

# **SAS<sup>®</sup> Enterprise Guide 4.2 and Stored Processes**

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## **ABSTRACT**

New in SAS 9, Stored Processes are SAS programs that can be stored centrally on a server so that they may be accessed from anywhere in the organization. The primary advantage of Stored Processes is the ability to centrally maintain and manage code. They can provide better control over changes, enhance security and application integrity, and ensure that every client executes the latest version of code. Also, since the programs run on the server, the client need only have SAS Enterprise Guide installed, which can greatly reduce software licensing and maintenance costs and lighten the burden on already overworked SAS system administrators.

SAS Stored Processes can be used in many different client applications, including SAS Enterprise Guide and the SAS Stored Process Web Application. This paper will cover creating and running SAS Stored Processes using SAS Enterprise Guide 4.2, part of the SAS 9.2 release.

## **INTRODUCTION**

SAS 9 represents an entirely new direction, probably the most significant upgrade since SAS Version 6 for the PC was introduced over 20 years ago. You can continue to use the old architecture but you are giving up the substantial advantages of this new approach to data management and analysis. New tools were introduced in SAS 8.2, including the Open Metadata Architecture (OMA), the SAS Management Console (SMC), Stored Processes and SAS Enterprise Guide, but SAS has substantially updated and enhanced these in the latest release. As always, check with your SAS sales representative for the most recent information about the products available.

The heart of these new technologies is the Open Metadata Architecture, which decisively moves SAS into the area of client/server computing. Originally (prior to Version 6) SAS only ran on mainframes or centrally managed minicomputers. In the old model both the processing and the data resided on the server. Users could log in via a dumb terminal and use a text based interface to run SAS programs. This approach had significant advantages in that it centralized the management of code and data. The drawbacks were that this approach put a heavy load on a single system, so a big machine was necessary. When microcomputers were introduced in the early 1980s, you could use SAS/Connect to attach to the mainframe system by giving up the advantage of using local processing power and treating the PC essentially as just a dumb terminal.

With Version 6, SAS moved to a graphical user interface, the SAS Display Manager. In addition, at networked sites, user data and code could be stored on a central server and processed locally on the PC. In this way users could share data and code. This strategy was responsible for lots of network traffic. Also it was hard to do concurrent updates, since SAS did not really support multiple users.

The most recent approach is the client/server or *n-tier* model, in which a central server provides metadata management and local clients are used for processing. Note that this requires a server application; SAS currently provides three choices:

- SAS/CONNECT
- SAS/SHARE
- SAS Integration Technologies

The first two, as noted, have been around for years. SAS Integration Technologies was new in SAS 8.2 and introduced the idea of an Integrated Object Model (IOM) server, discussed below.

In any case, to use SAS as a client/server protocol you must have one of these products installed on a central server. For this paper, it is assumed that you have access to an IOM server, and Enterprise Guide installed on your local client system. Note that the old SAS Display Manager does not support these new technologies, and should not be considered as a viable alternative to Enterprise Guide.

## OPEN METADATA ARCHITECTURE

The goal of the SAS Open Metadata Architecture is to enable centralized, enterprise-wide metadata management (see <http://support.sas.com/documentation/cdl/en/itechov/60309/HTML/default/a003260794.htm>). One metadata server will provide services to all applications in the enterprise, in an environment that supports multiple repositories and hundreds of concurrent users. (For more information about SAS Stored Processes and the OMA, see the references at the end of this paper.) The following brief overview should be considered as a high level introduction to an extremely complex and detailed set of product offerings. Again, you should consult you SAS representative for more information about the solutions offered.

The entry level product that offers access to SAS Stored Processes is Integration Technologies software. As the documentation notes:

SAS Integration Technologies provides you with the enabling software to build a secure client-server infrastructure on which to implement SAS distributed processing solutions. With SAS Integration Technologies, you can integrate SAS with other applications in your enterprise; provide proactive delivery of information from SAS throughout the enterprise; extend the capabilities of SAS to meet your organization's specific needs; and develop your own distributed applications that leverage the analytic and reporting powers of SAS.  
<http://support.sas.com/rnd/itech/doc9/overview/>.

Another way to say the same thing is that the Integration Technologies software allows you to write client/server applications in SAS. The following software tools are described at <http://support.sas.com/documentation/cdl/en/itechov/60309/HTML/default/a003260793.htm>:

- Integrated Object Model (IOM)
- SAS Workspace Server
- SAS Stored Process Server
- SAS Foundation Services
- Publishing Framework
- Application Messaging interface
- SAS Stored Processes
- SAS BI Web Services
- SAS Web Infrastructure Platform
- Directory Services interface.

The most important of these for an understanding of how to implement Stored Processes is the first one, the Integrated Object Model (IOM). This is a (mostly) new architecture for SAS that provides distributed object interfaces to base SAS software. It supports client/server architecture and is designed primarily for "thin clients," that is, applications that reside on the client and rely on a server to provide data and processing services. The IOM provides remote users with access to full capabilities of the SAS procedural language. (The old SAS 8.2 online documentation at <http://support.sas.com/rnd/itech/doc/dist-obj/> has a good discussion of developing distributed client applications with the Integrated Object Model; note however that SAS documentation is updated regularly, so you should check the support site for the most recent versions.)

There are five types of IOM servers:

- SAS Metadata Server (available in Base SAS)
- SAS Workspace Server (SAS IT)
- SAS Stored Process Server (SAS IT)
- SAS OLAP Server (SAS Intelligent Storage)
- SAS Table Server (new in 9.2)

This paper will cover the first three, since an understanding of these is critical to using Stored Processes in Enterprise Guide. The SAS Integration Technology documentation offers extensive support for using these tools; see <http://support.sas.com/documentation/cdl/en/itechov/60309/HTML/default/a003260734.htm> for an introduction to the technology.

## SAS METADATA SERVER

You must have a Metadata server configured to use the Open Metadata Architecture. "SAS Metadata Server provides an open, central repository for all metadata that is created and required by an organization to support its enterprise intelligence strategy" (<http://www.sas.com/technologies/bi/appdev/base/metadatasrv.html>). The advantages are that this simplifies system support and documentation and helps to ensure data integrity. The drawback: is that setting up and administering a Metadata server requires specialized skills and is considerably more complex to configure than SAS/SHARE or SAS/CONNECT.

