Paper 216-2008

SAS® Certification: Are You Ready to Put Your SAS Skills to the Test?
Dawn Hopper, SAS Institute Inc., Cary, NC

ABSTRACT

How do your SAS® skills stack up to the competition? With an ever-increasing demand for SAS professionals worldwide, the ability to validate your knowledge with global benchmarks is a necessity.

The SAS® Global Certification Program offers benchmarks for all SAS users to validate their expertise within programming, data warehousing, and predictive modeling. This paper will focus on how SAS exams are developed, exam topics, exam preparation tools, and a review of a few sample SAS exam questions and answers.

INTRODUCTION

With 96 of the top 100 companies on the 2007 Fortune Global 500 list leveraging the power of SAS coupled with the projection of IT software spending to increase by 8% this year (Bartels, 2007), the outlook is great for SAS to increase market share. With the prospect of the more than 43,000 sites using SAS expanding significantly, highly skilled SAS professionals are essential for existing and new SAS software customers to remain competitive. A recent survey of 130 CIOs and IT executives from 112 companies reported that 75.4% expect to maintain or increase their IT staff. This survey also found that the number one concern among IT leaders was attracting, developing, and retaining professionals (Pratt, 2008). The SAS Global Certification Program offers the only industry-recognized standard across the globe for SAS knowledge.

New SAS users, as well as seasoned SAS professionals, find value in obtaining credentials which validate their SAS software expertise. When Paul Winters, a U.S. postal carrier for 18 years, decided to make a career change, he was unsure of his future career opportunities. While studying for his master's degree in applied statistics, his department chair encouraged him to learn SAS to broaden his marketability to employers. Armed with this recommendation, Winters pursued and earned a SAS Certified Base Programmer credential. He currently serves as a lead programmer/analyst for the University of Rochester Medical Center and teaches advanced, graduate-level SAS courses at the university. "[Obtaining my certification] clearly gave me an advantage in obtaining my current position." Since beginning his new career, Winters has continued his study of SAS and successfully earned his SAS® Certified Advanced Programmer for SAS®9 credential this past year.

Highly experienced SAS users also recognize the value of earning SAS credentials to increase their credibility and validate their expertise. The roles and responsibilities of IT professionals are continually expanding, so more roles require not only technical know-how, but also strong business acumen (Pratt, 2008). Michael Tomb, a business owner with over 27 years of SAS expertise, earned his first SAS credential in 2000 when he found himself using this standard to hire other SAS users into his consulting firm. Tomb states, "I was hoping to find that the SAS certification was a good screening tool to verify expertise. I was immediately impressed that this was true." Tomb has continued along his SAS certification journey by earning the SAS Certified Advanced Programmer credential.

Regardless of your situation, earning a SAS certificate affords you several professional and personal rewards. This paper will contain three sections. The first section will focus on the ten steps needed to produce a valid and reliable certification examination. The second section will provide an overview of the current SAS certification offerings. The final section will encompass an overview of exam preparation tools offered by SAS to assist you in your journey to becoming a SAS Certified Professional.

EXAM DEVELOPMENT

SAS Certification exams are developed according to a rigorous test development process. This process has been developed to ensure that SAS exams across the globe are valid and reliable measurements to gauge SAS skills. The ten-step exam development process with which SAS strictly complies is summarized below:

STEP 1: CONDUCTING A JOB TASK ANALYSIS

The exam development process is initialized with a job task analysis which is often the most complex step within the process. A job task analysis convenes a group of internal and external subject matter experts (SMEs) from across the globe. The SMEs determine the responsibilities and skills associated with acceptable performance within a profession. During this workshop, the purpose of the exam, target audience description, and total number of

questions on the exam are determined. At the conclusion of the workshop, a complete listing of tasks is determined. These tasks become the basis for the certification exam objectives.

The second phase of the job task analysis begins with the complete list of tasks being validated by a representative sample of the population performing the job in which the certification exam is intended (Henderson, 1996). A survey which includes each exam objective/task is offered on the SAS Web site to determine the importance and frequency of the tasks presented. The findings of this survey are essential to move ahead to the next step of the exam development process: Developing an Exam Blueprint.

