side environment, SAS/ACCESS technologies, SAS/CONNECT, SAS/SHARE, and SAS OLAP Server.

Exams Required: SAS Advanced Programming Exam
SAS webAF Server-side Application Development Exam

SAS Certified Warehouse Development Specialist
This credential is intended to test skills involved in the detailed design of data warehouse components in accordance with system specifications and constructing the components of the warehouse. The Warehouse Development Specialist can be thought of as the implementer of a SAS Data Warehouse. Candidates should be able to design detailed components of the data warehouse in accordance with system specifications and construct the components of the

warehouse in compliance with the detailed design. Successful candidates will have a working knowledge in data management programming skills, data quality, extract, transform, and load (ETL), and testing procedures. Practical experience is likely to include work in data modeling, systems analysis, process design, data storage systems, and the software development life cycle. Successful candidates for the SAS Certified Warehouse Development Specialist certification should have a minimum of three years of experience in data warehouse development and design using SAS software.

SAS Certified Warehouse Development Specialists must have a detailed working knowledge of SAS® data warehousing technologies and their practical application in data warehousing projects, including the specific body of knowledge and understanding of the SAS Rapid Warehousing Methodology, practice and techniques.

Exams Required: SAS Advanced Programming Exam
SAS Warehouse Technology Exam
SAS Warehouse Development Specialist Concepts Exam

SAS Certified Warehouse Architect
This credential tests skills involved in designing, implementing, testing and deploying data warehouse solutions. Successful candidates for the SAS Certified Warehouse Architect certification should have detailed knowledge in the development of the information architecture and communicating the design to the customer, the construction team and all other designated parties. Successful candidates must exhibit knowledge of strategies for gathering requirements, designing, implementing, testing, and deploying data warehouse solutions. Examples include work in data modeling, systems analysis, process modeling, system architecture, data storage systems, system development life cycle; and extract, transform and load (ETL) procedures.

Exams Required: SAS Warehouse Technology Exam
SAS Warehouse Architect Concepts Exam

PREPARING FOR AND TAKING A SAS CERTIFICATION EXAM

Exam format: All current SAS Certification exams are computer-based and consist of multiple-choice questions. The number of questions varies per examination but is in the range of 50-80 items per exam. Each operational exam must be completed in two hours. Candidates receive immediate performance feedback upon completion of an operational exam.

Test preparation: Each exam challenges candidates to apply specific knowledge acquired through SAS Software training and practical work experience. Experience is a critical component of obtaining the knowledge necessary to become SAS Certified.

SAS offers a broad curriculum of instructor-based courses and e-learning training guides to assist individuals in preparing for an exam. Candidates may also benefit from reviewing product documentation or other reference material before taking an exam.

To gauge exam readiness, candidates are encouraged to visit support.sas.com/certify for a full listing of recommended test preparation materials and objectives for each exam.

Test registration: To ensure the security of the tests and the test results, SAS Certification exams are administered by Prometric, a Thomson Learning Company. Individuals may register for exams at more than 2,500 Authorized Prometric Testing Centers in more than 140 countries around the world. Within the United States and Canada, individuals may register by calling Prometric at (888) 895-5819. Online registration is also available at www.2test.com. Outside the United States and Canada, please visit the Prometric Test Center Locator at www.2test.com to find the Prometric Regional Service Center for a specific country.
Pricing: In the United States and Canada, the fee to sit for a production exam is currently US $150. Outside the U.S. and Canada, please contact the nearest Prometric Regional Service Center for specific pricing information. Certification exam prices are subject to change. For the latest pricing information, please visit support.sas.com/certify. Please note that pricing and test duration information may vary for beta exams.

SAS CERTIFICATION NEWSLETTER

To stay current with SAS Certification news, please register for our newsletter by visiting support.sas.com/certify/newsltr.html.

FOR MORE INFORMATION

Individuals are encouraged to visit support.sas.com/certify to learn more about the SAS Certified Professional Program, including any of the above exams, tracks, or credentials.

CONCLUSION

The SAS Certified Professional Program was developed to provide users with a universal, standardized measure of knowledge in a particular SAS job role. Candidates seeking a particular credential deserve the opportunity to take an examination covering material that is appropriate for the performance required for the credential. The test development process that SAS follows ensures candidates of this right.

In addition to the care used to develop the examinations, the same care was given to determining the needs of SAS users and arriving at the credentials offered within the program. In 2003, five new credentials are being introduced. This listing was determined to be the appropriate set of credentials to offer. However, market demand will also be considered in assessing if new certifications should be added. In the meantime, SAS encourages users to visit the support.sas.com/certify and begin the steps to becoming a SAS Certified Professional.

REFERENCES

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