## WORKSPACE SERVER

As the documentation notes, a Workspace Server is functionally equivalent to a SAS Display Manager session or the execution of the SAS System as a batch job. In other words, you can write a program in Java or the Microsoft .NET Framework to access a workspace server that will start a SAS session that provides all the same features as a batch job. There are three kinds of Workspace servers, depending on the software platform. The following table illustrates the options:

Server	Client	Server
Microsoft COM/DCOM	Windows	Windows
IOM Bridge for Java	Java	Any platform that supports the IOM (e.g., Windows, UNIX, z/OS)
IOM Bridge for COM	Windows	Any platform that supports the IOM (e.g., Windows, UNIX, z/OS)

**Table 1. IOM Workspace Servers**

## STORED PROCESS SERVER

A Stored Process Server runs SAS programs that can come from a variety of client applications, like SAS Enterprise Guide or the SAS Add-In for Microsoft Office. It is important to note that you can supply run-time parameters for the Stored Process using macro variables. Note that the "Stored Process server" is different from a "Stored Process service"; a Workspace Server can run Stored Processes, but the choice of output destinations is limited, as the examples in this paper will illustrate.

## CREATING A STORED PROCESS

A SAS Stored Process is a "canned" SAS program, stored on a server, that can be executed as required by requesting client applications; see "What Are SAS Stored Processes?" at <http://support.sas.com/documentation/cdl/en/stpug/61271/HTML/default/a003152554.htm>. As noted above, Stored Processes can be executed either on a Workspace Server or a Stored Process Server, although the latter provides significantly more capabilities. Note that there are two "flavors" of Stored Process:

- IOM Direct Interface Stored Processes -- introduced in Version 8; these operate on a Workspace Server and produce packages only.
- SAS Stored Processes -- new in Integration Technologies 9; can be used with either a Workspace Server to produce packages or a Stored Process Server to produce packages or streaming results.

There are lots of "consumers" for Stored Processes. Stored Process run in the following software applications (see <http://support.sas.com/documentation/cdl/en/stpug/61271/HTML/default/a003152556.htm>):

- SAS Enterprise Guide
- SAS Add-In for Microsoft Office
- SAS BI Web Services
- SAS Data Integration Studio
- SAS Information Delivery Portal
- SAS Information Map Studio
- SAS Stored Process Web Application
- SAS Web Report Studio

- Stored Process Service
- Stored Process Windows API

This paper only covers the first of these, Enterprise Guide, and presents a simple Stored Process example that uses the shoe sales data supplied with the SAS default installation. Here's the program:

```

%* Sales report Example - Display Product by Region;
%macro salesrpt;
  %global region;
  proc report data=sashelp.shoes;
    by region;
    %if (&region ne ) %then %do;
      where region="&region";
    %end;
    title "Sales by Product";
    footnote "Data are current as of &systemtime &sysdate9";
    column product sales;
    define product / group;
    define sales / analysis sum;
  quit;
%mend salesrpt;
%salesrpt

```

### Example 1. Sample SAS Code

If this code is run in Enterprise Guide with a non-null value for region it will produce a single table. Otherwise, a separate report is generated for each region. Note that this program does not work in the SAS Display Manager, which will abend with the message that you cannot use a "by" statement in Windows mode. (It does work in batch mode when run from the command line.)

The following discussion illustrates how to convert this program into a Stored Process with Enterprise Guide. SAS has provided extensive documentation on creating Stored Processes, available online at [http://support.sas.com/rnd/itech/doc9/dev\\_guide/stprocess/program.html](http://support.sas.com/rnd/itech/doc9/dev_guide/stprocess/program.html). The following discussion is intended as additional tutorial on SAS Stored Processes from the perspective of the end user.

## Running a Stored Process in Enterprise Guide

It is instructive first to run one of the sample Stored Processes supplied with the SAS installation. When Enterprise Guide 4.2 is first opened, something like the following should appear, depending on the installation configuration:

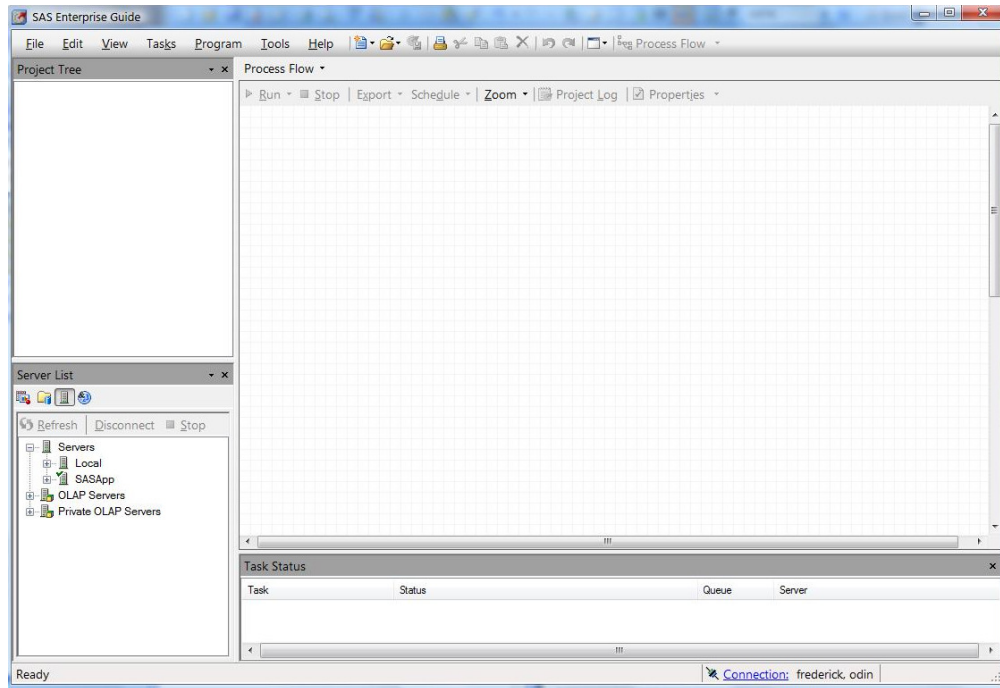


Figure 1. Open Enterprise Guide 4.2

To open one of the sample Stored Processes, go to **File>Open>Stored Process** on the Enterprise Guide menu. The following window should appear:

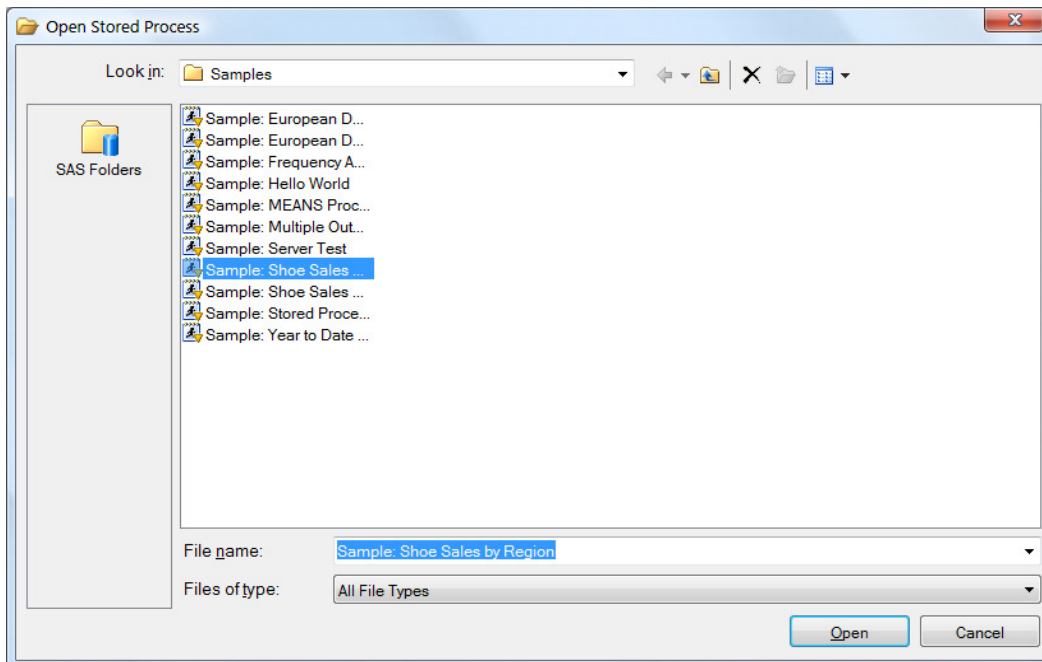
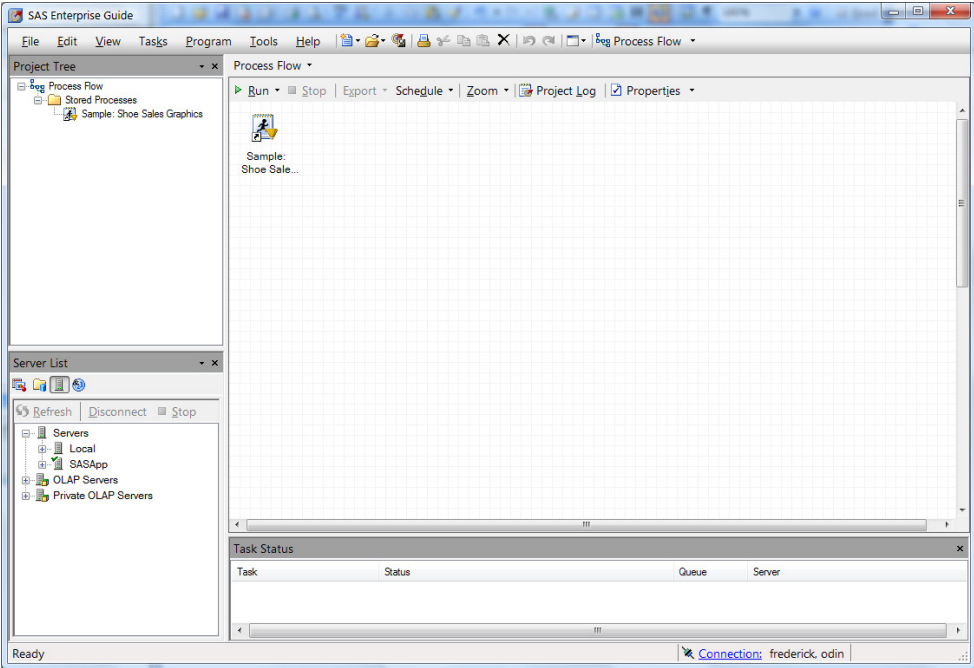


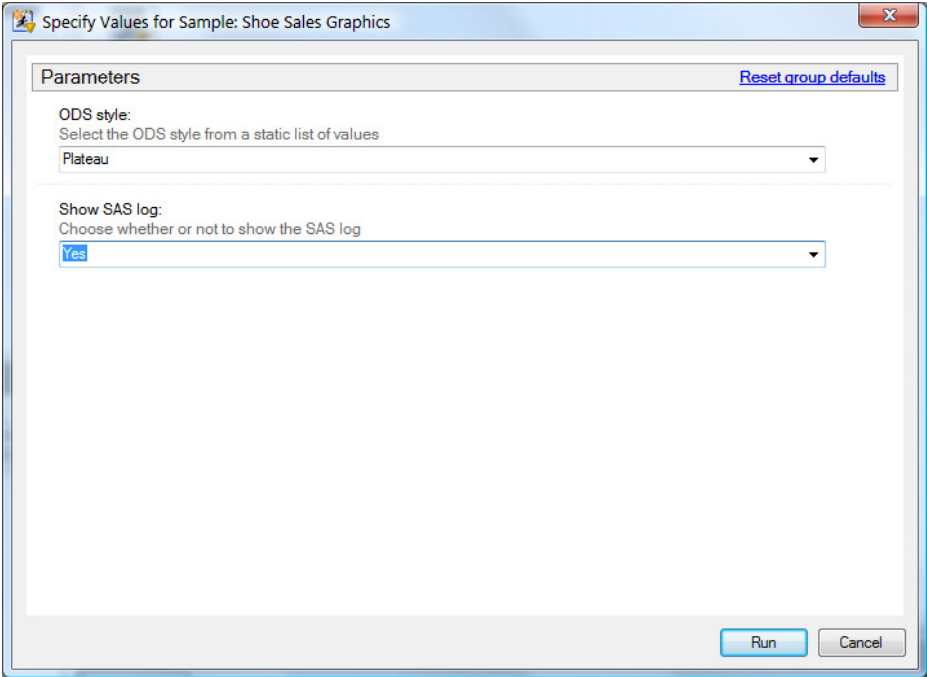
Figure 2. List samples in Enterprise Guide