STEP 2: DEVELOPING AN EXAM BLUEPRINT
The feedback from the exam objectives survey is the basis for the exam blueprint. The survey feedback highlights which tasks respondents rated higher within importance and frequency, as well as those not ranking highly. This data is used to determine how exam objectives are weighted. Those exam objectives receiving higher importance rankings have more questions than those receiving lower rankings. Once each objective has been reviewed to determine the appropriate number of questions, the test content outline is finalized.

The exam blueprint is complete once the exam format and item types are identified. SAS uses the multiple-choice format which is widely used within the IT certification industry. The decision to use the multiple-choice format was made after research of the advantages and disadvantages of this type of format versus other exam types (Dungan, 1996; Osterlind, 1997; Haladyna, 1999). The number of exam questions asked per SAS exam varies based on what can be measured reasonably within a 2–3 hour timeframe. The final exam blueprint provides the foundation for the next phase of the test development process: Developing Items.

STEP 3: DEVELOPING ITEMS
With the final exam blueprint in hand, a group of SMEs is brought together to establish a pool of items (questions) which measure the exam objectives. To assure that there are enough items for the final version of an exam, SMEs are placed into small groups and are asked to write three times as many items as requested per objective.

Once the first draft of the items is complete, the SMEs come together as a group to review all of the items developed. This initial review ensures that the items are measuring their intended exam objective, important for someone to know at this level, relevant to the job role being certified, easily understood by nonnative English speakers, and have only one correct answer. This initial review provides the groundwork for the more thorough review which is the next step of the exam development process: Reviewing Items.

STEP 4: REVIEWING ITEMS
A more thorough review of the items is conducted following the initial review by a psychometric/editing team from SAS. This review ensures that the items meet sound psychometric standards, as well as SAS standards. The next aspect of this review includes a group of SMEs. They are brought together to review the items during a week-long session.

During this session, each item is reviewed for technical accuracy, relevance, and clarity. All SAS programs and graphics are further scrutinized to ensure their correctness. At the conclusion of the session, final consensus is reached on the final set of items to use on the beta exam(s). This brings us to the next step within the exam development process: Assembling/Delivering Beta Exams.

STEP 5: ASSEMBLING/DELIVERING BETA EXAMS
The final set of items which are to be field-tested are placed into the beta item pool and provided to our testing administrator. The beta exam is offered for a limited time to the intended target audience for the exam. The beta exam consists of more exam items than the exam blueprint to account for items which might not perform well.

For those taking the beta exam, immediate feedback regarding results is not provided as the final exam pool has not been determined. For statistical accuracy, the beta period is concluded once a representative sample of the target audience has been met. The beta exam results and item statistics are used in the next phase of the exam development process begins: Beta Exam Results/Item Selection.

STEP 6: BETA EXAM RESULTS/ITEM SELECTION
At the conclusion of the beta exam, the results are provided to SAS from the testing administrator regarding the performance of each question on the exam. These item statistics provide the foundation for the item selection workshop, which convenes with a group of SMEs who review, at minimum, the item difficulty and item discrimination statistics.

The item difficulty (p-value) is defined as the number of exam takers who answered the item correctly. The p-value is lower when the exam item is difficult. For example, if an item has a p-value less than .30, it would be flagged by the

SMEs for further review as it might be too hard given that only 3 out of 10 examinees answered correctly. On the other hand, if an item has a p-value of greater than .95 it would be flagged for further review as it might be too easy. SAS generally uses items with p-values between .30 and .90.

The item discrimination serves as the correlation between scores on a question relative to the examinee's total score. An exam item should be able to distinguish between low-scoring and high-scoring candidates. For example, you would not want low-scoring candidates answering a particular item correctly, while high-scoring candidates are missing it. This would result in negative discrimination and would point to there being an issue with the exam question. The goal per exam is for all items to have positive discrimination; thus, higher-performing candidates answer the item correctly while lower-performing candidates answer the item incorrectly.

During this workshop, the SMEs go over each items' statistics and provide feedback regarding which items to keep on the final operational form of the exam. The final item pool is determined for the operational exam and a SAS team moves forward with the next step within the process: Equivalent Exam Forms.

