SAS THE POWER TO KNOW. SAS® TECH REPORT

Dear Readers,

It's that time of year again. SAS® Global Forum 2007 is just around the corner. At this annual SAS users group conference, formerly known as SAS Users Group International (SUGI), you have the unique opportunity to network with other SAS users and SAS staff from around the world. If you're planning to attend (and I hope you are), I look forward to meeting you.

I'll be there producing the daily newspaper *SAS® Global Forum News*. It's a printed publication designed to provide you with a peak at the day's upcoming activities and a recap of the previous day's key events. Look for it in stands near the registration area and Demo Area. You can also access it online at www.sasglobalforum.org/2007.

During the conference, I hope you'll learn how to get the most out of your software and find time to exchange ideas with your peers. And don't forget to carve out a little fun time. Walt Disney World has many things to see and do.

See you in Orlando!

Shelley Sessoms
Editor, *SAS Tech Report*

SAS/OR 9.1.3 Release 3.1 Now Available

This release features production versions of the OPTMODEL, OPTLP, and OPTQP procedures and also adds the experimental PROC OPTMILP for mixed-integer optimization. PROC OPTMODEL also adds experimental mixed-integer modeling capabilities. To obtain this new SAS/OR release, see

Request Form

Comprehensive Tools for Mathematical Programming

Mathematical programs are a class of problems with an objective that is a function of a set of decision variables and is to be optimized (maximized or minimized) subject to constraints on those decision variables. These problems are categorized by the structure of the objective function and constraints.

Mathematical programming techniques in SAS/OR software help solve mathematical programs that can correspond to a wide range of problems including resource allocation, distribution, product mix and blending, production planning, capital budgeting, asset allocation, portfolio selection and staffing, to name a few.

Specialized algorithms (called solvers) that exploit the structure in the problem have been developed for solving specific categories of mathematical programs. The approach is to exploit characteristics of the problem to find optimal solutions more efficiently. All optimization procedures in SAS/OR employ such specialized algorithms and are defined by the structure of the mathematical program that they solve. The following sections detail these structural categories.

Linear and Mixed-Integer Programming

The LP procedure solves linear, integer, and mixed-integer programs. Linear programs are problems that have an objective function and constraints that are defined using linear functions of the decision variables. The constraints can be a set of linear equalities and/or inequalities. If there is an additional constraint that all or some of the decision variables must be integer-valued, then the program is called an integer or mixed-integer program.

The procedure solves these problems using a primal simplex solver and provides interactive control of the solution process and printing, handles sparse and dense input formats, and enables you to perform ranging, objective and right-hand-side sensitivity analysis, and parametric programming. In addition, the software saves intermediate results for "warm-starts."

New Procedures

The OPTLP procedure (SAS/OR 9.1.3, Release 3.1) provides linear programming solvers and enables you to choose from three linear programming solvers: primal simplex, dual simplex, and iterative interior point (experimental). The simplex solvers implement a two-phase simplex method, and the interior point solver implements a primal-dual predictor-corrector algorithm. All three solvers are newly rewritten and are designed for excellent performance and scalability. Presolvers, which work aggressively to reduce the effective size of problems before the solvers are invoked, are also provided.

PROC OPTLP accepts linear programming problems that are submitted in an MPS-format SAS data set. The MPS-format SAS data set corresponds closely to the MPS-format text file (commonly used in the optimization community) and was first introduced in SAS/OR 9.1.3, release 2.1.

You can also use the PROC OPTMODEL modeling language (SAS/OR 9.1.3, Release 3.1) to solve linear programs. The OPTMODEL syntax enables you to express the problem indirectly in the SAS language in a form that very closely resembles the symbolic form.

Within both the OPTLP and OPTMODEL procedures, you have access to three LP solvers --- primal simplex, dual simplex, and the iterative interior point solver (experimental).

New Experimental Procedure

The new OPTMILP procedure, experimental in SAS/OR 9.1.3, Release 3.1, solves mixed-integer linear programming (MILP) problems with an LP-based branch-and-bound algorithm that has been completely rewritten for this release. The algorithm also implements advanced techniques including presolvers, cutting planes, and primal heuristics. The resulting improvements in efficiency enable you to use PROC OPTMILP to solve larger and more complex optimization problems than you could solve with previous releases of SAS/OR.

PROC OPTMILP accepts mixed-integer linear programming problems that are submitted in an MPS-format SAS data set.

You can also access this experimental MILP solver using PROC OPTMODEL.

Network Flow Programming

The NETFLOW procedure finds the shortest path, the maximum flow, or the minimum cost flow through a network, using a specialized simplex algorithm. In this procedure, the decision variables represent the flow through a network that has sources of flow and demands for flow. The procedure also supports linear side constraints on the flows through the network and on additional nonarc decision variables, and it can solve both network flow problems and pure linear programs using an interior-point optimization method.