Choosing to open `Sample Shoe Sales by Region` as shown results in the Stored Process being added to the current Enterprise Guide project, as shown in **Figure 3**:



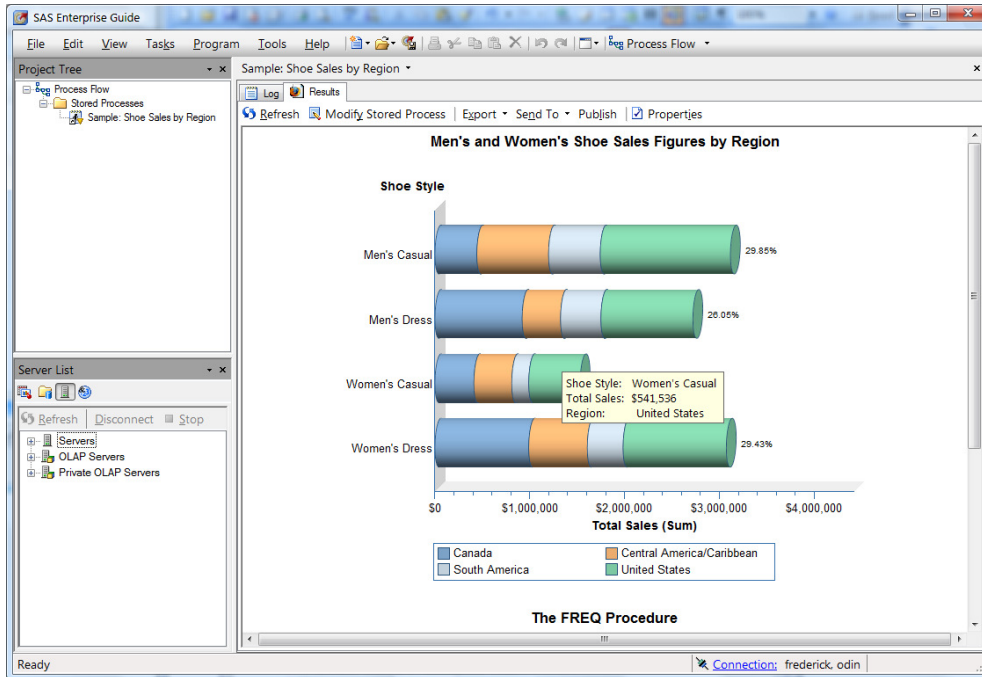
**Figure 3. Enterprise Guide Process Flow**

Select the icon for the program in the Process Flow diagram and click on the green arrow next to `Run` (or right-click on the icon). In the subsequent dialog box, select `Run: Sample Shoe Sales Graphics`. You will then be asked to supply some parameter values:



**Figure 4. Specify values for Stored Process Execution**

In this example, the default ODS style is selected, and we have chosen to display the SAS log. Click on Run; if all goes well, you will see the output as in **Figure 5**:



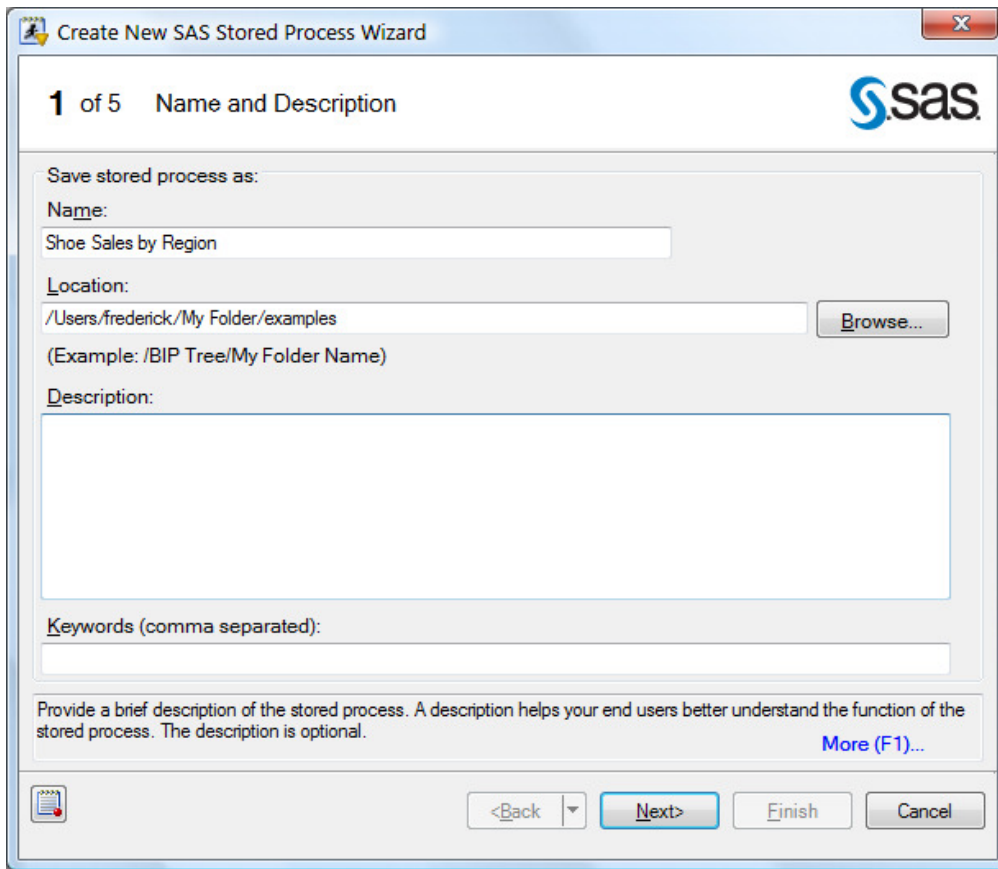
**Figure 5. Stored Process sample results**

Not shown is the bottom portion of the output, the frequency table of Product by Region. Hovering the mouse over a graph section displays the values for the sub-group, as shown.