STEP 7: EQUIVALENT EXAM FORMS
Armed with the final item pool, SAS moves forward with establishing multiple forms of the exam. When these multiple forms are constructed, it is of the utmost importance to assure that the exams are operationally equivalent from both a content and a statistical perspective. The first step to achieve this equivalence is to ensure that the exams align with the exam blueprint. Therefore, each exam form will contain the same number of items on a certain topic.

The second step toward equivalence focuses on the statistical aspect of the exam items. Examinees should not be penalized for taking harder versions of an exam, nor rewarded for taking easier versions of an exam. Therefore, SAS uses the beta test results and input from SMEs to select items for development of pre-equated exam forms. The items selected for the multiple forms should have equivalent average p-values. Once the equivalent exam forms are completed, we proceed with the next step: Establishing the Passing Score.

STEP 8: ESTABLISHING THE PASSING SCORE
The exam has been constructed, and a fair and reasonable passing score must be identified. There are two methods for determining passing scores, also known as standard setting. The first method, norm-referenced standard setting, bases pass/fail decisions on examinee performance relative to other candidates. The second method, criterion-referenced standard setting, pre-determines a particular level of performance that must be attained by the candidate. The passing scores for most certification exams are established through criterion referenced standard setting.

SAS uses the criterion-referenced Angoff (1971) method for passing score determination. A committee of at least five judges (SMEs) are brought together to first agree upon the definition of the minimally qualified candidate for the exam. Each exam item is reviewed and the judges determine the answer to this question: "What is the probability that a minimally qualified candidate will get this answer correct?" An average Angoff rating is applied to each item, and the average of the averages across all items is the Angoff passing score. The final passing score is derived, and we move to our final stage within the exam development process: Administering/Scoring exams.

STEP 9: ADMINISTERING/SCORING EXAMS
Once the passing score is established for the exam, the exam is ready for administration. The SAS certification exams which focus on programming and data warehousing are currently administered through Prometric, with testing locations around the world. The predictive modeling exam is offered at select SAS training centers, academic institutions, and user events. The predictive modeling exam is the first exam offered by SAS which requires candidates to use SAS® Enterprise Miner™ 5.2 software to derive the answers to a defined number of multiple-choice questions. This type of exam is not currently supported by our exam administrator.

All SAS exams are computer-based in format within a proctored environment. Examinees can view their exam performance immediately upon completing the operational exam (unless it is a beta exam). In addition to the percentage of items the candidate answered correctly, the candidate receives section scores for each domain area on the examination.

Repeat testing is allowed if unsuccessful. To maximize exam security and validity, SAS' retake policy requires candidates to wait at least 30 calendar days between exam attempts, with a maximum of three exam opportunities within a twelve-month period.

STEP 10: ONGOING EXAM MAINTENANCE
During the testing cycle, SAS reviews item-level and test-form statistics at specified times to ensure that the items are performing as intended. Monitoring of the full exam statistics is also conducted during these maintenance periods. The passing rate over time is also reviewed to ensure exam security has not been compromised.

The meticulous test development process outlined above ensures that SAS exams serve as a standardized measure of SAS expertise within a particular job role. As SAS software changes, exams are updated to assess enhancements and features which might have occurred from the prior software release. To ensure that SAS certification exams continually meet the needs of our customers, periodic surveys are conducted to assess future exam development initiatives. Today, SAS professionals across the globe can validate their mastery within SAS programming, data warehousing, and predictive modeling.

EXAM TOPICS

Like SAS software, the certification program has continually evolved to keep pace with the ever-changing needs of the analytical market. With enterprise software spending within the U.S. projected to grow over the prior year (Bartels, 2007), demand for skilled technical professionals will follow suit. SAS offers accomplished professionals worldwide the following credentials:

PROGRAMMING

You know the value of developing efficient code to solve problems and derive accurate answers. A recent survey by *Computerworld* lists programming as one of top eight skills in demand for 2008 (Hoffman, 2007). SAS programming credentials provide opportunities for intermediate or seasoned SAS users to validate their SAS programming knowledge. Two credentials are currently offered to measure SAS programming acumen.