New Options in PROC NETFLOW

Two new options, GENNET and EXCESS=, were introduced in the NETFLOW procedure in SAS/OR 9.1.3, Release 2.1. These options enable you to model and solve generalized networks, in which it is possible to have losses or gains in the flow over various arcs. Some real-life problems that lend themselves to be modeled as generalized networks include:

- Power generation: As electricity is transmitted over wires, there is some unavoidable loss along the way. This loss is represented by a multiplier less than 1.0.
- Financial models: A flow through an arc could represent money in a bank account earning interest over the specified time period. In this case, the gain is represented by a multiplier greater than 1.0.
- Changes in the form of flow through the network due to assembly operations: various subassemblies reach a particular node and the resulting commodity exiting that node is a completed part. In this case, the multipliers could be defined through the bill-of-material.

Nonlinear Programming

The NLP procedure solves mathematical programs in which the objective function is a general nonlinear function of the decision variables and the constraints are linear or general nonlinear functions of the decision variables. The procedure includes a variety of algorithms, each specializing in solving different variants of the general nonlinear program.

New Procedure

The OPTMODEL procedure's modeling language (SAS/OR 9.1.3, Release 3.1) enables you to formulate and solve nonlinear programming problems in a very concise manner. You can choose from a variety of optimization techniques provided by four nonlinear programming solvers: the NLPU solver, which is designed to solve unconstrained NLP problems, the NLPC solver, which is designed to solve linearly constrained NLP problems, and the SQP (sequential quadratic programming) and experimental IPNLP (interior-point NLP) solvers, both of which are designed to solve general NLP problems.

Quadratic Programming

The OPTQP procedure (SAS/OR 9.1.3, Release 3.1) solves mathematical programming problems with a quadratic objective function and a set of linear constraints. It replaces the earlier experimental QP procedure and uses an experimental quadratic programming solver which may also be accessed using PROC OPTMODEL.

SAS Education helps users get the most out of their SAS software

Vice President of SAS Education Herbert Kirk likes to use the phrase "good-sized university" to describe the number of SAS users his division serves each year. It's a fair assessment, considering an average year sees more than 30,000 students take an Education classroom course, sign in for a Live Web class, attend one of Education's three conferences, or participate in any of a number of other educational offerings.

Since SAS Education was formalized more than thirty years ago, the organization has been committed to providing users the quality instruction they need to help them realize the full potential of their SAS software investment. The group is recognized as a leader in technical instruction on SAS, Business Intelligence, JMP and industry-leading business theory and best practices.

Delivering the knowledge that improves performance

SAS Education's mission statement is simple: Deliver the knowledge customers need to improve their performance and skills using SAS technology. To accomplish this goal, SAS Education employs a network of nearly 100 certified instructors and 28 training facilities located throughout the country. The division also provides on-site instruction to organizations in need of group training at their site. For those users who do not live close to a regional training center, are looking to reduce travel expenses or time away from the office, or simply prefer the e-learning medium, the division offers a number of e-learning options, including Live Web classes and self-paced e-learning.

In 2006 alone, Education instructed more than 34,000 students and delivered more than 2,300 courses. The group also awarded its 9,000 SAS Certified Professional Credential, participated in numerous corporate-wide events, delivered seminars to hundreds of users at SAS' regional and international user group meetings, assisted hundreds of university professors interested in incorporating SAS technology into their curriculum, and conducted three internationally recognized conferences.

First and foremost a service organization

In addition to providing users cutting-edge educational content that helps them exploit the full capabilities of SAS, SAS Education is also committed to customer service and building user loyalty. During the division's 30-plus year history, SAS Education has trained more than 500,000 SAS users and regards the relationship it develops with each student as an important asset. Through literally hundreds of thousands of interactions, the division has helped SAS earn its reputation as a highly responsive company driven by the needs of its customer base.

"At SAS Education we take great pride in the fact that our customers consistently rank our training as excellent," says Kirk. "That's no accident. From the moment you register, during your training, and even after you're back at work, we strive to provide you with the highest level of customer care possible. Our goal is to help you learn how to use SAS more effectively. So, if you're not satisfied with your training experience, let us know and we will make things right. I promise"

SAS Education's Products and Services

SAS Education offers a broad curriculum of SAS, JMP and statistical courses. Supporting users with the latest foundation technology training, SAS Education courses cover a variety of topics arranged in more than twenty separate curriculum paths. While SAS programming, reporting, statistics and applications development courses account for a majority of the public course

registrations, the division serves the broad interests of SAS users through the delivery of more than 100 developed courses.