#### CREATING A STORED PROCESS USING ENTERPRISE GUIDE

In SAS 9.1.3 it was possible to create a Stored Process using SAS Management Console; an earlier SGF paper explained how to do this in detail (see Pratter, "SAS Enterprise Guide and Stored Processes", paper 2007-218.) Most sites do not allow users to access Management Console for security reasons. Consequently, this paper covers only Enterprise Guide 4.2, available in SAS 9.2.

There are several ways to start the "Create New Stored Process Wizard" in Enterprise Guide; one is just to click on **File>New>Stored Process** from the main menu. The first screen asks for a name for the new process. Here "Shoe Sales by Region" is used, to avoid confusion with the other processes. It is also necessary to specify a location for the stored code on the server. The exact location will be determined by the SAS configuration at your site. Contact your server administrator for details. In this case, "My Folder/examples" is selected. A description and keywords can be added as needed.



**Figure 6. Create New SAS Stored Process Wizard: Step 1**

The second screen prompts for the SAS program code. Here the source program can be on the client or the server. Choosing *Replace with Code* and *From My Computer* brings up a browse window that allows you to insert the desired code:

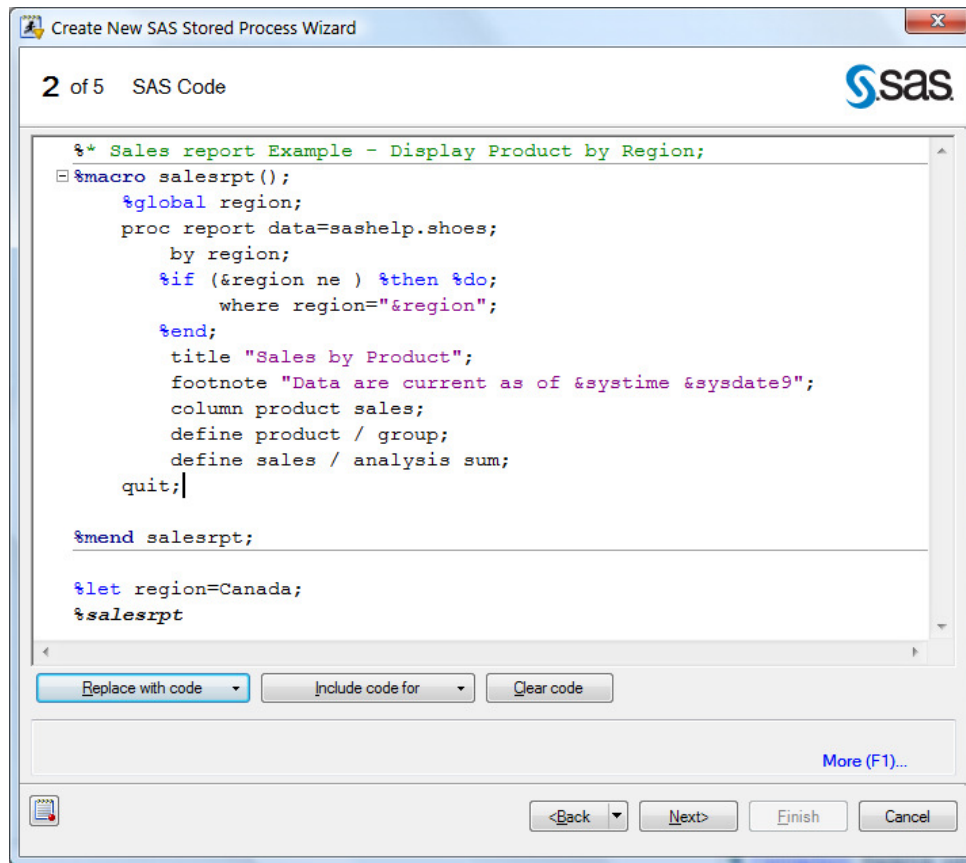
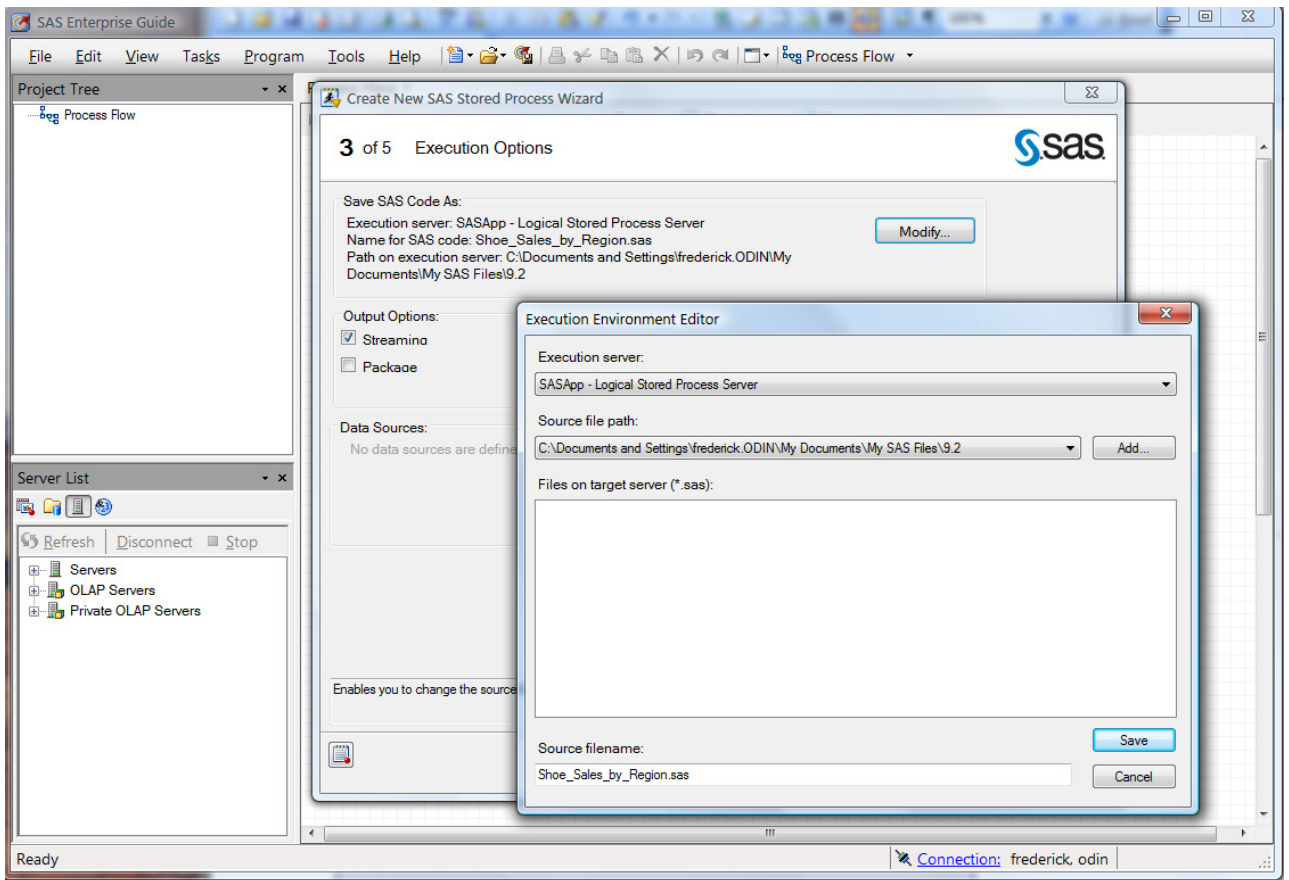