The first credential, the SAS® Certified Base Programmer for SAS®9 is for users who are responsible for analyzing and presenting data to solve business needs. Successful candidates for this credential should be able to import and export raw data files, manipulate and transform data, combine SAS data sets, create basic detail and summary reports using SAS procedures, and identify and correct data syntax and programming logic errors. Familiarity with enhancements and the new functionality available in SAS®9 is also beneficial. To gauge your exam readiness, you are encouraged to review the complete list of exam objectives on the SAS Web site. This credential requires the successful completion of the SAS® Base Programming exam for SAS®9 only.

The following sample question with corresponding answer is an example of the question format you might see on this exam. Please note that this question is not representative of the totality of the knowledge needed to successfully complete this exam.

SAS Base Programming exam for SAS®9 Sample Question

The following observation is stored in a SAS data set named EMPLOYEES:

```
LNAME           FNAME           JOBCODE
--------------------------------
Whitley         Sam             na1
```

If the DATA step below is executed, what will be the value of the variable JOBDESC in the output SAS data set when this observation is processed?

```
data navigate;
  set employees;
  if jobcode = 'NA1' then jobdesc = 'Navigator';
run;
```

A.   navigator
B.   Navigator
C.   NAVIGATOR
D.   a missing value

The correct answer is option "D." This option is correct because no match is found because the IF statement uses uppercase letters (if jobcode = 'NA1') and in the data set the value has lowercase letters 'na1'.

The second credential offering, the SAS® Certified Advanced Programmer for SAS®9, is for users who are responsible for writing efficient code to solve complex business problems, while minimizing the use of computing resources. Successful candidates for this credential should 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. You should also be familiar with the enhancements and new functionality that are available in SAS®9. To gauge your exam readiness, you are encouraged to review the complete list of exam objectives on the SAS Web site. This credential requires the successful completion of the following exams:

SAS® Base Programming exam for SAS®9
SAS® Advanced Programming exam for SAS®9

The following sample question with corresponding answer is an example of the question format you might see on this exam. Please note that this question is not representative of the totality of the knowledge needed to successfully complete this exam.

SAS Advanced Programming exam for SAS®9 Sample Question

Given the following SAS data sets ONE and TWO:

ONE				TWO		
YEAR	QTR	BUDGET		YEAR	QTR	SALES
2001	3	500		2001	4	300
2001	4	400		2002	1	600
2002	1	700				

The following SAS program is submitted:

```
proc sql;
   select one.*, sales
          from one right join two
          on one.year = two.year;
quit;
```

Which one of the following reports is generated?

A.

YEAR	QTR	BUDGET	SALES
2001	3	500	.

B.

YEAR	QTR	BUDGET	SALES
2001	4	400	300
2002	1	700	600

C.

YEAR	QTR	BUDGET	SALES
2001	3	500	.
2001	4	400	300
2002	1	700	600

D.

YEAR	QTR	BUDGET	SALES
2001	3	500	300
2001	4	400	300
2002	1	700	600

The correct answer is option "D." This option is correct because a right join lists matching rows from both tables and rows from the right-hand table (the second table listed in the FROM clause) that do not match any row in the left-hand table.

While accessing and manipulating data is important, the task is difficult to achieve if there are multiple versions of the

5

truth within your data. SAS combats this business pain by providing reliable data warehousing solutions for maximized data integrity.

DATA WAREHOUSING

Data warehousing is vital to the success of businesses across the globe, and ensures that you can quickly attain and manage consistent and trusted data throughout the organization to make sound business decisions. Two credentials are offered in this skill set: testing the user's expertise in the development, implementation, deployment, and maintenance of the data warehouse. The first credential, the SAS® Certified Warehouse Architect is for users who are responsible for designing and deploying data warehouse solutions. Successful candidates for this credential should have knowledge in the development of information architecture, gathering requirements, designing, implementing, testing, and deploying data warehouse solutions. To gauge your exam readiness, you are encouraged to review the complete list of exam objectives on the SAS Web site. This credential requires the successful completion of the following exams:

> SAS® Warehouse Architect Concepts exam
> SAS® Warehouse Technology exam

The second credential, the SAS® Certified Warehouse Development Specialist, is for users who are responsible for implementing and maintaining the warehouse. Successful candidates for this credential should have experience in software development and design in a data warehousing environment. Experience within data modeling, systems analysis, process design, data storage systems, and software development life cycle are also beneficial. To gauge your exam readiness, you are encouraged to review the complete list of exam objectives on the SAS Web site. This credential requires the successful completion of the following exams:

> SAS® Advanced Programming exam for SAS®9
> SAS® Warehouse Development Specialist Concepts exam
> SAS® Warehouse Technology exam

The following sample question with corresponding answer is an example of the question format you might see on the SAS Warehouse Technology exam. Please note that this question is not representative of the totality of the knowledge needed in order for successful completion of this exam.