In addition to its foundation training, SAS Education also offers solution training to support SAS' initiatives, including courses in Enterprise Intelligence, Supplier Intelligence, Organizational Intelligence, and others.

SAS Education is also uniquely equipped to address the variety of learning styles. From instructor-based courses taught by expert trainers to e-Learning courses that offer the convenience of Web-based learning, SAS delivers both technology and solutions-based training in support of SAS software.

Public Instructor-Led Training
SAS Education offers its extensive curriculum at 28 public training centers located throughout the United States. Courses combine lectures, software demonstrations, hands-on computer workshops and course notes to provide a comprehensive learning experience. Courses are taught by experienced, certified instructors who are recognized for leadership in their respective fields of instruction.

On-site Training
For organizations that need to train several employees at once, or need to train at their location, Education offers on-site training. Because these engagements are held at the customer's site, customers benefit from training in a familiar environment and save on travel costs. Any publicly offered course can also be offered at customer site locations if requested.

Live Web classes
Live Web classes provide customers with an interactive, instructor-based instruction delivered over the Internet. This interactive and synchronous (live) delivery method allows communication with instructors and classmates in real time. Live Web instruction offers significant benefits for students. Not only does it eliminate travel and reduce time away from the office, but the delivery of small chunks of information aids in retention.

In 2006, nearly 3,000 students took a Live Web class(es), a 44% increase in attendance over the previous year. Live Web classes especially help users overcome challenges they may face traveling for training or helps those who lack a SAS training center nearby. Registrations have come from some international cities as well as from users in the U.S. as far away as Hawaii and Alaska. Students from the contiguous United States who are several hundred miles away from the nearest training center (residing in states such as Utah, South Dakota, and Montana) have also saved both money and time by taking Live Web offerings this past year.

SAS Self-Paced e-Learning
Self-Paced e-Learning delivers fast, focused, and easily accessible SAS training directly to your desktop. Topics include: SAS Programming, Advanced SAS Programming, SAS Enterprise Guide, Certification, Business Intelligence, Data Analysis, and Data Integration.

Individual, short-term access is available directly from the Web. Customers can purchase individual lessons, courses, or entire libraries depending on their specific training needs. Free tutorials are also available.

Business Knowledge Series
The Business Knowledge Series provides professionals from a particular industry, specialized instruction from industry recognized professionals. Taught by noted experts in the field, these seminars tackle the latest business problems facing the industry. The BKS program offers courses in fields that include Accessing and Manipulating Data; Data Mining and Statistical

Analysis; Strategic Performance Management; Pharmaceutical and Health Care; and Telecommunications.

Certification
The SAS Certified Professional Program allows SAS users to earn globally recognized credentials denoting their in-depth understanding of SAS software. Exams address the full spectrum of SAS knowledge, from the basic understanding of the SAS system to exams at the specialty level designed to recognize candidates who have obtained an advanced level of knowledge.

This past year, the program enjoyed tremendous growth both in the Americas and internationally, awarding its 9,000 certification in early 2006. For more information about certification tracks, read Credentials and Exams.

Higher Education Consulting
In October 2001, SAS Education created the Higher Education Consulting group to increase SAS' presence in institutions of higher learning around the country. Since that time, the group has developed working relationships with faculty at hundreds of universities, community colleges and technical schools around the country, educating faculty on the value of SAS and its use in the classroom.

The Higher Education Consulting Group provides a variety of services to institutions interested in incorporating SAS into their curricula. One of the most popular services the group provides is the dissemination of Academic Trainer's Kits. Through this offering, interested faculty members have access to all of SAS Education's training materials free of charge, as long as they use them in conjunction with a degree program.

Through Higher Education Consulting's Data Mining Certificate Program, universities can offer students a battery of SAS courses, the successful completion of which results in a certificate or minor. Higher Education has a number of universities committed to the program, several of them, including the University of Alabama, Oklahoma State University, and the University of Central Florida (UCF) have already awarded certificates to a number of graduate students.

Starting a training program: overcoming the sometimes mysterious return on investment debate

Nearly every organization, regardless of industry, agrees that there is strategic value in training their workforce. They'll cite knowledge as a real organizational asset; talk about the significant impact learning has on revenues, productivity, and turnover; they'll even categorize training as imperative to the health of their organization, a foolproof way to gain competitive advantage. What they often struggle with, however, is documenting the return on investment for training. To help SAS users better understand the value of training, SAS Education conducted a survey of more than 2,100 U.S. students who attended public and Live Web courses from January 1-March 31, 2006.