Figure 7. Create New SAS Stored Process Wizard: Step 2

In Step 3 of the wizard, you need to specify the execution server and where you want the new Stored Process to be saved. Choosing the *Modify* button brings up additional file dialogs. For the *Execution server*, select *Logical Stored Process Server*. For *Source file path*, choose the location that your system administrator has provided for you. As **Figure 8** illustrates, this directory is on the server, not the client.

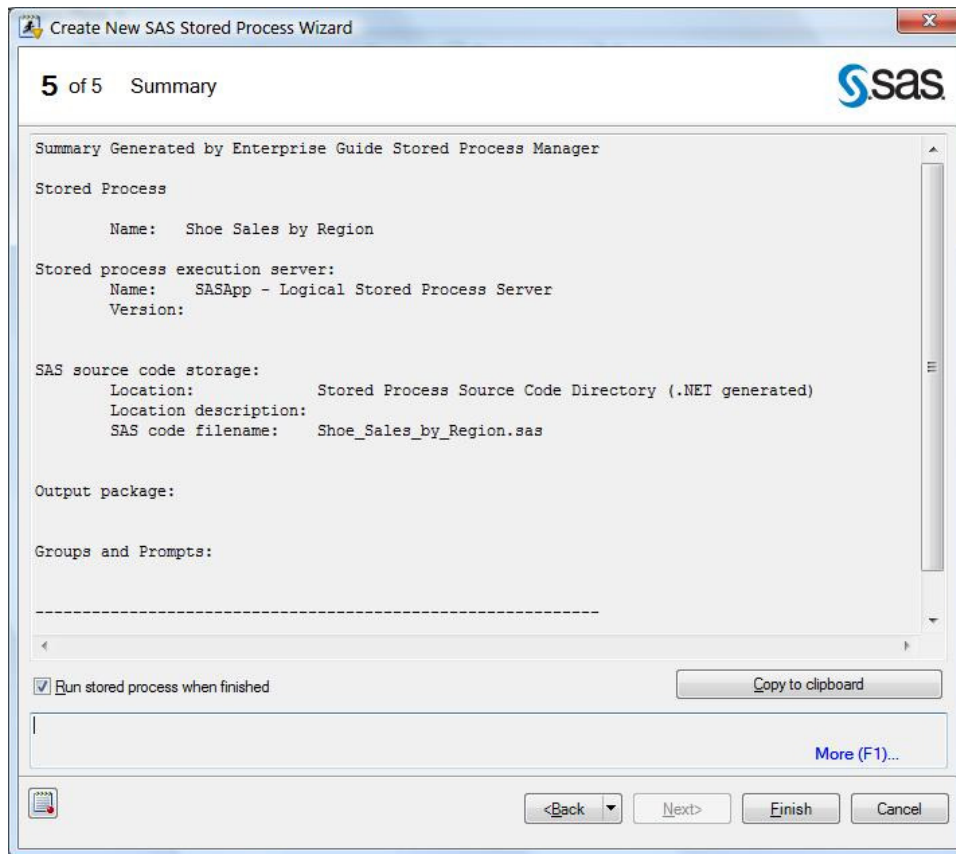
Note that you can also run a SAS Stored Process on the Workspace Server. (SAS Usage Note 31155: “Differences between using a SAS Workspace Server and SAS Stored Process Server for executing stored processes in a BI environment” explains why you probably do not want to do this.) The *Streaming* option is grayed out for the Workspace server but available for the Stored Process Server. Be sure to click on this and unclick *Package* so that you can get your results as an HTML file.



**Figure 8. Create New SAS Stored Process Wizard: Step 3**

The next screen is probably the most important. One of the main advantages of using Stored Processes is the ability to specify the value of macro parameters at run time. In Step 4, click on the *Add* button, then on *Prompt from SAS code*. The Wizard will look through your SAS program and suggest any macro variables that you may wish to use as run-time prompts. Selecting “region”, the only global variable in the sample code, results in the following:





Select `Finish` and the stored process will be saved and executed. The code for the Stored Process program is generated automatically by Enterprise Guide and includes a number of additional lines of code

**Figure 9. Create New SAS Stored Process Wizard: Step 4**

When the Stored Process is executed the user is prompted for any macro parameters specified in step 4 of the Wizard above, in this case "region";