SAS Warehouse Technology exam Sample Question

When using the Change Management feature of SAS® ETL Studio, what type of data may be changed?

A.   ETL process source code deployed for scheduling
B.   Physical data in the tables of the warehouse
C.   Existing transformations in the ETL Process Library
D.   Metadata in the SAS metadata repository

The correct answer is option "D." This option is correct because change management allows you to use such features as check-in, check-out, the inventory tree, and the custom tree, all of which affect the metadata within the SAS metadata repository. The change management features cannot access the source code or the physical tables in the warehouse.

With one version of the truth within your data, you have the ability to accurately predict future trends. With the SAS data mining solution, your organization can precisely forecast for tomorrow and beyond.
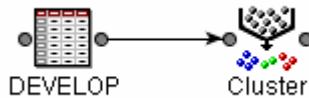
PREDICTIVE MODELING

SAS data mining solutions allow you to predict the future and help business leaders make better informed decisions. Predictive modelers with SAS software expertise guarantee your business stays ahead of the competition by continually identifying new opportunities. One credential is currently offered to test your SAS data mining knowledge.

The Predictive Modeler using SAS Enterprise Miner 5.2 credential validates your mastery of an array of modeling tasks. Successful candidates for this credential should be proficient in data preparation, building predictive models, assessing models, scoring new data sets, and implementing models. Candidates should also be familiar with the enhancements and new functionalities for predictive modeling that are available in SAS Enterprise Miner 5.2. To gauge your exam readiness, you are encouraged to review the complete list of exam objectives on the SAS Web site. This credential requires the successful completion of the Predictive Modeling using SAS Enterprise Miner 5.2 exam.

The following sample question with corresponding answer is an example of the question format you might see on the Predictive Modeling using SAS Enterprise Miner 5.2 exam. All exam answers are derived by successfully performing tasks within SAS Enterprise Miner 5.2. Please note that this question is not representative of the totality of the knowledge needed in order for successful completion of this exam.

Predictive Modeling using SAS Enterprise Miner 5.2 exam Sample Question

Open the diagram labeled Project AA within the project labeled Project AA.

Perform the following in SAS® Enterprise Miner™ 5.2:
1.   Set the Clustering method to Average.
2.   Run the Cluster node.

 What is the Importance statistic for MTGBal (Mortgage Balance)?
A.   0.32959
B.   0.42541
C.   0.42667
D.   1.00000

The correct answer is option "C." To derive this answer, you would open SAS Enterprise Miner 5.2 and change the default clustering method to Average. Once the analysis is completed, the results of the clustering are presented. Within the clustering results, the Output window provides the Importance statistic for MTGBal.

Each exam outlined above challenges you 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. Before embarking on your SAS certification journey, a review of the exam content is encouraged to gauge preparedness.

EXAM PREPARATION
Upon review of the exam objectives, you might determine that there are areas in which additional review or preparation is needed to master the topic. Whether you are new to using SAS software or an expert, SAS offers a broad curriculum of instructor-led and self-paced e-learning courses to assist you in preparing for an exam.

Learning styles vary by individual with some preferring an expert on hand to answer questions, while others prefer learning at their own pace. Each learning style is addressed in more detail below.

Instructor-led training
SAS training offered within a training center or a virtual class via Live Web is available to you. With classroom training, an instructor leads you through topics and is there to help you work on exercises and answer questions. If you are unable to travel to a SAS training center, our virtual Live Web environment brings SAS training to your desktop with real-time instruction and feedback. The instructor-led training format provides you with access to a SAS expert, which is appealing to most students, while others prefer to learn at their own pace.