The purpose of the survey was to determine the impact of SAS training on students' job performance and the overall value of SAS training. The survey was timed to allow at least 60 and no more than 120 days back on the job. The results of the 400-plus responses provided great evidence of the often overlooked return on investment of training:

My SAS knowledge has increased	93% **
I would recommend SAS training to a colleague	93%
The training that I received from SAS was better than other training I have taken.	81%
My productivity has increased.	69%
I am more efficient after having completed my training.	61%

**Percent of students who responded "agree" or "strongly agree" to each statement.

"This survey clearly shows the value of SAS training to our students and their organizations," says Kirk. "The survey also gives us evidence that SAS training can be linked to an increase in productivity and efficiency and confirms that our students strongly believe that we're the best in the business."

Learn to Program in SAS® or Expand Your Current Programming Skills

SAS offers a variety of programming topics for new and intermediate programmers. Intro courses are offered for programmers and those who prefer to point-and-click. Other popular efficiency topics include SAS Programming II and III, SAS Macro Language, and SQL Processing with SAS. View the SAS programming curriculum path for a complete list of courses and recommended sequence.

Read more: http://support.sas.com/training/us/paths/access.html

Defining an OLEDB Library in SAS® Management Console Using Windows Authentication

This document explains how to define an OLEDB library in SAS® Management Console in order to access the Microsoft SQL Server using Windows authentication.

Read the complete 29-page PDF: http://support.sas.com/techsup/technote/ts783.pdf

FAQ # 4578

Q: What is the Application Response Measurement (ARM)?

A: Developed by an industry partnership, ARM is an application programming interface (API) that is used to monitor the availability and performance of transactions within and across diverse applications. While there are other techniques for measuring response times,only ARM measures them accurately. With ARM, you can log transaction records from an application in order to

- determine the application response times
- determine the workload/throughput of your applications
- verify that service level objectives are being met
- determine why the application is not available
- verify who is using an application
- determine why a user is having poor response time
- determine what queries are being issued by an application
- determine the subcomponents of an application's response time
- determine which servers are being used
- calculate the load time for data warehouses.

The ARM standard is vendor-neutral and is targeted toward managing the performance of distributed applications. For more details on why ARM was developed and how it is used, refer to the following Web documents:

- ARM – Application Response Measurement
- ARM – Frequently Asked Questions

FAQ # 4579

Q: How do I take advantage of the Application Response Measurement (ARM)?

A: The ARM API consists of definitions for a standard set of function calls that are callable from an application. SAS implemented the ARM API as an ARM agent. In addition, SAS supplies ARM macros, which generate calls to the ARM API function calls, along with ARM SAS system options manage the ARM environment and enable you to log internal SAS processing transactions. You must determine the transactions within your application that you want to measure. The method for using ARM depends on what transactions you want to measure within your application:

- To log internal SAS processing transactions, you use the ARMSUBSYS= system option. This system option turns on the transactions that you want to log.
- To log transactions that you want to identify, you insert ARM macros into the application's code. This method offers the most flexibility because you can place the macros at strategic points in the application's code so that the desired transaction response time and other statistics that you want are collected.

For detailed information on SAS ARM macros, see the section “SAS ARM Macros” in SAS® 9.1.3 Language Reference: Dictionary, Fifth Edition.

FAQ # 4581

Q: How do I use the SAS® ARM macros?

A: For a general overview and an explanation of how to use SAS ARM macros, see the Scalability and Performance Community's Web page titled *SAS ARM Macros*. For syntax, examples, and other details, make the following selections in *SAS® 9.1.3 Language Reference: Dictionary, Fifth Edition*:

```
Base SAS => SAS Language Reference Dictionary => Dictionary of
Language Elements => SAS ARM M
```

Implementing a SAS® Metadata Server Configuration for Use with SAS® Enterprise Guide®

This document explains how to install a server administered by a SAS® Metadata Repository as a back-end server for your SAS Enterprise Guide client machines.

Read the full 20-page PDF: http://support.sas.com/techsup/technote/ts775.pdf

Webcasts and Events

SAS® Global Forum 2007
April 16 - 19
Orlando, FL
Here's your chance to network and learn from thousands of SAS users. Don't delay – the conference begins in just **seven days**!

PharmaSUG 2007
June 3 - 6
Denver
Learn all about the great things planned for this year's premier event for SAS users in the pharmaceutical industry. Registration is now open!

F2007, SAS' Business Forecasting Conference
June 4 - 5
Cary, NC
Join more than 20 of the top forecasting experts in the world to learn the latest theories, trends and best practices in business forecasting.

Spotlight on SAS® Model Manager
On-Demand Webcast
Join us for this latest live installment in our popular Inside SAS Web seminar series, and find out how you can streamline your organization's model implementation process.