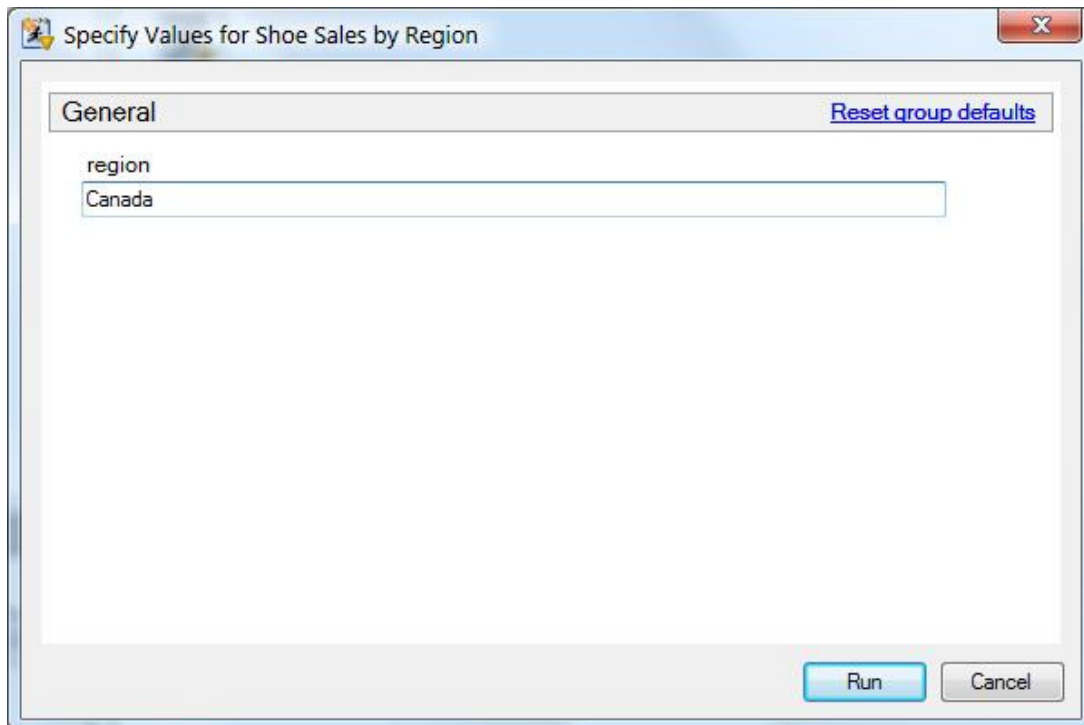


Figure 10. Supply values for run-time parameters

At last, we see the totally cool results.