Learn on your own
SAS also offers you the ability to work through instructional material on your own over the Web. Appealing to those with limited training budgets, SAS self-paced e-learning material leads you through topics, offers quizzes, and suggests practices that you can do in your own SAS session. There are several SAS certification-focused e-learning materials which cover the topics on specific exams. Documentation is also available for you free from the SAS Web site, or for sale through SAS Publishing. SAS Publishing also offers books which focus on SAS certification exam topics.

Finally, SAS offers you the ability to purchase complete training packages at a discount. These training packages bring together top-notch training tools and an exam voucher. Therefore, regardless of your experience level, you can obtain SAS knowledge from a multitude of resources offered by SAS.

CONCLUSION

The SAS Global Certification Program was developed to provide a universal, standardized measure of knowledge within specific SAS job roles to SAS users worldwide. As competition for highly competent SAS professionals increases, the ability for users to differentiate themselves to hiring officials and current employers is key. SAS certification provides you with the competitive advantage you need to stand out, and also boosts your credibility as a technical professional. Candidates seeking a credential deserve to take an exam covering material that appropriately tests the performance required for the credential. The exam development process that SAS follows ensures candidates of this right.

The same care that was used to develop the exam is used when determining the needs of SAS users and arriving at the credentials offered within the program. Credentials offered today focus on programming, data warehousing and predictive modeling job roles. As SAS software continues to evolve, the certification program will follow suit, establishing future credentials based on market demand and the needs of our customers. In support of the credentials offered, SAS will continue to offer educational tools to assist you in your pursuit of SAS knowledge. SAS encourages you to visit the Web site: http://support.sas.com/certification and begin or continue your SAS certification journey.

SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. ® indicates USA registration. Other brand and product names are trademarks of their respective companies.

REFERENCES

Althouse, L. & Vaglio-Laurin, M. 2003. "An Overview of SAS Certification and the Test Development Process." *Proceedings of the Twenty Eighth Annual SAS Users Group International Conference*, Seattle, WA, 245-28.

Peters, A. 2007. "Navigating the SAS® Training Experience." *Proceedings of SAS Global Forum 2007*. Orlando, FL. 122-2007.

Bartels, A. 2007. "US IT Spending Summary: Q3 2007." Forrester Research, Inc. http://www.forrester.com/Research/Document/Excerpt/0,7211,43020,00.html

Pratt, M. K. 2008. "IT Hiring on the Rise." http://www.cio.com/article/print/168350

Hoffman, T. 2007. "The 8 Hottest Skills for '08." *Computerworld* http://www.computerworld.com/action/article.do?command=printArticleBasic&articleId=308800

American Education Research Association, American Psychological Association, and National Measurement in Education. 1999. *Standards for educational and psychological testing*. Washington, DC: American Psychological Association.

Angoff, W. H. 1971. "Scales, norms, and equivalent scores." In *Educational Measurement (2nd ed.)*, ed. R. L. Thorndike, pp. 508–600. Washington, DC: American Council on Education.

Dungan, L. 1996. "Examination Development." In *Certification: A NOCA handbook*, eds. A. H. Browning, A. C. Bugbee, Jr., and M. A. Mullins. Washington, DC: National Organization for Competency Assurance.

Flaherty, V. L. & Hogan, J. B. 1998. "Job analysis for high-stakes credentialing examinations." *CLEAR Exam Review*, IX (3), pp. 23-28.

Haladyna, T. M. 1999. *Developing and Validating Multiple-Choice Test Items (2nd edition)*. Mahway, NJ: Lawrence Erlbaum Associates.

Henderson, J. P. 1996. "Job analysis." In *Certification: A NOCA handbook*, eds. A. H. Browning, A. C. Bugbee, Jr., and M. A. Mullins. Washington, DC: National Organization for Competency Assurance.

Osterlind, S. J. 1997. *Constructing Test Items (2nd edition).* Boston, MA: Kluwer Academic Publishers.

CONTACT INFORMATION

Your comments and questions are valued and encouraged. Contact the author at:

Name:	Dawn Hopper
Enterprise:	SAS Institute Inc.
Address	SAS Campus Drive
City, State ZIP	Cary, NC 27513
Work Phone:	919-531-6926
Fax:	919-677-4444
E-mail:	dawn.hopper@sas.com
Web:	http://support.sas.com/certification