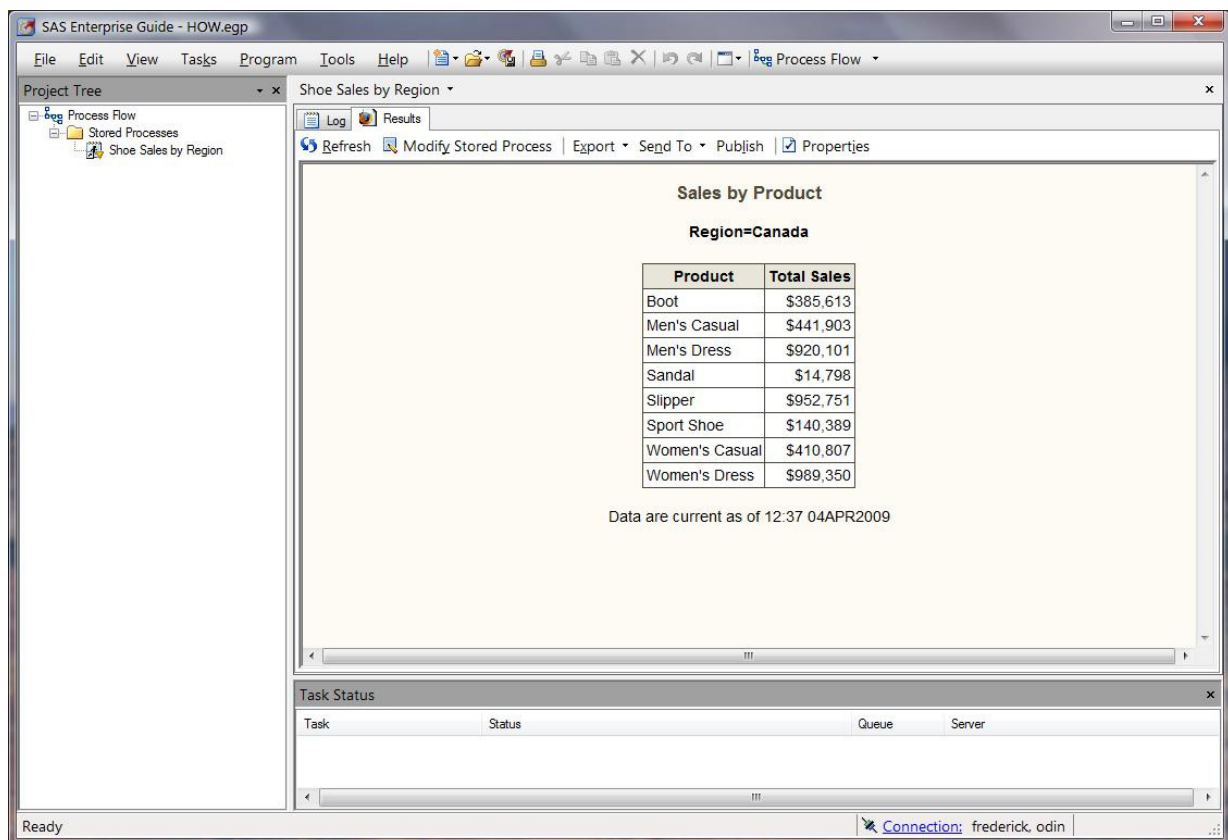


Figure 11. Stored Process Results in Enterprise Guide 4.2

Clicking on the Log tab illustrates what actually happened behind the scenes. First, the values of current environment macro variables are listed. Then the code is included from the server and executed, as shown.

```
>>> SAS Macro Variables:

REGION=Canada

__APSLIST=REGION,__RESULT,__ODSSTYLE,__METAUSER,__ENCODING,__CLIENTNAME,__ODSDEST,__ODS
STYLESHEET,__GOPT_DEVICE,__METAPERSON,__ODSOPTIONS,__METAFOLDER,__PROGRAM,__CLIENT,__U
SERNAME,__SECUREUSERNAME
__CLIENT=SAS Enterprise Guide; CLR 2.0.50727.3074; Microsoft Windows NT
6.0.6001 Service Pack 1
__CLIENTNAME=SAS Enterprise Guide
__ENCODING=utf-8
__GOPT_DEVICE=ACTIVEX
__METAFOLDER=/Users/frederick/My Folder/examples/
__METAPERSON=frederick
__METAUSER=frederick@odin
__ODSDEST=HTML
__ODSOPTIONS=ATTRIBUTES=("CODEBASE"="http://www2.sas.com/codebase/graph/v92/
sasgraph.exe#version=9,2")
__ODSSTYLE=Analysis

__ODSSTYLESHEET=(URL="file:///C:/Program%20Files/SAS/SharedFiles/BIClientStyles/
4.2/Analysis.css")
__PROGRAM=/Users/frederick/My Folder/examples/Shoe Sales by Region
__REPLAY="&__URL?_sessionId=05DCBBDD-A654-49A1-834E-6FC6C9382ECD&
__program=replay&__entry=&__TMPCAT.."
__RESULT=STREAM
__SECUREUSERNAME=frederick
__TMPCAT=APSWORK.TCAT000F
__USERNAME=frederick

1          options nosource source2 center notes nodate nonumber ls=195
formchar='|----|+|---+|=|-\<>*' pagesize=40 noovp nomprint nomlogic
nosymbolgen; title; footnote;

NOTE: %INCLUDE (level 1) file C:\Documents and Settings\frederick.ODIN\My
Documents\My SAS Files\9.2\Shoe_Sales_by_Region.sas is file C:\Documents and
Settings\frederick.ODIN\My Documents\My SAS Files\9.2\Shoe_Sales_by_Region.sas.

3          +*   Begin EG generated code (do not edit this line);
4          +*
5          +*   Stored process registered by
6          +*   Enterprise Guide Stored Process Manager V4.2
7          +*
8          +*
=====
9          +*   Stored process name: Shoe Sales by Region
10         +*
=====
11         +*;
12         +
13         +
14         +*ProcessBody;
15         +
16         +%STPBEGIN;
17         +
18         +OPTIONS VALIDVARNAME=ANY;
19         +
20         +*   End EG generated code (do not edit this line);
21         +
22
```

```

+* Sales report Example - Display Product by Region;
23   +%macro salesrpt();
24   +   %global region;
25   +   proc report data=sashelp.shoes;
26   +       by region;
27   +       %if (&region ne ) %then %do;
28   +           where region="&region";
29   +       %end;
30   +       title "Sales by Product";
31   +       footnote "Data are current as of &sysptime &sysdate9";
32   +       column product sales;
33   +       define product / group;
34   +       define sales / analysis sum;
35   +   quit;
36   +
37   +%mend salesrpt;
38   +
39   +%let region=Canada;
40   +%salesrpt
41   +
42   +* Begin EG generated code (do not edit this line);

NOTE: There were 37 observations read from the data set SASHELP.SHOES.
      WHERE region='Canada';
NOTE: PROCEDURE REPORT used (Total process time):
      real time          0.09 seconds
      cpu time           0.01 seconds

43   +; *'; *"; */; quit;
44   +%STPEND;
45   +
46   +* End EG generated code (do not edit this line);
NOTE: %INCLUDE (level 1) ending.

```

### Example 3. Log from generated Stored Process Code

## Conclusion

SAS Stored Processes provide a way to implement client/server distributed applications in SAS. With Enterprise 4.1, it is relatively straightforward to convert existing code to a Stored Process, which should pay immediate benefits for programs that are run repeatedly. Of course there is a significant initial investment required to set up the metadata correctly and to configure the Stored Process server, but once this has been done—and it only needs to happen once—end users can, given the proper authorization, create applications which are reliable, useful, and truly cool.

## REFERENCES

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### SAS Integration Technologies

- Pratter, Frederick E. 2006. *Web Development with SAS® by Example, 2<sup>nd</sup> edition*. Cary, NC: SAS Institute Inc.

### SAS GLOBAL FORUM 2009 Presentations

- Collado, Evangeline: "Parameter-Driven Data Integration Using SAS Stored Processes." Paper 102-2009.
- Dhillon, Rupinder and Marje Fecht. "A 'SAS® Programmer's Guide' to SAS Enterprise Guide® ". Paper 157-2009.
- Flynn, Joe. "SAS Stored Processes: Going Beyond the Current Capabilities of the Stored Process Wizard." Paper 330-2009.

### **SAS GLOBAL FORUM 2008 Presentations**

- Eberhardt, Peter. "Crossing the Border: Steps to Writing SAS Stored Processes." Paper 035-2008.

### **SAS GLOBAL FORUM 2007 Presentations**

- Dhillon, Rupinder and Peter W. Eberhardt. "My First Stored Process...and How It Almost Removed the "L" Word from My Relationship with SAS." Paper 022-2007.
- Pope, David. "Empowering Your SAS Business Intelligence End Users via a SAS Stored Process." Paper 038-2007.
- Zender, Cynthia L. "SAS Stored Process Case Study." Paper 249-2007 and "ODS Options and SAS Stored Processes." Paper 021-2007.
- Weinstein, Heather. "Converting SAS/IntrNet® Programs to SAS Stored Processes." Paper 023-2007.

### **SUGI 31 Presentations**

- Fecht, Marje and Peter R. Bennett. "SAS Enterprise Guide® Stored Processes, Part 1: The Information Consumer's View" and "Part 2: Creation and Deployment." Papers 257-31 and 258-31.
- Pratter, Frederick E. "Delivering Dynamic Content with the SAS Stored Process Web Application." Paper 231-31.

### **SUGI 30 Presentations**

- Rosslund, Eric and Kari Richardson. "Creating and Using SAS Stored Processes with SAS Enterprise Guide®." Paper 135-30.
- Wright, Jeff. "Catch the Stream: Stored Processes, ODS, and Java." Paper 235-30.

### **More Resources**

- SAS Stored Processes Forum at <http://support.sas.com/forums/forum.jspa?forumID=8>.

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